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INDOCTI DISCANT, ET AMENT MEMINISSE PERITI.

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BRITISH MUSEUM

ENCYCLOPÆDIA.

1 mportance f the ſub-ect.

STRENGTH OF MATERIALS, in mechanics, is a ſubject of ſo much importance, that in nations eminent for invention and ingenuity in all ſpecies of manufactures, and in particular diſtinguiſhed for their improvements in machinery of every kind, it is ſomewhat ſingular that no writer has treated it in the detail which its importance and difficulty demands. The man of ſcience who viſits great manufactures is delighted with the ingenuity which he obſerves in every part, the innumerable inventions which come even from individual artiſans, and the determined purpoſe of improvement and refinement which he ſees in every workſhop. Every cotton mill appears an academy of mechanical ſcience; and mechanical invention is ſpreading from theſe fountains over the whole country: But the philoſopher is mortified to ſee this ardent ſpirit ſo cramped by ignorance of principle, and many of theſe original and brilliant thoughts obſcured and clogged with needleſs and even hurtful additions, and a complication of machinery which checks improvement even by its appearance of ingenuity. There is nothing in which this want of ſcientific education, this ignorance of principle, is ſo frequently obſerved as in the injudicious proportion of the parts of machines and other mechanical ſtructures; proportions and forms of parts in which the ſtrength and poſition are nowiſe regulated by the ſtrains to which they are expoſed, and where repeated failures have been the only leſſons.

It cannot be otherwiſe. We have no means of inſtruction, except two very ſhort and abſtracted treatiſes of the late Mr Emerſon on the ſtrength of materials. We do not recollect a performance in our language from which our artiſts can get information. Treatiſes written expreſsly on different branches of mechanical arts are totally ſilent on this, which is the baſis and *only principle* of their performances. Who would imagine that PRICE's BRITISH CARPENTER, the work of the firſt reputation in this country, and of which the ſole aim is to teach the carpenter to erect ſolid and durable ſtructures, does not contain one propoſition or one reaſon by which one form of a thing can be ſhown to be ſtronger or weaker than another? We doubt very much if one carpenter in an hundred can give a reaſon to convince his own mind that a joiſt is ſtronger when laid on its edge than when laid on its broad ſide. We ſpeak in this ſtrong manner in hopes of exciting ſome man of ſcience to publiſh a ſyſtem of inſtruction on this ſubject. The limits of our Work will not admit of a detail: but we think it neceſſary to point out the leading principles, and to give the traces of that ſyſtematic connection by which all the knowledge already poſſeſſed of this ſubject may be brought together and properly arranged. This we ſhall now attempt in as brief a manner as we are able.

2 Strength of materials ariſes from coheſion.

THE ſtrength of materials ariſes immediately or ultimately from the coheſion of the parts of bodies. Our examination of this property of tangible matter has as yet been very partial and imperfect, and by no means enables us to apply mathematical calculations with preciſion and ſucceſs. The various modifications of coheſion, in its different appearances of perfect ſoftneſs, plaſticity, ductility, elaſticity, hardneſs, have a mighty influence on the ſtrength of bodies, but are hardly ſuſceptible of meaſurement. Their texture alſo, whether uniform like glaſs and ductile metals, cryſtallized or granulated like other metals and freeſtone, or fibrous like timber, is a circumſtance no leſs important; yet even here, although we derive ſome advantage from remarking to which of theſe forms of aggregation a ſubſtance belongs, the aid is but ſmall.

3 Experiments to aſcertain it.

All we can do in this want of general principles is to make experiments on every claſs of bodies. Accordingly philoſophers have endeavoured to inſtruct the public in this particular. The Royal Society of London at its very firſt inſtitution made many experiments at their meetings, as may be ſeen in the firſt regiſters of the Society†. Several individuals have added their experiments. The moſt numerous collection in detail is by Muſchenbroek, profeſſor of natural philoſophy at Leyden. Part of it was publiſhed by himſelf in his *Eſſais de Phyſique*, in 2 vols 4to; but the full collection is to be found in his Syſtem of Natural Philoſophy, publiſhed after his death by Lulofs, in 3 vols 4to. This was tranſlated from the Low Dutch into French by Sigaud de la Fond, and publiſhed at Paris in 1760, and is a prodigious collection of phyſical knowledge of all kinds, and may almoſt ſuffice for a library of natural philoſophy. But this collection of experiments on the coheſion of bodies is not of that value which one expects. We preſume that they were carefully made and faithfully narrated; but they were made on ſuch ſmall ſpecimens that the unavoidable natural inequalities of growth or texture produced irregularities in the reſults which bore too great a proportion to the whole quantities obſerved. We may make the ſame remark on the experiments of Couplet, Pitot, De la Hire, Du Hamel, and others of the French academy. In ſhort, if we except the experiments of Buffon on the ſtrength of timber, made at the public expence on a large ſcale, there is nothing to be met with from which we can obtain abſolute meaſures which may be employed with confidence; and there is nothing in the Engliſh language except a ſimple liſt by Emerſon, which is merely a ſet of affirmations, without any narration of circumſtances, to enable us to judge of the validity of his concluſions: but the character of Mr Emerſon, as a man of knowledge and of integrity gives even to theſe aſſertions a conſiderable value.

4 Rendered uſeful by generalization.

But to make uſe of any experiments, there muſt be employed ſome general principle by which we can generalize their reſults. They will otherwiſe be only narrations of detached facts. We muſt have ſome notion of that intermedium, by the intervention of which an external force applied to one part of a lever, joiſt, or pillar, occaſions a ſtrain on a diſtant part. This can be nothing but the coheſion between the parts.

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† See Birche's Hiſtory, and Hooke's Mathematical Collections.

5
Strength defined.

parts. It is this connecting force which is brought into action, or, as we more ſhortly expreſs it, excited. This action is modified in every part by the laws of mechanics. It is this action which is what we call the *ſtrength* of that part, and its effect is the ſtrain on the adjoining parts; and thus it is the ſame force, differently viewed, that conſtitutes both the ſtrain and the ſtrength. When we conſider it in the light of a reſiſtance to fracture, we call it *ſtrength*.

6
Cauſes known only from their effects.

We call every thing a *force* which we obſerve to be ever accompanied by a change of motion; or, more ſtrictly ſpeaking, we infer the preſence and agency of a force wherever we obſerve the ſtate of things in reſpect of motion different from what we know to be the reſult of the action of all the forces which we know to act on the body. Thus when we obſerve a rope prevent a body from falling, we infer a moving force inherent in the rope with as much confidence as when we obſerve it drag the body along the ground. The *immediate* action of this force is undoubtedly exerted between the immediately adjoining parts of the rope. The immediate effect is the keeping the particles of the rope together. They ought to ſeparate by any external force drawing the ends of the rope contrarywiſe; and we aſcribe their not doing ſo to a mechanical force really oppoſing this external force. When deſired to give it a name, we name it from what we conceive to be its effect, and therefore its characteriſtic, and we call it COHESION. This is merely a name for the fact; but it is the ſame thing in all our denominations. We know nothing of the cauſes but in the effects; and our name for the cauſe is in fact the name of the effect, which is COHESION. We mean nothing elſe by gravitation or magnetiſm. What do we mean when we ſay that Newton underſtood thoroughly the nature of gravitation, of the force of gravitation; or that Franklin underſtood the nature of the electric force? Nothing but this: Newton conſidered with patient ſagacity the general facts of gravitation, and has deſcribed and claſſed them with the utmoſt preciſion. In like manner, we ſhall underſtand the nature of coheſion when we have diſcovered with equal generality the laws of coheſion, or general facts which are obſerved in the appearances, and when we have deſcribed and claſſed them with equal accuracy.

Let us therefore attend to the more ſimple and obvious phenomena of coheſion, and mark with care every circumſtance of reſemblance by which they may be claſſed. Let us receive theſe as the laws of coheſion characteriſtic of its ſuppoſed cauſe, the force of coheſion. We cannot pretend to enter on this vaſt reſearch. The modifications are innumerable; and it would require the penetration of more than Newton to detect the circumſtance of ſimilarity amidſt millions of diſcriminating circumſtances. Yet this is the only way of diſcovering which are the primary facts characteriſtic of the force, and, which are the modifications. The ſtudy is immenſe, but is by no means deſperate; and we entertain great hopes that it will ere long be ſucceſsfully proſecuted: but, in our particular predicament, we muſt content ourſelves with ſelecting ſuch general laws as ſeem to give us the moſt immediate information of the circumſtances that muſt be attended to by the mechanician in his conſtructions, that he may unite ſtrength with ſimplicity, economy, and energy.

7
All bodies elaſtic.

1*ſt*, Then, it is a matter of fact that all bodies are in a certain degree perfectly elaſtic; that is, when their form or bulk is changed by certain moderate compreſſions or diſtractions, it requires the continuance of the changing force to continue the body in this new ſtate; and when the force is removed, the body recovers its original form. We limit the aſſertion to *certain moderate* changes: For inſtance, take a lead wire of $\frac{1}{15}$th of an inch in diameter and ten feet long; fix one end firmly to the ceiling, and let the wire hang perpendicular; affix to the lower end an index like the hand of a watch; on ſome ſtand immediately below let there be a circle divided into degrees, with its centre correſponding to the lower point of the wire: now turn this index twice round, and thus twiſt the wire. When the index is let go, it will turn backwards again, by the wire's untwiſting itſelf, and make almoſt four revolutions before it ſtops; after which it twiſts and untwiſts many times, the index going backwards and forwards round the circle, diminiſhing however its arch of twiſt each time, till at laſt it ſettles preciſely in its original poſition. This may be repeated for ever. Now, in this motion, every part of the wire partakes equally of the twiſt. The particles are ſtretched, require force to keep them in their ſtate of extenſion, and recover completely their original relative poſitions. Theſe are all the characters of what the mechanician calls *perfect* elaſticity. This is a quality quite familiar in many caſes; as in glaſs, tempered ſteel, &c. but was thought incompetent to lead, which is generally conſidered as having little or no elaſticity. But we make the aſſertion in the moſt general terms, with the limitation to moderate derangement of form. We have made the ſame experiment on a thread of pipe-clay, made by forcing ſoft clay through the ſmall hole of a ſyringe by means of a ſcrew; and we found it more elaſtic than the lead wire: for a thread of $\frac{1}{20}$th of an inch diameter and 7 feet long allowed the index to make two turns, and yet completely recovered its firſt poſition.

8
What is meant by a ſet.

9
Ductility.

2*dly*, But if we turn the index of the lead wire four times round, and let it go again, it untwiſts again in the ſame manner, but it makes little more than four turns back again; and after many oſcillations it finally ſtops in a poſition almoſt two revolutions removed from its original poſition. It has now acquired a new arrangement of parts, and this new arrangement is permanent like the former; and, what is of particular moment, it is perfectly elaſtic. This change is familiarly known by the denomination of a SET. The wire is ſaid to have TAKEN A SET. When we attend minutely to the procedure of nature in this phenomenon, we find that the particles have as it were ſlid on each other, ſtill cohering, and have taken a new poſition, in which their connecting forces are in equilibrio: and in this change of relative ſituation, it appears that the connecting forces which maintained the particles in their firſt ſituations were not in equilibrio in ſome poſition intermediate between that of the firſt and that of the laſt form. The force required for changing this firſt form augmented with the change, but only to a certain degree; and during this proceſs the connecting forces always tended to the recovery of this firſt form. But after the change of mutual poſition has paſſed a certain magnitude, the union has been partly deſtroyed, and the particles have been brought into new ſituations; ſuch, that the forces which now connect each with its neighbour tend, not to the recovery of the firſt arrangement, but to puſh them farther from it, into a new ſitution, to which they now verge, and require force to prevent them from acquiring. The wire is now in fact again perfectly elaſtic; that is, the forces which now connect the particles with their new neighbours augment to a certain degree as the derangement from this new poſition augments. This is not reaſoning from any theory. It is narrating facts, on which a theory is to be founded. What we have been juſt now ſaying is evidently a deſcription of that ſenſible form of tangible matter which we call *ductility*. It has every gradation of variety, from the ſoftneſs of butter to the firmneſs of gold. All theſe bodies have ſome elaſticity; but we ſay they are not perfectly elaſtic, becauſe they do not completely recover their original form when it has been greatly

10 Viſcidity

greatly deranged. The whole gradation may be moſt diſtinctly obſerved in a piece of glaſs or hard ſealing-wax. In the ordinary form glaſs is perhaps the moſt completely elaſtic body that we know, and may be bent till juſt ready to ſnap, and yet completely recovers its firſt form, and takes no ſet whatever; but when heated to ſuch a degree as juſt to be viſible in the dark, it loſes, its brittleneſs, and becomes ſo tough that it cannot be broken by any blow; but it is no longer elaſtic, takes any ſet, and keeps it. When more heated, it becomes as plaſtic as clay; but in this ſtate is remarkably diſtinguiſhed from clay by a quality which we may call VISCIDITY, which is ſomething like elaſticity, of which clay and other bodies purely plaſtic exhibit no appearance. This is the joint operation of ſtrong adheſion and ſoftneſs. When a rod of perfectly ſoft glaſs is ſuddenly ſtretched a little, it does not at once take the ſhape which it acquires after ſome little time. It is owing to this, that in taking the impreſſion of a ſeal, if we take off the ſeal while the wax is yet very hot, the ſharpneſs of the impreſſion is deſtroyed immediately. Each part drawing its neighbour, and each part yielding, the prominent parts are pulled down and blunted, and the ſharp hollows are pulled upwards and alſo blunted. The ſeal muſt be kept on till all has become not only ſtiff but hard.

11 Obſerved in all homogeneous plaſtic bodies.

This viſcidity is to be obſerved in all plaſtic bodies which are homogeneous. It is not obſerved in clay, becauſe it is not homogenous, but conſiſts of hard particles of the argillaceous earth ſticking together by their attraction for water. Something like it might be made of finely powdered glaſs and a clammy fluid ſuch as turpentine. Viſcidity has all degrees of ſoftneſs till it degenerates to ropy fluidity like that of olive oil. Perhaps ſomething of it may be found even in the moſt perfect fluid that we are acquainted with, as we obſerved in the experiments for aſcertaining ſpecific gravity.

There is in a late volume of the Philoſophical Tranſactions a narration of experiments, by which it appears that the thread of the ſpider is an exception to our firſt general law, and that it is perfectly ductile. It is there aſſerted, that a long thread of goſſamer, furniſhed with an index, takes any poſition whatever; and that though the index be turned round any number of times (even many hundreds), it has no tendency to recover its firſt form. The thread takes completely any ſet whatever. We have not had an opportunity of repeating this experiment, but we have diſtinctly obſerved a phenomenon totally inconſiſtent with it. If a fibre of goſſamer about an inch long be held by the end horizontally, it bends downward in a curve like a ſlender ſlip of whalebone or a hair. If totally devoid of elaſticity, and perfectly indifferent to any ſet, it would hang down perpendicularly without any curvature.

When ductility and elaſticity are combined in different proportions, an immenſe variety of ſenſible modes of aggregation may be produced. Some degree of both are probably to be obſerved in all bodies of complex conſtitution; that is, which conſiſt of particles made up of many different kinds of atoms. Such a conſtitution of a body muſt afford many ſituations permanent, but eaſily deranged.

12 Particles acted on by attractions and repulſions.

13 The great problem in corpuſcular mechaniſm.

In all theſe changes of diſpoſition which take place among the particles of a ductile body, the particles are at ſuch diſtance that they ſtill cohere. The body may be ſtretched a little; and on removing the extending force, the body ſhrinks into its firſt form. It alſo reſiſts moderate compreſſions; and when the compreſſing force is removed, the body ſwells out again. Now the corpuſcular *fact* here is that the particles are acted on by attractions and repulſions, which balance each other when no external force is acting on the body, and which augment as the particles are made, by any external cauſe, to recede from this ſituation of mutual inactivity; for ſince force is requiſite to produce either the dilatation or the compreſſion, and to maintain it, we are obliged, by the conſtitution of our minds, to infer that it is oppoſed by a force accompanying or inherent in every particle of dilatable or compreſſible matter: and as this neceſſity of employing force to produce a change indicates the agency of theſe corpuſcular forces, and marks their kind, according as the tendencies of the particles appear to be toward each other in dilatation, or from each other in compreſſion; ſo it alſo meaſures the degrees of their intenſity. Should it require three times the force to produce a double compreſſion, we muſt reckon the mutual repulſions triple when the compreſſion is doubled; and ſo in other inſtances. We ſee from all this that the phenomena of coheſion indicate ſome relation between the intenſity of the force of coheſion and the diſtance between the centres of the particles. To diſcover this relation is the great problem in corpuſcular mechaniſm, as it was in the Newtonian inveſtigation of the force of gravitation. Could we diſcover this law of action between the corpuſcles with the ſame certainty and diſtinctneſs, we might with equal confidence ſay what will be the reſult of any poſition which we give to the particles of bodies; but this is beyond our hopes. The law of gravitation is ſo ſimple that the diſcovery or detection of it amid the variety of celeſtial phenomena required but one ſtep; and in its own nature its poſſible combinations ſtill do not greatly exceed the powers of human reſearch. One is almoſt diſpoſed to ſay that the Supreme Being has exhibited it to our reaſoning powers as ſufficient to employ with ſucceſs our utmoſt efforts, but not ſo abſtruſe as to diſcourage us from the noble attempt. It ſeems to be otherwiſe with reſpect to coheſion. Mathematics informs us, that if it deviates ſenſibly from the law of gravitation, the ſimpleſt combinations will make the joint action of ſeveral particles an almoſt impenetrable myſtery. We muſt therefore content ourſelves, for a long while to come, with a careful obſervation of the ſimpleſt caſes that we can propoſe, and with the diſcovery of ſecondary laws of action, in which many particles combine their influence. In purſuance of this plan, we obſerve,

14 Particles kept in their places by a balance of forces.

3*dly*, That whatever is the ſituation of the particles of a body with reſpect to each other, when in a quieſcent ſtate, they are kept in theſe ſituations by the balance of oppoſite forces. This cannot be refuſed, nor can we form to ourſelves any other notion of the ſtate of the particles of a body. Whether we ſuppoſe the ultimate particles to be of certain magnitudes and ſhapes, touching each other in ſingle points of coheſion; or whether we (with Boſcovich) conſider them as at a diſtance from each other, and acting on each other by attractions and repulſions—we muſt acknowledge, in the firſt place, that the centres of the particles (by whoſe mutual diſtances we muſt eſtimate the diſtance of the particles) may and do vary their diſtances from each other. What elſe can we ſay when we obſerve a body increaſe in length, in breadth, and in thickneſs, by heating it, or when we ſee it diminiſh in all theſe dimenſions by an external compreſſion? A particle, therefore, ſituated in the midſt of many others, and remaining in that ſituation, muſt be conceived as maintained in it by the mutual balancing of all the forces which connect it with its neighbours. It is like a ball kept in its place by the oppoſite action of two ſprings. This illuſtration merits a more particular application. Suppoſe a number of balls ranged on the table in the angles of equilateral triangles, and that each ball is connected with the ſix which lie around it by means of an elaſtic wire curled like a cork-ſcrew; ſuppoſe ſuch another ſtratum of balls above this, and parallel to it, and ſo placed that

15 Illuſtration of this propoſition

each ball of the upper ſtratum is perpendicularly over the centre of the equilateral triangle below, and let theſe be connected with the balls of the under ſtratum by ſimilar ſpiral wires. Let there be a third and a fourth, and any number of ſuch ſtrata, all connected in the ſame manner. It is plain, that this may extend to any ſize and fill any ſpace.—Now let this aſſemblage of balls be firmly contemplated by the imagination, and be ſuppoſed to ſhrink continually in all its dimenſions, till the balls, and their diſtances from each other, and the connecting wires, all vaniſh from the ſight as diſcrete individual objects. All this is very conceivable. It will now appear like a ſolid body, having length, breadth, and thickneſs; it may be compreſſed, and will again reſume its dimenſions; it may be ſtretched, and will again ſhrink; it will move away when ſtruck; in ſhort, it will not differ in its ſenſible appearance from a ſolid elaſtic body. Now when this body is in a ſtate of compreſſion, for inſtance, it is evident that any one of the balls is at reſt, in conſequence of the mutual balancing of the actions of all the ſpiral wires which connect it with thoſe around it. It will greatly conduce to the full underſtanding of all that follows to recur to this illuſtration. The analogy or reſemblance between the effects of this conſtitution of things and the effects of the corpuſcular forces is very great; and wherever it obtains, we may ſafely draw concluſions from what we know would be the condition of the balls in particular circumſtances to what will be the condition of a body of common tangible matter. We ſhall juſt give one inſtructive example, and then have done with this hypothetical body. We can ſuppoſe it of a long ſhape, reſting on one point; we can ſuppoſe two weights A, B, ſuſpended at the extremities, and the whole in equilibrio. We commonly expreſs this ſtate of things by ſaying that A and B are in equilibrio. This is very inaccurate. A is in fact in equilibrio with the united action of all the ſprings which connect the ball to which it is applied with the adjoining balls. Theſe ſprings are brought into action, and each is in equilibrio with the joint action of all the reſt. Thus through the whole extent of the hypothetical body, the ſprings are brought into action in a way and in a degree which mathematics can eaſily inveſtigate. We need not do this: it is enough for our purpoſe that our imagination readily diſcovers that ſome ſprings are ſtretched, others are compreſſed, and that a preſſure is excited on the middle point of ſupport, and the ſupport exerts a reaction which preciſely balances it; and the other weight is, in like manner, in immediate equilibrio with the equivalent of the actions of all the ſprings which connect the laſt ball with its neighbours. Now take the analogical or reſembling caſe, an oblong piece of ſolid matter, reſting on a fulcrum, and loaded with two weights in equilibrio. For the actions of the connecting ſprings ſubſtitute the corpuſcular forces, and the reſult will reſemble that of the hypotheſis.

1
By example.

Now as there is ſomething that is at leaſt analogous to a change of diſtance of the particles, and a concomitant change of the intenſity of the connecting forces, we may expreſs this in the ſame way that we are accuſtomed to do in ſimilar caſes. Let A and B (fig. 1) repreſent the centres of two particles of a coherent elaſtic body in their quieſcent inactive ſtate, and let us conſider only the mechanical condition of B. The body may be ſtretched. In this caſe the diſtance A B of the particles may become A C. In this ſtate there is ſomething which makes it neceſſary to employ a force to keep the particles at this diſtance. C has a tendency towards A, or we may ſay that A attracts C. We may repreſent the magnitude of this tendency of C *towards* A, or this attraction of A, by a line C *c* perpendicular to A C. Again, the body may be compreſſed, and the diſtance A B may become A D. Something obliges us to employ force to continue this compreſſion; and D tends *from* A, or A appears to *repel* D. The intenſity of this tendency or repulſion may be repreſented by another perpendicular D *d*; and, to repreſent the different directions of theſe tendencies, or the different nature of theſe actions, we may ſet D *d* on the oppoſite ſide of A B. It is in this manner that the Abbé Boſcovich has repreſented the actions of corpuſcular forces in his celebrated Theory of Natural Philoſophy. Newton had ſaid, that, as the great movements of the ſolar ſyſtem were regulated by forces operating at a diſtance and varying with the diſtance, ſo he ſtrongly ſuſpected (*valdi ſuſpicor*) that all the phenomena of coheſion, with all its modifications in the different ſenſible forms of aggregation, and in the phenomena of chemiſtry and phyſiology, reſulted from the ſimilar agency of forces varying with the diſtance of the particles. The learned Jeſuit purſued this thought; and has ſhown, that if we ſuppoſe an ultimate atom of matter endowed with powers of attraction and repulſion, varying, both in kind and degree, with the diſtance, and if this force be the ſame in every atom, it may be regulated by ſuch a relation to the diſtance from the neighbouring atom, that a collection of ſuch atoms may have all the ſenſible appearances of bodies in their different forms of ſolids, liquids, and vapours, elaſtic or unelaſtic, and endowed with all the properties which we perceive, by whoſe immediate operation the phenomena of motion by impulſe, and all the phenomena of chemiſtry, and of animal and vegetable economy, may be produced. He ſhows, that notwithſtanding a perfect ſameneſs, and even a great ſimplicity in this atomical conſtitution, there will reſult from this union all that unſpeakable variety of form and property which diverſify and embelliſh the face of nature. We ſhall take another opportunity of giving ſuch an account of this celebrated work as it deſerves. We mention it only, by the by, as far as a general notion of it will be of ſome ſervice on the preſent occaſion. For this purpoſe, we juſt obſerve that Boſcovich conceives a particle of any individual ſpecies of matter to conſiſt of an unknown number of particles of ſimpler conſtitution; each of which particles, in their turn, is compounded of particles ſtill more ſimply conſtituted, and ſo on through an unknown number of orders, till we arrive at the ſimpleſt poſſible conſtitution of a particle of tangible matter, ſuſceptible of length, breadth, and thickneſs, and neceſſarily conſiſting of four atoms of matter. And he ſhows that the more complex we ſuppoſe the conſtitution of a particle, the more muſt the ſenſible qualities of the aggregate reſemble the obſerved qualities of tangible bodies. In particular, he ſhows how a particle may be ſo conſtituted, that although it act on one other particle of the ſame kind through a conſiderable interval, the interpoſition of a third particle of the ſame kind may render it totally, or almoſt totally, inactive; and therefore an aſſemblage of ſuch particles would form ſuch a fluid as air. All theſe curious innferences are made with uncontrovertible evidence; and the greateſt encouragement is thus given to the mathematical philoſopher to hope, that by cautious and patient proceeding in this way, we may gradually approach to a knowledge of the laws of coheſion, that will not ſhun a compariſon even with the *Principia* of Newton. No ſtep can be made in this inveſtigation, but by obſerving with care, and generalizing with judgment, the phenomena, which are abundantly numerous, and much more at our command than thoſe of the great and ſenſible motions of bodies. Following this plan, we obſerve,

Plate CCCCLXXXIV.

17
How Boſcovich repreſents the action of corpuſcular forces.

4thly, It is matter of fact, that every body has ſome degree of compreſſibility and dilatability; and when the changes of dimenſion are ſo moderate that the body completely recovers its

18
Every body compreſſible and dilatable.

19
Law of nature diſcovered by Dr Hooke,

its original dimenſions on the ceſſation of the changing force, the extenſions or compreſſions are ſenſibly proportional to the extending or compreſſing forces; and therefore *the connecting forces are proportional to the diſtances of the particles from their quieſcent, natural, or inactive poſitions.* This ſeems to have been firſt viewed as a law of nature by the penetrating eye of Dr Robert Hooke, one of the moſt eminent philoſophers of the laſt century. He publiſhed a cipher, which he ſaid contained the theory of ſpringineſs and of the motions of bodies by the action of ſprings. It was this, *ceiiinosssttuu*—When explained in his diſſertation, publiſhed ſome years after, it was *ut tenſio ſic vis.* This is preciſely the propoſition juſt now aſſerted as a general fact, a law of nature. This diſſertation is full of curious obſervations of facts in ſupport of his aſſertion. In his application to the motion of bodies he gives his noble diſcovery of the balance-ſpring of a watch, which is founded on this law. The ſpring, as it is more and more coiled up, or unwound, by the motion of the balance, acts on it with a force proportional to the diſtance of the balance from its quieſcent poſition. The balance therefore is acted on by an accelerating force, which varies in the ſame manner as the force of gravity acting on a pendulum ſwinging in a cycloid. Its vibrations therefore muſt be performed in equal time, whether they are wide or narrow. In the ſame diſſertation Hooke mentions all the facts which John Bernoulli afterwards adduced in ſupport of Leibnitz's whimſical doctrine of the force of bodies in motion, or the doctrine of the *vires vivæ;* a doctrine which Hooke might juſtly have claimed as his own, had he not ſeen its futility.

20
And confirmed by the experiments of others.

Experiments made ſince the time of Hooke ſhow that this law is ſtrictly true in the extent to which we have limited it, viz. in all the changes of form which will be completely undone by the elaſticity of the body. It is nearly true to a much greater extent. James Bernoulli, in his diſſertation on the elaſtic curve, relates ſome experiments of his own, which ſeem to deviate conſiderably from it; but on cloſe examination they do not. The fineſt experiments are thoſe of Coulomb, publiſhed in ſome late volumes of the memoirs of the Academy of Paris. He ſuſpended balls by wires, and obſerved their motions of oſcillation, which he found accurately correſponding with this law.

This we ſhall find to be a very important fact in the doctrine of the ſtrength of bodies, and we deſire the reader to make it familiar to his mind. If we apply to this our manner of expreſſing theſe forces by perpendicular ordinates C *c*, D *d* (fig. 1.), we muſt take other ſituations E, F, of the particle B, and draw E *e*, F *f*; and we muſt have $Dd : Ff = BD : BF$, or $Cc : Ee = BC : BE$. In ſuch a ſuppoſition F *d* B *c e* muſt be a ſtraight line. But we ſhall have abundant evidence by and by that this cannot be ſtrictly true, and that the line B *c e* which limits the ordinates expreſſing the attractive forces becomes concave towards the line ABE, and that the part B *d f* is convex towards it. All that can be ſafely concluded from the experiments hitherto made is, that *to a certain extent* the forces, both attractive and repulſive, are *ſenſibly* proportional to the dilatations and compreſſions. For,

21
When a body is much dilated, a ſmall addition of force will increaſe its dilatation.

5thly, It is univerſally obſerved, that when the dilatations have proceeded a certain length, a leſs addition of force is ſufficient to increaſe the dilatation in the ſame degree. This is always obſerved when the body has been ſo far ſtretched that it takes a ſet, and does not completely recover its form. The like may be generally obſerved in compreſſions. Moſt perſons will recollect, that in violently ſtretching an elaſtic cord, it becomes ſuddenly weaker, or more eaſily ſtretched. But theſe phenomena do not poſitively prove a diminution of the corpuſcular force acting on one particle: It more probably ariſes from the diſunion of ſome particles, whoſe action contributed to the whole or ſenſible effect. And in compreſſions we may ſuppoſe ſomething of the ſame kind; for when we compreſs a body in one direction, it commonly bulges out in another; and in caſes of every violent action ſome particles may be diſunited, whoſe tranſverſe action had formerly balanced *part* of the compreſſing force. For the reader will ſee on reflection, that ſince the compreſſion, in one direction cauſes the body to bulge out in the tranſverſe direction; and ſince this bulging out is in oppoſition to the tranſverſe forces of attraction, it muſt employ ſome part of the compreſſing force. And the common appearances are in perfect uniformity with this conception of things. When we preſs a bit of dryiſh clay, it ſwells out and cracks tranſverſely. When a pillar of wood is overloaded, it ſwells out, and ſmall crevices appear in the direction of the fibres. After this it will not bear half of the load. This the carpenters call CRIPPLING; and a knowledge of the circumſtances which modify it is of great importance, and enables us to underſtand ſome very paradoxical appearances, as will be ſhown by and by.

This partial diſuniting of particles formerly cohering is, we imagine, the chief reaſon why the totality of the forces which really oppoſe an external ſtrain does not increaſe in the proportion of the extenſions and compreſſions. But ſufficient evidence will alſo be given that the forces which would connect one particle with one other particle do not augment in the accurate proportion of the change of diſtance; that in extenſions they increaſe more ſlowly, and in compreſſions more rapidly.

22
Ductility another cauſe of deviation.

But there is another cauſe of this deviation perhaps equally effectual with the former. Moſt bodies manifeſt ſome degree of ductility. Now what is this? The fact is, that the parts have taken a new arrangement, in which they again cohere. Therefore, in the paſſage to this new arrangement, the ſenſible forces, which are the joint reſult of many corpuſcular forces, begin to reſpect this new arrangement inſtead of the former. This muſt change the ſimple law of corpuſcular force, characteriſtic of the particular ſpecies of matter under examination. It does not require much reflection to convince us that the poſſible arrangements which the particles of a body may acquire, without appearing to change their nature, muſt be more numerous according as the particles are of a more complex conſtitution; and it is reaſonable to ſuppoſe that the conſtitution even of the moſt ſimple kind of matter that we are acquainted with is exceedingly complex. Our microſcopes ſhow us animals ſo minute, that a heap of them muſt appear to the naked eye an uniform maſs with a grain finer that that of the fineſt marble or razor hone; and yet each of theſe has not only limbs, but bones, muſcular fibres, blood-veſſels, fibres, and a blood conſiſting, in all probability, of globules organiſed and complex like our own. The imagination is here loſt in wonder; and nothing is left us but to adore inconceivable art and wiſdom, and to exult in the thought that we are the only ſpectators of this beautiful ſcene who can derive pleaſure from the view. What is trodden under foot with indifference, even by the half-reaſoning elephant, may be made by us the ſource of the pureſt and moſt unmixed pleaſure. But let us proceed to obſerve,

23
The forces which connect the particles of tangible bodies change by a change of diſtance.

6thly, That the forces which connect the particles of tangible bodies change by a change of diſtance, not only in degree, but alſo in kind. The particle B (fig. 1.) is attracted by A when in the ſituation C or E. It is repelled by it when at D or F. It is not affected by it when in the ſituation B. The reader is requeſted carefully to remark, that this is not an inference founded on the authority of our mathematical figure. The figure is an expreſſion (to aſſiſt the imagination) of facts in nature. It requires no force to keep the particles of a body in their quieſcent ſituations: but if they are ſeparated by ſtretching the body, they endeavour (pardon the figurative expreſſion) to come together again. If they are brought nearer by compreſſion, they endeavour to recede. This endeavour is manifeſt by the neceſſity of employing force to maintain the extenſion or condenſation; and we repreſent this by the different poſition of our lines. But this is not all: the particle B, which is repelled by A when in the ſituation F or D, is neutral when at B, and is attracted when at C or E, may be placed at ſuch a diſtance AG from A greater than AB that it ſhall be again repelled, or at ſuch a diſtance AH that it ſhall again be attracted; and theſe alterations may be repeated again and again. This is curious and important, and requires ſomething more than a bare aſſertion for its proof.

24 Light alternately attracted and repelled.

In the article Optics we mentioned the moſt curious and valuable obſervations of Sir Iſaac Newton, by which it appears that light is thus alternately attracted and repelled by bodies. The rings of colour which appear between the object glaſſes of long teleſcopes ſhowed, that in the ſmall interval of $\frac{1}{1000}$th of an inch, there are at leaſt an hundred ſuch changes obſervable, and that it is highly probable that theſe alterations extend to a much greater diſtance. At one of theſe diſtances the light actually converges towards the ſolid matter of the glaſs, which we expreſs ſhortly, by ſaying that it is attracted by it, and that at the next diſtance it declines from the glaſs, or is repelled by it. The ſame thing is more ſimply inferred from the phenomena of light paſſing by the edges of knives and other opaque bodies. We refer the reader to the experiments themſelves, the detail being too long for this place; and we requeſt the reader to conſider them minutely and attentively, and to form diſtinct notions of the inferences drawn from them. And we deſire it to be remarked, that although Sir Iſaac, in his diſcuſſion, always conſiders light as a ſet of corpuſcles moving in free ſpace, and obeying the actions of external forces like any other matter, the particular concluſion in which we are juſt now intereſted does not at all depend on this notion of the nature of light. Should we, with Des Cartes or Huygens, ſuppoſe light to be the undulation of an elaſtic medium, the concluſion will be the ſame. The undulations at certain diſtances are diſturbed by forces directed towards the body, and at a greater diſtance, the diſturbing forces tend *from* the body.

25 The ſame alternations of attraction and repulſion obſervable in the particles of other bodies, as glaſs.

But the ſame alternations of attraction and repulſion may be obſerved between the particles of common matter. If we take a piece of very flat and well poliſhed glaſs, ſuch as are made for the horizon glaſſes of a good Hadley's quadrant, and if we wrap round it a fibre of ſilk as it comes from the cocoon, taking care that the fibre nowhere croſs another, and then preſs this pretty hard on ſuch another piece of glaſs, it will lift it up and keep it ſuſpended. The particles therefore of the one do moſt certainly attract thoſe of the other, and this at a diſtance equal to the thickneſs of the ſilk fibre. This is nearly the limit; and it ſometimes requires a conſiderable preſſure to produce the effect. The preſſure is effectual only by compreſſing the ſilk fibre, and thus diminiſhing the diſtance between the glaſs plates. This adheſion cannot be attributed to the preſſure of the atmoſphere, becauſe there is nothing to hinder the air from inſinuating itſelf between the plates, ſince they are ſeparted by the ſilk. Beſides, the experiment ſucceeds equally well under the receiver of an air pump. This moſt valuable experiment was firſt made by Huygens, who reported it to the Royal Society. It is narrated in the Philoſophical Tranſactions, n° 86.

Here then is an attraction acting, like gravity, at a diſtance. But take away the ſilk fibre, and try to make the glaſſes touch each other, and we ſhall find a very great force neceſſary. By Newton's experiments it appears, that unleſs the priſmatic colours begin to appear between the glaſſes, they are at leaſt $\frac{1}{890}$th of an inch aſunder or more. Now we know that a very conſiderable force is neceſſary for producing theſe colours, and that the more we preſs the glaſſes together the more rings of colours appear. It alſo appears from Newton's meaſures, that the difference of diſtance between the glaſſes where each of theſe colours appear is about the 89,000th part of an inch. We know farther, that when we have produced the leaſt appearance of a greaſy or pearly colour, and then augment the preſſure, making it about a thouſand pounds on the ſquare inch, all colours vaniſh, and the two pieces of glaſs ſeem to make one tranſparent undiſtinguiſhable maſs. They appear now to have no air between them, or to be in mathematical contact. But another fact ſhows this concluſion to be premature. The ſame circles of colours appear in the top of a ſoap bubble; and as it grows thinner at top, there appears an unreflecting ſpot in the middle. We have the greateſt probability therefore that the perfect tranſparency in the middle of the two glaſſes does nor ariſe from their being in contact, but becauſe the thickneſs of air between them is too ſmall in that place for the reflection of light. Nay, Newton expreſsly found no reflection where the thickneſs was $\frac{2}{3}$ths or more of the $\frac{1}{89000}$th part of an inch.

All this while the glaſſes are ſtrongly repelling each other, for great preſſure is neceſſary for continuing the apearance of theſe colours, and they vaniſh in ſucceſſion as the preſſure is diminiſhed. This vaniſhing of the colours is a proof that the glaſſes are moving off from each other, or repelling each other. But we can put an end to this repulſion by very ſtrong preſſure, and at the ſame time ſliding the glaſſes on each other. We do not pretend to account for this effect of the ſliding motion; but the fact is, that by ſo doing, the glaſſes will cohere with very great force, ſo that we ſhall break them by any attempt to pull them aſunder. It commonly happens (at leaſt it did ſo with us), that in this ſliding compreſſion of two ſmooth flat plates of glaſs they ſcratch and mutually deſtroy each other's ſurface. It is alſo worth remarking, that different kinds of glaſs exhibit different properties in this reſpect. Flint glaſs will attract even though a ſilk fibre lies double between them, and they much more readily cohere by this ſliding preſſure.

Here then are two diſtances at which the plates of glaſs attract each other; namely, when the ſilk fibre is interpoſed, and when they are forced together with this ſliding motion. And in any intermediate ſituation they repel each other. We ſee the ſame thing in other ſolid bodies. Two pieces of lead made perfectly clean, may be made to cohere by grinding them together in the ſame manner. It is in this way that pretty ornaments of ſilver are united to iron. The piece is ſcraped clean, and a ſmall bit of ſilver like a fiſh ſcale is laid on. The die which is to ſtrike it into a flower or other ornament is then ſet on it, and we give it a ſmart blow, which forces the metals into contact as firm as if they were ſoldered together. It ſometimes happens that the die adheres to the coin ſo that they cannot be ſeparated: and it is found that this frequently happens, when the engraving is ſuch, that the raiſed figure is not completely ſurrounded with a ſmooth flat ground. The probable cauſe of this is curious. When the coin has a flat ſurface all around, this is produced by the moſt prominent part of the die. This applies to the metal, and completely confines the air which filled the hollow of the die. As the preſſure goes on, the metal is ſqueezed up into the hollow of the die; but there is ſtill air compreſſed between them, which cannot eſcape by any paſſage. It is therefore prodigiouſly condenſed,

26 Lead and iron.

27 Probable cauſe why the die adheres to the coin.

condenſed, and exerts an elaſticity proportioned to the condenſation. This ſerves to ſeparate the die from the metal when the ſtroke is over. The hollow part of the die has not touched the metal all the while, and we may ſay that the impreſſion was made by air. If this air eſcape by any engraving reaching through the border, they cohere inſeparably.

We have admitted that the glaſs plates are in contact when they cohere thus firmly. But we are not certain of this: for if we take theſe cohering glaſſes, and touch them with water, it quickly inſinuates itſelf between them. Yet they ſtill cohere, but can now be pretty eaſily ſeparated.

28
Repulſion the cauſe of ſome bodies ſwimming in a fluid ſpecifically lighter than themſelves.

It is owing to this repulſion, exerted through its proper ſphere, that certain powders ſwim on the ſurface of water, and are wetted with great difficulty. Certain inſects can run about on the ſurface of water. They have bruſhy feet, which occupy a conſiderable ſurface; and if their ſteps are viewed with a magnifying glaſs, the ſurface of the water is ſeen depreſſed all around, reſembling the footſteps of a man walking on feather-beds. This is owing to a repulſion between the bruſh and the water. A common fly cannot walk in this manner on water. Its feet are wetted, becauſe they attract the water inſtead of repelling it. A ſteel needle wiped very clean will lie on the ſurface of water, making an impreſſion as a great bar would make on a feather bed; and its weight is leſs than that of the diſplaced water. A dew drop lies on the leaves of plants without touching them mathematically, as is plain from the extreme brilliancy of the reflection at the poſterior ſurface; nay, it may be ſometimes obſerved that the drops of rain lie on the ſurface of water, and roll about on it like balls on a table. Yet all theſe ſubſtances can be wetted; that is, water can be applied to them at ſuch diſtances that they attract it.

What we ſaid a little ago of water inſinuating itſelf between the glaſs plates without altogether deſtroying their coheſion, ſhows that this coheſion is not the ſame that obtains between the particles of one of the plates; that is, the two plates are not in the ſtate of one continued maſs. It is highly probable, therefore, that between theſe two ſtates there is an intermediate ſtate of repulſion, nay, perhaps many ſuch, alternated with attractive ſtates.

A piece of ice is elaſtic, for it rebounds and it rings. Its particles, therefore, when compreſſed, reſile; and when ſtretched, contract again. The particles are therefore in the ſtate repreſented by B in figure 1. acted on by repulſive forces, if brought nearer; and by attractive forces, if drawn further aſunder. Ice expands, like all other bodies, by heat. It abſorbs a vaſt quantity of fire; which, by combining its attractions and repulſions with thoſe of the particles of ice, changes completely the law of action, without making any ſenſible change in the diſtance of the particles, and the ice becomes water. In this new ſtate the particles are again in limits between attractive and repulſive forces; for water has been ſhown, by the experiments of Canton and Zimmerman, to be elaſtic or compreſſible. It again expands by heat. It again abſorbs a prodigious quantity of heat, and becomes elaſtic vapour; its particles repelling each other at all diſtances yet obſerved. The diſtance between the particles of one plate of glaſs and thoſe of another which lies on it, and is carried by it, is a diſtance of repulſion; for the force which ſupports the upper piece is acting in oppoſition to its weight. This diſtance is leſs than that at which it would *ſuſpend* it below it with a ſilk fibre interpoſed; for no priſmatic colours appear between them when the ſilk fibre is interpoſed. But the diſtance at which glaſs attracts water is much leſs than this, for no colours appear when glaſs is wetted with water. This diſtance is leſs, and not greater, than the other; for when the glaſſes have water interpoſed between them inſtead of air, it is found, that when any particular colour appears, the thickneſs of the plate of water is to that of the plate of air which would produce the ſame colour nearly as 3 to 4. Now, if a piece of glaſs be wetted, and exhibit no colour, and another piece of glaſs be ſimply laid on it, no colour will appear; but if they are ſtrongly preſſed, the colours appear in the ſame manner as if the glaſſes had air between. Alſo, when glaſs is ſimply wetted, and the film of water is allowed to evaporate, when it is thus reduced to a proper thickneſs, the colours ſhow themſelves in great beauty.

29
Particles of matter connected by forces acting at a diſtance.

Theſe are a few of many thouſand facts, by which it is unqueſtionably proved that the particles of tangible matter are connected by forces acting at a diſtance, varying with the diſtance, and alternately attractive and repulſive. If we repreſent theſe forces as we have already done in fig. 1. by the ordinates C *c*, D *d*, E *e*, F *f*, &c. of a curve, it is evident that this curve muſt croſs the axis at all thoſe diſtances where the forces change from attractive to repulſive, and the curve muſt have branches alternately above and below the axis.

All theſe alternations of attraction and repulſion take place at ſmall and inſenſible diſtances. At all ſenſible diſtances the particles are influenced by the attraction of gravitation; and therefore this part of the curve muſt be a hyperbola whoſe equation is $y = \frac{a^3}{x^2}$. What is the form of the curve correſponding to the ſmalleſt diſtance of the particles? that is, what is the mutual action between the particles juſt before their coming into abſolute contact? Analogy ſhould lead as to ſuppoſe it to be repulſion: for ſolidity is the laſt and ſimpleſt form of bodies with which we are acquainted.—Fluids are more compounded, containing fire as an eſſential ingredient. We ſhould conclude that this ultimate repulſion is inſuperable, for the hardeſt bodies are the moſt elaſtic. We are fully entitled to ſay, that this repelling force exceeds all that we have ever yet applied to overcome it; nay, there are good reaſons for ſaying that this ultimate repulſion, by which the particles are kept from mathematical contact, is really inſuperable in its own nature, and that it is impoſſible to produce mathematical contact.

30
Mathematical contact impoſſible.

We ſhall juſt mention one of theſe, which we conſider as unanſwerable. Suppoſe two atoms, or ultimate particles of matter A and B. Let A be at reſt, and B move up to it with the velocity 2; and let us ſuppoſe that it comes into mathematical contact, and impels it (according to the common acception of the word). Both move with the velocity 1. This is granted by all to be the final reſult of the colliſion. Now the inſtant of time in which this communication happens is no part either of the duration of the ſolitary motion of A, nor of the joint motion of A and B: It is the ſeparation or boundary between them. It is at once the end of the firſt, and the beginning of the ſecond, belonging equally to both. A was moving with the velocity 2. The diſtinguiſhing circumſtance therefore of its mechanical ſtate is, that it has a determination (however incomprehenſible) by which it would move for ever with the velocity 2, if nothing changed it. This it has during the whole of its ſolitary motion, and therefore in the laſt inſtant of this motion. In like manner, during the whole of the joint motion, and therefore in the firſt inſtant of this motion, the atom A has a determination by which it would move for ever with the velocity 1. In one and the ſame inſtant, therefore, the atom A has two incompatible determinations. Whatever notion we can form of this ſtate, which we call velocity, as a diſtinction of condition, the ſame impoſſibility of conception or the ſame abſurdity occurs. Nor can it be avoided in any other way than by ſaying, that this change of A's motion is brought about by inſenſible gradations; that is, that A and B influence each other preciſely as they would do if a ſlender ſpring were interpoſed. The reader is deſired to look at what we have ſaid in the article Physics, § 82.

The two magnets there ſpoken of are good repreſentatives of two atoms endowed with mutual powers of repulſion; and the communication of motion is accompliſhed in both caſes in preciſely the ſame manner.

If, therefore, we ſhall ever be ſo fortunate as to diſcover the law of variation of that force which connects one atom of matter with another atom, and which is therefore characteriſtic of matter, and the ultimate ſource of all its ſenſible qualities, the curve whoſe ordinates repreſent the kind and the intenſity of this atomical force will be ſomething like that ſketched in fig. 2. The firſt branch $a\ n$ B will have AK (perpendicular to the axis AH) for its aſſymptote, and the laſt branch $l\ m\ o$ will be to all ſenſe a hyperbola, having AO for its aſſymptote; and the ordinates l L, m M, &c. will be proportional to $\frac{1}{AL^2}$, $\frac{1}{AM^2}$, &c. expreſſing the univerſal gravitation of matter. It will have many branches B b C, D d E, F f G, &c. expreſſing attractions, and alternate repulſive branches C c D, E e F, G g H, &c. All theſe will be contained within a diſtance A H, which does not exceed a very minute fraction of an inch.

31 The ſimpleſt extended particle conſiſts of four atoms.

The ſimpleſt particle which can be a conſtituent of a body having length, breadth, and thickneſs, muſt conſiſt of four ſuch atoms, all of which combine their influence on each attom of another ſuch particle. It is evident that the curve which expreſſes the forces that connect two ſuch particles muſt be totally different from this original curve, this hylarchic principle. Suppoſing the laſt known, our mathematical knowledge is quite able to diſcover the firſt; but when we proceed to compoſe a body of particles, each of which conſiſts of four ſuch particles, we may venture to ſay, that the compound force which connects them is almoſt beyond our ſearch, and that the diſcovery of the primary force from an *accurate* knowledge of the corpuſcular forces of *this* particular matter is abſolutely out of our power.

All that we can learn is, the poſſibility, nay the certainty, of an innumerable variety of external ſenſible forms and qualities, by which different kinds of matter will be diſtinguiſhed, ariſing from the number, the order of compoſition, and the arrangement of the ſubordinate particles of which a particle of this or that kind of matter is compoſed. All theſe varieties will take place at thoſe ſmall and inſenſible diſtances which are between A and H, and may produce all that variety which we obſerve in the tangible or mechanical forms of bodies, ſuch as elaſticity, ductility, hardneſs, ſoftneſs, fluidity, vapour, and all thoſe unſeen motions or actions which we obſerve in fuſion and congelation, evaporation and condeſation, ſolution and precipitation, cryſtallization, vegetable and animal aſſimilation and ſecretion, &c. &c. &c. while all bodies muſt be, in a certain degree, elaſtic, all muſt gravitate, and all muſt be incompenetrable.

This general and ſatisfactory reſemblance between the appearances of tangible matter and the legitimate conſequence of this general hypothetical property of an atom of matter, affords a conſiderable probability that ſuch is the origin of all the phenomena. We earneſtly recommend to our readers a *careful* peruſal of Boſcovich's celebrated treatiſe. A careful peruſal is neceſſary for ſeeing its value; and nothing will be got by a haſty look at it. The reader will be particularly pleaſed with the facility and evidence with which the ingenious author has deduced all the ordinary principles of mechanics, and with the explanation which he has given of fluidity, and his deduction from thence of the laws of hydroſtatics. No part of the treatiſe is more valuable than the doctrine of the propagation of preſſure through ſolid bodies. This, however, is but juſt touched on in the courſe of the inveſtigation of the principles of mechanics. We ſhall borrow as much as will ſuffice for our preſent inquiry into the ſtrength of materials; and we truſt that our readers are not diſpleaſed with this general ſketch of the doctrine (if it may be ſo called) of the coheſion of bodies. It is curious and important in itſelf, and is the foundation of all the knowledge we can acquire of the preſent article. We are ſorry to ſay that it is as yet a new ſubject of ſtudy; but it is a very promiſing one, and we by no means deſpair of ſeeing the whole of chemiſtry brought by its means within the pale of mechanical ſcience. The great and diſtinguiſhing agent in chemiſtry is heat, or fire the cauſe of heat; and one of its moſt ſingular effects is the converſion of bodies into elaſtic vapour. We have the cleareſt evidence that this is brought about by mechanical forces: for it can be oppoſed or prevented by external preſſure, a very familiar mechanical force. We may perhaps find another mechanical force which will prevent fuſion.

32 The doctrine of coheſion yet a new ſubject.

Having now made our readers familiar with the mode of action in which coheſion operates in giving ſtrength to ſolid bodies, we proceed to conſider the ſtrains to which the ſtrength is oppoſed.

33 Strains to which ſtrength is oppoſed.

A piece of ſolid matter is expoſed to four kinds of ſtrain, pretty different in the manner of their operation.

1. It may be torn aſunder, as in the caſe of ropes, ſtretchers, king-poſts, tye-beams, &c.
2. It may be cruſhed, as in the caſe of pillars, poſts, and truſs-beams.
3. It may be broken acroſs, as happens to a joiſt or lever of any kind.
4. It may be wrenched or twiſted, as in the caſe of the axle of a wheel, the nail of a preſs, &c.

I. It may be pulled asunder.

34 Matter may be pulled aſunder.

This is the ſimpleſt of all ſtrains, and the others are indeed modifications of it. To this the force of coheſion is *directly* oppoſed, with very little modification of its action by any particular circumſtances.

When a long cylindrical or priſmatic body, ſuch as a rod of wood or metal, or a rope, is drawn by one end, it muſt be reſiſted at the other, in order to bring its coheſion into action. When it is faſtened at one end, we cannot conceive it any other way than as equally ſtretched in all its parts; for all our obſervations and experiments on natural bodies concur in ſhowing us that the forces which connect their particles, in any way whatever, are equal and oppoſite. This is called the *third law of motion*; and we admit its univerſality, while we affirm that it is purely experimental (ſee Physics). Yet we have met with diſſertations by perſons of eminent knowledge, where propoſitions are maintained inconſiſtant with this. During the diſpute about the communication of motion, ſome of the ableſt writers have ſaid, that a ſpring compreſſed or ſtretched at the two ends was gradually leſs and leſs compreſſed or ſtretched from the extremities towards the middle: but the ſame writers acknowledge the univerſal equality of action and reaction, which is quite incompatible with this ſtate of the ſpring. No ſuch inequality of compreſſion or dilatation has ever been obſerved;

ved; and a little reflection will ſhow it to be impoſſible, in conſiſtency with the equality of action and reaction.

Since all parts are thus equally ſtretched, it follows, that the ſtrain in any tranſverſe ſection is the ſame, as alſo in every point of that ſection. If therefore the body be ſuppoſed of a homogeneous texture, the coheſion of the parts is equable; and ſince every part is equally ſtretched, the particles are drawn to equal diſtances from their quieſcent poſitions, and the forces which are thus excited, and now exerted in oppoſition to the ſtraining force, are equal. This external force may be increaſed by degrees, which will gradually ſeparate the part of the body more and more from each other, and the connecting forces increaſe with this increaſe of diſtance, till at laſt the coheſion of ſome particles is overcome. This muſt be immediately followed by a rupture, becauſe the remaining forces are now weaker than before.

It is the united force of coheſion, immediately before the diſunion of the firſt particles, that we call the STRENGTH of the ſection. It may alſo be properly called its ABSOLUTE STRENGTH, being exerted in the ſimpleſt form, and not modified by any relation to other circumſtances.

35
A circumſtance to be attended to in every construction requiring ſtrength.

If the external force has not produced any permanent change on the body, and it therefore recovers its former dimenſions when the force is withdrawn, it is plain that this ſtrain may be repeated as often as we pleaſe, and the body which withſtands it once will always withſtand it. It is evident that this ſhould be attended to in all conſtructions and that in all our inveſtigations on this ſubject this ſhould be kept ſtrictly in view. When we treat a piece of ſoft clay in this manner, and with this precaution, the force employed muſt be very ſmall. If we exceed this, we produce a permanent change. The rod of clay is not indeed torn aſunder; but it has become ſomewhat more ſlender: the number of particles in a croſs ſection is now ſmaller; and therefore, although it will again, in this new form, ſuffer, or allow an endleſs repetition of a *certain* ſtrain without any farther permanent change, this ſtrain is ſmaller than the former.

Something of the ſame kind happens to all bodies which receive a SETT by the ſtrain to which they are expoſed. All ductile bodies are of this kind. But there are many bodies which are not ductile. Such bodies break completely whenever they are ſtretched beyond the limit of their perfect elaſticity. Bodies of a fibrous ſtructure exhibit very great varieties in their coheſion. In ſome the fibres have no lateral coheſion, as in the caſe of a rope. The only way in which all the fibres can be made to unite their ſtrength is, to twiſt them together. This cauſes them to bind each other ſo faſt, that any one of them will break before it can be drawn out of the bundle. In other fibrous bodies, ſuch as timber, the fibres are held together by ſome cement or gluten. This is ſeldom as ſtrong as the fibre. Accordingly timber is much eaſier pulled aſunder in a direction tranſverſe to the fibres. There is, however, every poſſible variety in this particular.

35
Great varieties in coheſion, but

In ſtretching and breaking fibrous bodies, the viſible extenſion is frequently very conſiderable. This is not ſolely the increaſing of the diſtance of the particles of the cohering fibre: the greateſt part chiefly ariſes from drawing the crooked fibre ſtraight. In this, too, there is great diverſity; and it is accompanied with important differences in their power of withſtanding a ſtrain. In ſome woods, ſuch as fir, the fibres on which the ſtrength moſt depends are very ſtraight. Such woods are commonly very elaſtic, do not take a ſet, and break abruptly when overſtrained: others, ſuch as oak and birch, have their reſiſting fibres very undulating and crooked, and ſtretch very ſenſibly by a ſtrain. They are very liable to take a ſet, and they do not break ſo ſuddenly, but give warning by *complaining*, as the carpenters call it; that is, by giving viſible ſigns of a derangement of texture. Hard bodies of an uniform glaſſy ſtructure, or granulated like ſtones, are elaſtic through the whole extent of their coheſion, and take no ſet, but break at once when overloaded.

Notwithſtanding the immenſe variety which nature exhibits in the ſtructure and coheſion of bodies, there are certain general facts of which we may now avail ourſelves with advantage. In particular,

37
The abſolute coheſion or ſtrength proportional to the area of the ſection perpendicular to the extending force.

The abſolute coheſion is proportional to the area of the ſection. This muſt be the caſe where the texture is perfectly uniform, as we have reaſon to think it is in glaſs and the ductile metals. The coheſion of each particle being alike, the whole coheſion muſt be proportional to their number, that is, to the area of the ſection. The ſame muſt be admitted with reſpect to bodies of a granulated texture, where the granulation is regular and uniform. The ſame muſt be admitted of fibrous bodies, if we ſuppoſe their fibres equally ſtrong, equally denſe, and ſimilarly diſpoſed through the whole ſection; and this we muſt either ſuppoſe, or muſt ſtate the diverſity, and meaſure the coheſion accordingly.

We may therefore aſſert, as a general propoſition on this ſubject, that the abſolute ſtrength in any part of a body by which it reſiſts being pulled aſunder, or the force which muſt be employed to tear it aſunder *in that part*, is proportional to the area of the ſection perpendicular to the extending force.

Therefore all cylindrical or priſmatical rods are equally ſtrong in every part, and will break alike in any part; and bodies which have unequal ſections will always break in the ſlendereſt part. The length of the cylinder or priſm has no effect on the ſtrength; and the vulgar notion, that it is eaſier to break a very long rope than a ſhort one, is a very great miſtake. Alſo the abſolute ſtrengths of bodies which have ſimilar ſections are proportional to the ſquares of their diameters or homologous ſides of the ſection.

38
Relative ſtrength.

The weight of the body itſelf may be employed to ſtrain it and to break it. It is evident, that a rope may be ſo long as to break by its own weight. When the rope is hanging perpendicularly, although it is equally ſtrong in every part, it will break towards the upper end, becauſe the ſtrain on any part is the weight of all that is below it. Its RELATIVE STRENGTH in any part, or power of withſtanding the ſtrain which is actually laid on it, is inverſely as the quantity below that part.

When the rope is ſtretched horizontally, as in towing a ſhip, the ſtrain ariſing from its weight often bears a very ſenſible proportion to its whole ſtrength.

Let AEB (fig. 3.) be any portion of ſuch a rope, and AC, BC be tangents to the curve into which its gravity bends it. Complete the parallelogram ACBD. It is well known that the curve is a catenaria, and that DC is perpendicular to the horizon; and that DC is to AC as the weight of the rope AEB to the ſtrain at A.

In order that a ſuſpended heavy body may be equally able in every part to carry its own weight, the ſection in that part muſt be proportional to the ſolid contents of all that is below it. Suppoſe it a conoidal ſpindle, formed by the revolution of the curve $\mathrm{A}ae$ (fig. 4.) round the axis CE. We muſt have $\mathrm{AC}^2 : ac^2 = \mathrm{AEB}$ ſol. : $a\mathrm{E}b$ ſol. This condition requires the logarithmic curve for $\mathrm{A}ae$, of which $\mathrm{C}c$ is the axis.

Theſe are the chief general rules which can be ſafely deduced from our cleareſt notions of the coheſion of bodies. In order to make any practical uſe of them, it is proper to have ſome meaſures of the coheſion of ſuch bodies as are

39 The coheſion of metals depends on various circumſtances.

commonly employed in our mechanics, and other ſtructures where they are expoſed to this kind of ſtrain. Theſe muſt be deduced ſolely from experiment. Therefore they muſt be conſidered as no more than general values, or as the averages of many particular trials. The irregularities are very great, becauſe none of the ſubſtances are conſtant in their texture and firmneſs. Metals differ by a thouſand circumſtances unknown to us, according to their purity, to the heat with which they were melted, to the moulds in which they were caſt, and the treatment they have afterwards received, by forging, wire-drawing, tempering, &c.

It is a very curious and inexplicable fact, that by forging a metal, or by frequently drawing it through a ſmooth hole in a ſteel plate, its coheſion is greatly increaſed. This operation undoubtedly deranges the natural ſituation of the particles. They are ſqueezed cloſer together in one direction; but it is not in the direction in which they reſiſt the fracture. In this direction they are rather ſeparated to a greater diſtance. The general denſity, however, is augmented in all of them except lead, which grows rather rarer by wire-drawing: but its coheſion may be more than tripled by this operation. Gold, ſilver, and braſs, have their coheſion nearly tripled; copper and iron have it more than doubled. In this operation they alſo grow much harder. It is proper to heat them to redneſs after drawing a little. This is called *nealing* or *annealing*. It ſoftens the metal again, and renders it ſuſceptible of another drawing without the riſk of cracking in the operation.

We do not pretend to give any explanation of this remarkable and very important fact, which has ſomething reſembling it in woods and other fibrous bodies, as will be mentioned afterwards.

The varieties in the coheſion of ſtones and other minerals, and of vegetables and animal ſubſtances, are hardly ſuſceptible of any deſcription or claſſification.

40 Coheſion and ſtrength of different metals.

We ſhall take for the meaſure of coheſion the number of pounds avoirdupois which are juſt ſufficient to tear aſunder a rod or bundle of one inch ſquare. From this it will be eaſy to compute the ſtrength correſponding to any other dimenſion.

1*ſt*, METALS.

		lbs.
Gold, caſt	- - -	20,000 24,000
Silver, caſt	- -	40,000 43,000
Copper, caſt	Japan - -	19,500
	Barbary - - -	22,000
	Hungary - -	31,000
	Angleſea - -	34,000
	Sweden - -	37,000
Iron, caſt	- - -	42,000 59,000
Iron, bar	Ordinary - -	68,000
	Stirian - - -	75,000
	Beſt Swediſh and Ruſſian	84,000
	Horſe-nails - -	71,000 (A)
Steel, bar	Soft - -	120,000
	Razor temper -	150,000
Tin, caſt	Malacca - -	3,100
	Banca - -	3,600
	Block - -	3,800
	Engliſh block - -	5,200
	——— grain -	6,500
Lead, caſt	- - - - -	860
Regulus of antimony	- -	1,000
Zinc	- - - - -	2,600
Biſmuth	- - - -	2,900

41 Tenacity of metals increaſed by mixture.

It is very remarkable that almoſt all the mixtures of metals are more tenacious than the metals themſelves. The change of tenacity depends much on the proportion of the ingredients, and the proportion which produces the moſt tenacious mixture is different in the different metals. We have ſelected the following from the experiments of Muſchenbroek. The proportion of ingredients here ſelected is that which produces the greateſt ſtrength.

Two parts of gold with one of ſilver -	28,000
Five parts of gold with one of copper -	50,000
Five parts of ſilver with one of copper -	48,500
Four parts of ſilver with one of tin -	41,000
Six parts of copper with one of tin -	41,000
Five parts of Japan copper with one of Banca tin - - - -	57,000
Six parts of Chili copper with one of Malacca tin - - - -	60,000
Six parts of Swediſh copper with one of Malacca tin - - - -	64,000
Braſs conſiſts of copper and zinc in an unknown proportion; its ſtrength is - -	51,000
Three parts of block-tin with one part of lead	10,200
Eight parts of block-tin with one part of zinc	10,000
Four parts of Malacca tin with one part of regulus of antimony - -	12,000
Eight parts of lead with one of zinc -	4,500
Four parts of tin with one of lead and one of zinc - - -	13,000

Theſe numbers are of conſiderable uſe in the arts. The mixtures of copper and tin are particularly intereſting in the fabric of great guns. We ſee that, by mixing copper whoſe greateſt ſtrength does not exceed 37,000 with tin which does not exceed 6,000, we produce a metal whoſe tenacity is almoſt double, at the ſame time that it is harder and more eaſily wrought. It is, however, more fuſible, which is a great inconvenience. We alſo ſee that a very ſmall addition of zinc almoſt doubles the tenacity of tin, and increaſes the tenacity of lead five times; and a ſmall addition of lead doubles the tenacity of tin. Theſe are economical mixtures. This is a very valuable information to the plumbers for augmenting the ſtrength of water-pipes.

By having recourſe to theſe tables, the engineer can proportion the thickneſs of his pipes (of whatever metal) to the preſſures to which they are expoſed.

2*d*, WOODS.

WE may premiſe to this part of the table the following general obſervations:

42 Tenacity or ſtrength of wood.

1. The wood immediately ſurrounding the pith or heart of the tree is the weakeſt, and its inferiority is ſo much more remarkable as the tree is older. In this aſſertion, however, we ſpeak with ſome heſitation. Muſchenbroek's *detail* of experiments is decidedly in the affirmative. Mr Buffon, on the other hand, ſays, that his experience has taught him that the heart of a ſound tree is the ſtrongeſt; but he gives no inſtances. We are certain, from many obſervations

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(A) This was an experiment by Muſchenbroek, to examine the vulgar notion that iron forged from old horſe-nails was ſtronger than all others, and ſhows its falſity ſervations of our own on *very large* oaks and firs, that the heart is much weaker than the exterior parts.

2. The wood next the bark, commonly called the *white* or *blea*, is alſo weaker than the reſt; and the wood gradually increaſes in ſtrength as we recede from the centre to the blea.

3. The wood is ſtronger in the middle of the trunk than at the ſpringing of the branches or at the root; and the wood of the branches is weaker than that of the trunk.

4. The wood of the north ſide of all trees which grow in the European climates is the weakeſt, and that of the ſouth-eaſt ſide is the ſtrongeſt; and the difference is moſt remarkable in hedge row trees, and ſuch as grow ſingly. The heart of a tree is never in its centre, but always nearer to the north ſide, and the annual coats of wood are thinner on that ſide. In conformity with this, it is a general opinion of carpenters that timber is ſtronger whoſe annual plates are thicker. The trachea or air-veſſels are weaker than the ſimple ligneous fibres. Theſe air-veſſels are the ſame in diameter and number of rows in the trees of the ſame ſpecies, and they make the viſible ſeparation between the annual plates. Therefore when theſe are thicker, they contain a greater proportion of the ſimple ligneous fibres.

5. All woods are more tenacious while green, and loſe very conſiderably by drying after the trees are felled.

The only author who has put it in our power to judge of the propriety of his experiments is Muſchenbroek. He has deſcribed his method of trial minutely, and it ſeems unexceptionable. The woods were all formed into ſlips fit for his apparatus, and part of the ſlip was cut away to a parallelopiped of $\frac{1}{5}$th of an inch ſquare and therefore $\frac{1}{25}$th of a ſquare inch in ſection. The abſolute ſtrengths of a ſquare inch were as follow:

43
Abſolute ſtrength of different kinds of wood,

	lib.		lib.
Locuſt tree	20,100	Pomegranate	9,750
Jujeb -	18,500	Lemon	9,250
Beech, oak	17,300	Tamarind	8,750
Orange	15,500	Fir -	8,330
Alder -	13,900	Walnut -	8,130
Elm -	13,200	Pitch pine	7,650
Mulberry	12,500	Quince -	6,750
Willow -	12,500	Cypreſs	6,000
Aſh -	12,000	Poplar -	5,500
Plum -	11,800	Cedar -	4,880
Elder -	10,000		

Mr. Muſchenbroek has given a very minute detail of the experiments on the aſh and the walnut, ſtating the weights which were required to tear aſunder ſlips taken from the four ſides of the tree, and on each ſide in a regular progreſſion from the centre to the circumference. The numbers of this table correſponding to theſe two timbers may therefore be conſidered as the average of more than 50 trials made of each; and he ſays that all the others were made with the ſame care. We cannot therefore ſee any reaſon for not confiding in the reſults; yet they are conſiderably higher than thoſe given by ſome other writers. Mr Pitot ſays, on the authority of his own experiments, and of thoſe of Mr Parent, that 60 pounds will juſt tear aſunder a ſquare line of ſound oak, and that it will bear 50 with ſafety. This gives 8640 for the utmoſt ſtrength of a ſquare inch, which is much inferior to Muſchenbroek's valuation.

We may add to theſe,

44
And of other ſubſtances.

Ivory - - - - . . -	16,270
Bone - - - - -	5,250
Horn - - - - - -	8,750
Whalebone - - - -	7,500
Tooth of ſea-calf - - - -	4,075

The reader will ſurely obſerve, that theſe numbers expreſs ſomething more than the utmoſt coheſion; for the weights are ſuch as will very quickly, that is, in a minute or two, tear the rods aſunder. It may be ſaid in general, that two-thirds of theſe weights will ſenſibly impair the ſtrength after a conſiderable while, and that one half is the utmoſt that can remain ſuſpended at them without riſk for ever; and it is this laſt allotment that the engineer ſhould reckon upon in his conſtructions. There is, however, conſiderable difference in this reſpect. Woods of a very ſtraight fibre, ſuch as fir, will be leſs impaired by any load which is not ſufficient to break them immediately.

45
No ſubſtance to be ſtrained in architecture above one half its ſtrength.

According to Mr Emerſon, the load which may be ſafely ſuſpended to an inch ſquare is as follows:

Iron - - -	76,400
Braſs - - -	35,600
Hempen rope - - - -	19,600
Ivory - - -	15,700
Oak, box, yew, plum-tree - -	7,850
Elm, aſh, beech - -	6,070
Walnut, plum - - -	5,360
Red fir, holly, elder, plane, crab -	5,000
Cherry, hazle - - -	4,760
Alder, aſp, birch, willow - -	4,290
Lead - - -	430
Freeſtone - - -	914

He gives us a practical rule, that a cylinder whoſe diameter is *d* inches, loaded to one-fourth of its abſolute ſtrength, will carry as follows:

Iron -	135	Cwt.
Good rope -	22	
Oak -	14	
Fir -	9	

The rank which the different woods hold in this liſt of Mr Emerſon's is very different from what we find in Muſchenbroek's. But preciſe meaſures muſt not be expected in this matter. It is wonderful that in a matter of ſuch unqueſtionable importance the public has not enabled ſome perſons of judgment to make proper trials. They are beyond the abilities of private perſons.

II. Bodies may be crushed.

46
It is of importance to know what will cruſh bodies.

It is of equal, perhaps greater, importance to know the ſtrain which may be laid on ſolid bodies without danger of cruſhing them. Pillars and poſts of all kinds are expoſed to this ſtrain in its ſimpleſt form; and there are caſes where the ſtrain is enormous, viz. where it ariſes from the oblique poſition of the parts; as in the ſtuts, braces, and truſſes, which occur very frequently in our great works.

It is therefore moſt deſirable to have ſome general knowledge of the principle which determines the ſtrength of bodies in oppoſition to this kind of ſtrain. But unfortunately we are much more at a loſs in this than in the laſt caſe. The mechaniſm of nature is much more complicated in the preſent caſe. It muſt be in ſome circuitous way that compreſſion can have any tendency to tear aſunder the parts of a ſolid body, and it is very difficult to trace the ſteps.

If we ſuppoſe the particles inſuperably hard and in contact, and diſpoſed in lines which are in the direction of the external preſſures, it does not appear how any preſſure can diſunite the particles; but this is a gratuitous ſuppoſition. There are infinite odds againſt this preciſe arrangement of the lines of particles; and the compreſſibility of all kinds of matter in ſome degree ſhows that the particles are in a ſituation equivalent to diſtance. This being the caſe, and the particles, with their intervals, or what is equivalent to intervals,

tervals, being in ſituations that are oblique with reſpect to the preſſures, it muſt follow, that by ſqueezing them together in one direction, they are made to bulge out or ſeparate in other directions. This may proceed ſo far that ſome may be thus puſhed laterally beyond their limits of coheſion. The moment that this happens the reſiſtance to compreſſion is diminiſhed, and the body will now be cruſhed together. We may form ſome notion of this by ſuppoſing a number of ſpherules, like ſmall ſhot, ſticking together by means of a cement. Compreſſing this in ſome particular direction cauſes the ſpherules to act among each other like ſo many wedges, each tending to penetrate through between the three which lie below it: and this is the ſimpleſt, and perhaps the only diſtinct, notion we can have of the matter. We have reaſon to think that the conſtitution of very homogeneous bodies, ſuch as glaſs, is not very different from this. The particles are certainly arranged ſymmetrically in the angles of ſome regular ſolids. It is only ſuch an arrangement that is conſiſtent with tranſparency, and with the free paſſage of light in *every* direction.

47 Their ſtrength or power of reſiſtance to ſuch a force

If this be the conſtitution of bodies, it appears probable that the ſtrength, or the reſiſtance which they are capable of making to an attempt to cruſh them to pieces, is proportional to the area of the ſection whoſe plane is perpendicular to the external force; for each particle being ſimilarly and equally acted on and reſiſted, the whole reſiſtance muſt be as their number; that is, as the extent of the ſection.

Accordingly this principle is aſſumed by the few writers who have conſidered this ſubject; but we confeſs that it appears to us very doubtful. Suppoſe a number of brittle or friable balls lying on a table uniformly arranged, but not cohering nor in contact, and that a board is laid over them and loaded with a weight; we have no heſitation in ſaying, that the weight neceſſary to cruſh the whole collection is proportional to their number or to the area of the ſection. But when they are in contact (and ſtill more if they cohere), we imagine that the caſe is materially altered. Any individual ball is cruſhed only in conſequence of its being bulged outwards in the direction perpendicular to the preſſure employed. If this could be prevented by a hoop put round the ball like an equator, we cannot ſee how any force can cruſh it. Any thing therefore which makes this bulging outwards more difficult, makes a greater force neceſſary. Now this effect will be produced by the mere contact of the balls before the preſſure is applied; for the central ball cannot ſwell outward laterally without puſhing away the balls on all ſides of it. This is prevented by the friction on the table and upper board, which is at leaſt equal to one third of the preſſure. Thus any interior ball becomes ſtronger by the mere vicinity of the others; and if we farther ſuppoſe them to cohere laterally, we think that its ſtrength will be ſtill more increaſed.

The analogy between theſe balls and the cohering particles of a friable body is very perfect. We ſhould therefore expect that the ſtrength by which it reſiſts being cruſhed will increaſe in a greater ratio than that of the ſection, or the ſquare of the diameter of ſimilar ſections; and that a ſquare inch of any matter will bear a greater weight in proportion as it makes a part of a greater ſection. Accordingly this appears in many experiments, as will be noticed afterwards. Muſchenbroek, Euler, and ſome others, have ſuppoſed the ſtrength of columns to be as the biquadrates of their diameters. But Euler deduced this from formulæ which occurred to him in the courſe of his algebraic analyſis; and he boldly adopts it as a principle, without looking for its foundation in the phyſical aſſumptions which he had made in the beginning of his inveſtigation. But ſome of his original aſſumptions were as paradoxical, or at leaſt as gratuitous, as theſe reſults: and thoſe, in particular, from which this proportion of the ſtrength of columns was deduced, were almoſt foreign to the caſe; and therefore the inference was of no value. Yet it was received as a principle by Muſchenbroek and by the academicians of St. Peterſburgh. We make theſe very few obſervations, becauſe the ſubject is of great practical importance; and it is a great obſtacle to improvements when deference to a great name, joined to incapacity or indolence, cauſes authors to adopt his careleſs reveries as principles from which they are afterwards to draw important conſequences. It muſt be acknowledged that we have not as yet eſtabliſhed the relation between the dimenſions and the ſtrength of a pillar on ſolid mechanical principles. Experience plainly contradicts the general opinion, that the ſtrength is proportional to the area of the ſection; but it is ſtill more inconſiſtent with the opinion, that it is in the quadruplicate ratio of the diameters of ſimilar ſections. It would ſeem that the ratio depends much on the internal ſtructure of the body; and experiment ſeems the only method for aſcertaining its general laws.

48 To be aſcertained only by experiment.

If we ſuppoſe the body to be of a fibrous texture, having the fibres ſituated in the direction of the preſſure, and ſlightly adhering to each other by ſome kind of cement, ſuch a body will fail only by the bending of the fibres, by which they will break the cement and be detached from each other. Something like this may be ſuppoſed in wooden pillars. In ſuch caſes, too, it would appear that the reſiſtance muſt be as the number of equally reſiſting fibres, and as their mutual ſupport, jointly; and, therefore, as ſome function of the area of the ſection. The ſame thing muſt happen if the fibres are naturally crooked or undulated, as is obſerved in many woods, &c. provided we ſuppoſe ſome ſimilarity in their form. Similarity of ſome kind muſt always be ſuppoſed, otherwiſe we need never aim at any general inferences.

In all caſes therefore we can hardly refuſe admitting that the ſtrength in oppoſition to compreſſion is proportional to a function of the area of the ſection.

As the whole length of a cylinder or priſm is equally preſſed, it does not appear that the ſtrength of a pillar is at all affected by its length. If indeed it be ſuppoſed to bend under the preſſure, the caſe is greatly changed, becauſe it is then expoſed to a tranſverſe ſtrain; and this increaſes with the length of the pillar. But this will be conſidered with due attention under the next claſs of ſtrains.

Few experiments have been made on this ſpecies of ſtrength and ſtrain. Mr Petit ſays, that his experiments, and thoſe of Mr Parent, ſhow that the force neceſſary for cruſhing a body is nearly equal to that which will tear it aſunder. He ſays that it requires ſomething more than 60 pounds on every ſquare line to cruſh a piece of ſound oak. But the rule is by no means general: Glaſs, for inſtance, will carry a hundred times as much as oak in this way, that is, reſting on it; but will not *ſuſpend* above four or five times as much. Oak will ſuſpend a great deal more than fir; but fir will carry twice as much as a pillar. Woods of a ſoft texture, although conſiſting of very tenacious fibres, are more eaſily cruſhed by their load. This ſoftneſs of texture is chiefly owing to their fibres not being ſtraight but undulated, and there being conſiderable vacuities between them, ſo that they are eaſily bent laterally and cruſhed. When a poſt is overſtrained by its load, it is obſerved to ſwell ſenſibly in diameter. Increaſing the load cauſes longitudinal cracks or ſhivers to appear, and it preſently after gives way. This is called *crippling*.

In all caſes where the fibres lie oblique to the ſtrain the ſtrength is greatly diminiſhed, becauſe the parts can then be made to ſlide on each other, when the coheſion of the cementing matter is overcome.

Muſchenbroek has given ſome experiments on this ſubject; but they are caſes of long pillars, and therefore do not belong to this place. They will be conſidered afterwards.

The only experiments of which we have ſeen any detail (and it is uſeleſs to inſert mere aſſertions) are thoſe of Mr Gauthey, in the 4th volume of Rozier's *Journal de Phyſique*. This engineer expoſed to great preſſures ſmall rectangular parallelopipeds, cut from a great variety of ſtones, and noted the weights which cruſhed them. The following table exhibits the medium reſults of many trials on two very uniform kinds of freeſtone, one of them among the hardeſt and the other among the ſofteſt uſed in building.

49 Experiments for this purpoſe made on freeſtone.

Column 1ſt expreſſes the length AB of the ſection in French lines or 12ths of an inch; column 2d expreſſes the breadth BC; column 3d is the area of the ſection in ſquare lines; column 4th is the number of ounces required to cruſh the piece; column 5th is the weight which was then borne by each ſquare line of the ſection; and column 6th is the round numbers to which Mr Gauthey imagines that thoſe in column 5th approximate.

Hard Stone.

	AB	BC	AB × BC	Weight	Force	
1	8	8	64	736	11,5	12
2	8	12	96	2625	27,3	24
3	8	16	128	4496	35,1	36
			Soft Stone.			
4	9	16	144	560	3,9	4
5	9	18	162	848	5,3	4,5
6	18	18	324	2928	9	9
7	18	24	432	5296	12,2	12

Little can be deduced from theſe experiments: The 1ſt and 3d, compared with the 5th and 6th, ſhould furniſh ſimilar reſults; for the 1ſt and 5th are reſpectively half of the 3d and 6th: but the 3d is three times ſtronger (that is, a line of the 3d) than the firſt, whereas the 6th is only twice as ſtrong as the 5th.

It is evident, however, that the ſtrength increaſes much faſter than the area of the ſection, and that a ſquare line can carry more and more weight, according as it makes a part of a larger and larger ſection. In the ſeries of experiments on the ſoft ſtone, the individual ſtrength of a ſquare line ſeems to increaſe nearly in the proportion of the ſection of which it makes a part.

Mr Gauthey deduces, from the whole of his numerous experiments, that a pillar of hard ſtone of Givry, whoſe ſection is a ſquare foot, will bear with perfect ſafety 664,000 pounds, and that its extreme ſtrength is 871,000, and the ſmalleſt ſtrength obſerved in any of his experiments was 460,000. The ſoft bed of Givry ſtone had for its ſmalleſt ſtrength 187,000, for its greateſt 311,000, and for its ſafe load 249,000. Good brick will carry with ſafety 320,000; chalk will carry only 9000. The boldeſt piece of architecture in this reſpect which he has ſeen is a pillar in the church of All Saints at Angers. It is 24 feet long and 11 inches ſquare, and is loaded with 60,000, which is not $\frac{1}{7}$th of what is neceſſary for cruſhing it.

We may obſerve here by the way, that Mr Gauthey's meaſure of the ſuſpending ſtrength of ſtone is vaſtly ſmall in proportion to its power of ſupporting a load laid above it. He finds that a priſm of the hard bed of Givry, of a foot ſection, is torn aſunder by 4600 pounds; and if it be firmly fixed horizontally in a wall, it will be broken by a weight of 56,000 ſuſpended a foot from the wall. If it reſt on two props at a foot diſtance, it will be broken by 206,000 laid on its middle. Theſe experiments agree ſo ill with each other, that little uſe can be made of them. The ſubject is of great importance, and well deſerves the attention of the patriotic philoſopher.

50 Not ſatisfactory.

51 Good experiments much wanted.

A ſet of good experiments would be very valuable, becauſe it is againſt this kind of ſtrain that we muſt guard by judicious conſtruction in the moſt delicate and difficult problems which come through the hands of the civil and military engineer. The conſtruction of ſtone arches, and the conſtruction of great wooden bridges, and particularly the conſtruction of the frames of carpentry called *centres* in the erection of ſtone bridges, are the moſt difficult jobs that occur. In the centres on which the arches of the bridge of Orleans were built ſome of the pieces of oak were carrying upwards of two tons on every ſquare inch of their ſcantling. All who ſaw it ſaid that it was not able to carry the fourth part of the intended load. But the engineer underſtood the principles of his art, and ran the riſk: and the reſult completely juſtified his confidence; for the centre did not complain in any part, only it was found too ſupple; ſo that it went out of ſhape while the haunches only of the arch were laid on it. The engineer corrected this by loading it at the crown, and thus kept it completely in ſhape during the progreſs of the work.

In the Memoirs (old) of the Academy of Peterſburgh for 1778, there is a diſſertation by Euler on this ſubject, but particularly limited to the ſtrain on columns, in which the bending is taken into the account. Mr Fuſs has treated the ſame ſubject with relation to carpentry in a ſubſequent volume. But there is little in theſe papers beſides a dry mathematical diſquiſition, proceeding on aſſumptions which (to ſpeak favourably) are extremely gratuitous. The moſt important conſequence of the compreſſion is wholly overlooked, as we ſhall preſently ſee. Our knowledge of the mechaniſm of coheſion is as yet far too imperfect to entitle us to a confident application of mathematics. Experiments ſhould be multiplied.

52 How they are to be made uſeful.

The only way we can hope to make theſe experiments uſeful is to pay a careful attention to the *manner* in which the fracture is produced. By diſcovering the general reſemblances in this particular, we advance a ſtep in our power of introducing mathematical meaſurement. Thus, when a cubical piece of chalk is ſlowly cruſhed between the chaps of a vice, we ſee it uniformly ſplit in a ſurface oblique to the preſſure, and the two parts then ſlide along the ſurface of fracture. This ſhould lead us to examine mathematically what relation there is between this ſurface of fracture and the neceſſary force; then we ſhould endeavour to determine experimentally the poſition of this ſurface. Having diſcovered ſome general law or reſemblance in this circumſtance, we ſhould try what mathematical hypotheſis will agree with this. Having found one, we may then apply our ſimpleſt notions of coheſion, and compare the reſult of our computations with experiment. We are authoriſed to ſay, that a ſeries of experiments have been made in this way, and that their reſults have been very uniform, and therefore ſatisfactory, and that they will ſoon be laid before the public as the foundations of ſucceſsful practice in the conſtruction of arches.

III. A Body may be broken across.

53 It is of importance to know what ſtrain will break a body tranſverſely.

The moſt uſual, and the greateſt ſtrain, to which materials are expoſed, is that which tends to break them tranſverſely. It is ſeldom, however, that this is done in a manner perfectly ſimple; for when a beam projects horizontally from a wall, and a weight is ſuſpended from its extremity, the beam is commonly broken near the wall, and the intermediate part has performed the functions of a lever. It ſometimes, though rarely, happens that the pin in the joint of a pair of pincers or ſciſſars is cut through by the ſtrain; and this is almoſt the only caſe of a ſimple tranſverſe fracture. Being ſo rare, we may content ourſelves with ſaying, that in this caſe the ſtrength of the piece is proportional to the area of the ſection.

54 Experiments made to aſcertain

Experiments were made for diſcovering the reſiſtances made by bodies to this kind of ſtrain in the following manner: Two iron bars were diſpoſed horizontally at an inch diſtance; a third hung perpendicularly between them, being ſupported by a pin made of the ſubſtance to be examined. This pin was made of a priſmatic form, ſo as to fit exactly the holes in the three bars, which were made very exact, and of the ſame ſize and ſhape. A ſcale was ſuſpended at the lower end of the perpendicular bar, and loaded till it tore out that part of the pin which filled the middle hole. This weight was evidently the meaſure of the lateral coheſion of two ſections. The ſide-bars were made to graſp the middle bar pretty ſtrongly between them, that there might be no diſtance impoſed between the oppoſite preſſures. This would have combined the energy of a lever with the purely tranſverſe preſſure. For the ſame reaſon it was neceſſary that the internal parts of the holes ſhould be no ſmaller than the edges. Great irregularities occurred in our firſt experiments from this cauſe, becauſe the pins were ſomewhat tighter within than at the edges; but when this was corrected they were extremely regular. We employed three ſets of holes, viz. a circle, a ſquare (which was occaſionally made a rectangle whoſe length was twice its breadth), and an equilateral triangle. We found in all our experiments the ſtrength exactly proportional to the area of the ſection, and quite independant of its figure or poſition, and we found it conſiderably above the direct coheſion; that is, it took conſiderably more than twice the force to tear out this middle piece than to tear the pin aſunder by a direct pull. A piece of fine freeſtone required 205 pounds to pull it directly aſunder, and 575 to break it in this way. The difference was very conſtant in any one ſubſtance, but varied from $\frac{4}{3}$ds to $\frac{6}{3}$ds in different kinds of matter, being ſmalleſt in bodies of a fibrous texture. But indeed we could not make the trial on any bodies of conſiderable coheſion, becauſe they required ſuch forces as our apparatus could not ſupport. Chalk, clay baked in the ſun, baked ſugar, brick, and freeſtone, were the ſtrongeſt that we could examine.

55 Their reſult.

But the more common caſe, where the energy of a lever intervenes, demands a minute examination.

56 The ſtrength of a lever.

Let DABC (fig. 5. n° 1.) be a vertical ſection of a priſmatic ſolid (that is, of equal ſize throughout), projecting horizontally from a wall in which it is firmly fixed; and let a weight P be hung on it at B, or let any power P act at B in a direction perpendicular to AB. Suppoſe the body of inſuperable ſtrength in every part except in the vertical ſection DA, perpendicular to its length. It muſt break in this ſection only. Let the coheſion be uniform over the whole of this ſection; that is, let each of the adjoining particles of the two parts cohere with an equal force *f*.

There are two ways in which it may break. The part ABCD may ſimply ſlide down along the ſurface of fracture, provided that the power acting at B is equal to the accumulated force which is exerted by every particle of the ſection in the direction AD.

But ſuppoſe this effectually prevented by ſomething that ſupports the point A. The action at P tends to make the body turn round A (or round a horizontal line paſſing thro' A at right angles to AB) as round a joint. This it cannot do without ſeparating at the line DA. In this caſe the adjoining particles at D or at E will be ſeparated horizontally. But their coheſion reſiſts this ſeparation. In order, therefore, that the fracture may happen, the energy or momentum of the power P, acting by means of the lever AB, muſt be ſuperior to the accumulated energies of the particles. The energy of each depends not only on its coheſive force, but alſo on its ſituation: for the ſuppoſed inſuperable firmneſs of the reſt of the body makes it a lever turning round the fulcrum A, and the coheſion of each particle, ſuch as D or E, acts by means of the arm DA or EA. The energy of each particle will therefore be had by multiplying the force exerted by it in the inſtant of fracture by the arm of the lever by which it acts.

Let us therefore firſt ſuppoſe, that in the inſtant of fracture every particle is exerting an equal force *f*. The energy of D will be $f \times$DA, and that of E will be $f \times$EA, and that of the whole will be the ſum of all theſe products. Let the depth DA of the ſection be called *d*, and let any undetermined part of it EA be called x, and then the ſpace occupied by any particle will be $\dot{x}$. The coheſion of this ſpace may be repreſented by $f\dot{x}$, and that of the whole by fd. The energy by which each element $\dot{x}$ of the line DA, or *d*, reſiſts the fracture, will be $f x \dot{x}$, and the whole accumulated energies will be $f \times \int x \dot{x}$. This we know to be $f \times \frac{1}{2}d^2$, or $fd \times \frac{1}{2}d$. It is the ſame therefore as if the coheſion fd of the whole ſection had been acting at the point G, which is in the middle of DA.

The reader who is not familiarly acquainted with this fluxionary calculus may arrive at the ſame concluſion in another way. Suppoſe the beam, inſtead of projecting horizontally from a wall, to be hanging from the ceiling, in which it is firmly fixed. Let us conſider how the equal coheſion of every part operates in hindering the lower part from ſeparating from the upper by opening round the joint A. The equal coheſion operates juſt as equal gravity would do, but in the oppoſite direction. Now we know, by the moſt elementary mechanics, that the effect of this will be the ſame as if the whole weight were concentrated in the centre of gravity G of the line DA, and that this point G is in the middle of DA. Now the number of fibres being as the length *d* of the line, and the coheſion of each fibre being $= f$, the coheſion of the whole line is $f \times d$ or fd.

The accumulated energy therefore of the coheſion in the inſtant of fracture is $fd \times \frac{1}{2}d$. Now this muſt be equal or juſt inferior to the energy of the power employed to break it. Let the length AB be called l; then $P \times l$ is the correſponding energy of the power. This gives us $fd\frac{1}{2}d = p\,l$ for the equation of equilibrium correſponding to the vertical ſection ADCB.

Suppoſe now that the fracture is not permitted at DA, but at another ſection $\delta\,\alpha$ more remote from B. The body being priſmatic, all the vertical ſections are equal; and therefore $fd\,\frac{1}{2}\,d$ is the ſame as before. But the energy of the power is by this means increaſed, being now $= P \times B\,\alpha$, inſtead of P × BA: Hence we ſee that when the priſmatic body is not inſuperably ſtrong in all its parts, but equally ſtrong throughout, it muſt break cloſe at the wall, where the ſtrain or energy of the power is greateſt. We ſee, too, that a power which is juſt able to break it at the wall is unable to break it anywhere elſe; alſo an abſolute coheſion fd, which can withſtand the power p in the ſection DA, will not withſtand it in the ſection $\delta\,\alpha$, and will withſtand more in the ſection $d'\,a'$.

This teaches us to diſtinguiſh between abſolute and relative ſtrength. The relative ſtrength of a ſection has a reference to the ſtrain actually exerted on that ſection. This relative ſtrength is properly meaſured by the power which is juſt able to balance or overcome it, when applied at its proper place. Now ſince we had $f d \frac{1}{2} d = p l$, we have $p = \frac{f d \frac{1}{2} d}{l}$ for the meaſure of the ſtrength of the ſection DA, in relation to the power applied at B.

If the ſolid is a rectangular beam, whoſe breadth is *b*, it is plain that all the vertical ſections are equal, and that AG or $\frac{1}{2}d$ is the ſame in all. Therefore the equation expreſſing the equilibrium between the momentum of the external force and the accumulated momenta of coheſion will be $p l = f d b \times \frac{1}{2} d$.

The product $d b$ evidently expreſſes the area of the ſection of fracture, which we may call s, and we may expreſs the equilibrium thus, $p l = f s \frac{1}{2} d$, and $2 l : d = f s : p$.

Now $f s$ is a proper expreſſion of the abſolute coheſion of the ſection of fracture, and p is a proper meaſure of its ſtrength in relation to a power applied at B. We may therefore ſay, that *twice the length of a rectangular beam is to the depth as the abſolute coheſion to the relative ſtrength.*

Since the action of equable coheſion is ſimilar to the action of equal gravity, it follows, that whatever is the figure of the ſection, the relative ſtrength will be the ſame as if the abſolute coheſion of all the fibres were acting at the centre of gravity of the ſection. Let g be the diſtance between the centre of gravity of the ſection and the axis of fracture, we ſhall have $p l = f s g$, and $l : g = f s : p$. It will be very uſeful to recollect this analogy in words: "*The length of a priſmatic beam of any ſhape is to the height of the centre of gravity above the lower ſide, as the abſolute coheſion to the ſtrength relative to this length.*"

Becauſe the relative ſtrength of a rectangular beam is $\frac{f b d \frac{1}{2} d}{l}$ or $\frac{f b d^2}{2 l}$, it follows, that the relative ſtrengths of different beams are proportional to the abſolute coheſion of the particles, to the breadth, and to the ſquare of the depth directly, and to the length inverſely; alſo in priſms whoſe ſections are ſimilar, the ſtrengths are as the cubes of the diameters.

57 Aſcertained on the hypotheſis of equal coheſion;

Such are the more general reſults of the mechaniſm of this tranſverſe ſtrain, in the hypotheſis that all the particles are exerting equal forces in the inſtant of fracture. We are indebted for this doctrine to the celebrated Galileo; and it was one of the firſt ſpecimens of the application of mathematics to the ſcience of nature.

We have not included in the preceding inveſtigation that action of the external force by which the ſolid is drawn ſidewiſe, or tends to ſlide along the ſurface of fracture. We have ſuppoſed a particle E to be pulled only in the direction E *e*, perpendicular to the ſection of fracture, by the action of the crooked lever BAE. But it is alſo pulled in the direction EA; and its reaction is in ſome direction ε E, compounded of ε *f*, by which it reſiſts being pulled outwards; and ε *e*, by which it reſiſts being pulled downwards. We are but imperfectly acquainted with the force ε *e*, and only know that their accumulated ſum is equal to the force *p*: but in all important caſes which occur in practice, it is unneceſſary to attend to this force; becauſe it is ſo ſmall in compariſon of the forces in the direction E *e*, as we eaſily conclude from the uſual ſmallneſs of AD in compariſon of AB.

58 But that hypotheſis not conformable to nature.

The hypotheſis of equal coheſion, exerted by all the particles in the inſtant of fracture, is not conformable to nature: for we know, that when a force is applied tranſverſely at B, the beam is bent downwards, becoming convex on the upper ſide; that ſide is therefore on the ſtretch. The particles at D are farther removed from each other than thoſe at E, and are therefore *actually exerting* greater coheſive forces. We cannot ſay with certainty and preciſion in what proportion each fibre is extended. It ſeems moſt probable that the extenſions are proportional to the diſtances from A. We ſhall ſuppoſe this to be really the caſe. Now recollect the general law which we formerly ſaid was *obſerved* in all moderate extenſions, *viz.* that the attractive forces exerted by the dilated particles were proportional to their dilatations. Suppoſe now that the beam is ſo much bent that the particles at D are exerting their utmoſt force, and that this fibre is juſt ready to break or actually breaks. It is plain that a total fracture muſt immediately enſue; becauſe the force which was ſuperior to the full coheſion of the particle at D, and a certain portion of the coheſion of all the reſt, will be more than ſuperior to the full coheſion of the particle next within D, and a ſmaller portion of the coheſion of the remainder.

Now let F repreſent, as before, the full force of the exterior fibre D, which is exerted by it in the inſtant of its breaking, and then the force exerted at the ſame inſtant by the fibre E will be had by this analogy AD : AE, or $d : x = f : \frac{f x}{d}$, and the force really exerted by the fibre E is $f \times \frac{x}{d}$.

The force exerted by a fibre whoſe thickneſs is $\dot{x}$ is therefore $\frac{f x \dot{x}}{d}$; but this force reſiſts the ſtrain by acting by means of the lever EA or x. Its energy or momentum is therefore $\frac{f x^2 \dot{x}}{d}$, and the accumulated momenta of all the fibres in the line AE will be $f \times$ ſum of $\frac{x^2 \dot{x}}{d}$. This, when x is taken equal to d, will expreſs the momentum of the whole fibres in the line AD. This, therefore, is $f \frac{\frac{1}{3} d^3}{d}$, or $f \frac{1}{3} d^2$, or $f d \times \frac{1}{3} d$. Now $f d$ expreſſes the abſolute coheſion of the whole line AD. The accumulated momentum is therefore the ſame as if the abſolute coheſion of the whole line were exerted at $\frac{1}{3}$d of AD from A.

59 The ſtrength aſcertained on other principles.

From theſe premiſes it follows that the equation expreſſing the equilibrium of the ſtrain and coheſion is $p l = f d \times \frac{1}{3} d$; and hence we deduce the analogy, "*As thrice the length is to the depth, ſo is the abſolute coheſion to the relative ſtrength.*"

This equation and this proportion will equally apply to rectangular beams whoſe breadth is *b*; for we ſhall then have $p l = f b d \times \frac{1}{3} d$.

We alſo ſee that the relative ſtrength is proportional to the abſolute coheſion of the particles, to the breadth, and to the ſquare of the depth directly, and to the length inverſely: for p is the meaſure of the force with which it is reſiſted, and $p = \frac{f b d \frac{1}{3} d}{l}, = \frac{f b d^2}{3 l}$. In this reſpect therefore this hypotheſis agrees with the Galilean; but it aſſigns to every beam a ſmaller proportion of the abſolute coheſion of the ſection of fracture, in the proportion of 3 to 2. In the Galilean hypotheſis this ſection has a momentum equal to $\frac{1}{2}$ of its abſolute ſtrength, but in the other hypotheſis it is only $\frac{1}{3}$d. In beams of a different form the proportion may be different.

As this is a moſt important propoſition, and the foundation of many practical maxims, we are anxious to have it clearly comprehended, and its evidence perceived by all. Our better informed readers will therefore indulge us while we endeavour to preſent it in another point of view, where it will be better ſeen by thoſe who are not familiarly acquainted with the fluxionary calculus.

Fig.

60 The ſame propoſition preſented in another point of view.

Fig. 5. n° 2. A is a perſpective view of a three ſided beam projecting horizontally from a wall, and loaded with a weight at B juſt ſufficient to break it. DABC is a vertical plane through its higheſt point D, in the direction of its length. $a\,D\,a$ is another vertical ſection perpendicular to AB. The piece being ſuppoſed of inſuperable ſtrength everywhere except in the ſection $a\,D\,a$, and the coheſion being alſo ſuppoſed inſuperable along the line $a\,A\,a$, it can break nowhere but in this ſection, and by turning round $a\,A\,a$ as round a hinge. Make $D\,d$ equal to AD, and let $D\,d$ repreſent the abſolute coheſion of the fibre at D, which abſolute coheſion we expreſſed by the ſymbol f. Let a plane $a\,d\,a$ be made to paſs through $a\,a$ and d, and let $d\,a'\,a'$ be another croſs ſection. It is plain that the priſmatic ſolid contained between the two ſections $a\,D\,a$ and $a'\,d\,a'$ will repreſent the full coheſion of the whole ſection of fracture; for we may conceive this priſm as made up of lines ſuch as $F\,f$, equal and parallel to $D\,d$, repreſenting the abſolute coheſion of each particle ſuch as F. The pyramidal ſolid $d\,D\,a\,a$, cut off by the plane $d\,a\,a$, will repreſent the coheſions *actually exerted* by the different fibres in the inſtant of fracture. For take any point E in the ſurface of fracture, and draw $E\,e$ parallel to AB, meeting the plane $a\,d\,a$ in e, and let $e\,A\,E$ be a vertical plane. It is evident that $D\,d$ is to $E\,e$ as AD to AE; and therefore (ſince the forces exerted by the different fibres are as their extenſion, and their extenſion as their diſtances from the axis of fracture) $E\,e$ will repreſent the force actually exerted by the fibre in E, while D is exerting its full force $D\,d$. In like manner, the plane $F\,F\,f\,f$ expreſſes the coheſion exerted by all the fibres in the line F F, and ſo on through the whole ſurface. Therefore the pyramid $d\,a\,a\,D$ expreſſes the accumulated exertion of the whole ſurface of fracture.

Farther, ſuppoſe the beam to be held perpendicular to the horizon with the end B uppermoſt, and that the weight of the priſm contained between the two ſections $a\,D\,a$ and $a'\,d\,a'$ (now horizontal) is juſt able to overcome the full coheſion of the ſection of fracture. The weight of the pyramid $d\,D\,a\,a$ will alſo be juſt able to overcome the coheſions *actually exerted* by the different fibres in the inſtant of fracture, becauſe the weight of each fibre, ſuch as $E\,e$, is juſt ſuperior to the coheſion actually exerted at E.

Let o be the centre of gravity of the pyramidal ſolid, and draw $o\,O$ perpendicular to the plane $a\,D\,a$. The whole weight of the ſolid $d\,D\,a\,a$ may be conceived as accumulated in the point o, and as acting on the point O, and it will have the ſame tendency to ſeparate the two cohering ſurfaces as when each fibre is hanging by its reſpective point. For this reaſon the point O may be called the *centre of actual effort* of the unequal forces of coheſion. The momentum therefore, or energy by which the cohering ſurfaces are ſeparated, will be properly meaſured by the weight of the ſolid $d\,D\,a\,a$ multiplied by OA; and this product is equal to the product of the weight p multipled by BA, or by l. Thus ſuppoſe that the coheſion along the line AD only is conſidered. The whole coheſion will be repreſented by a triangle $A\,D\,d$. $D\,d$ repreſents f, and AD is d, and AD is x. Therefore $A\,D\,d$ is $\frac{1}{2}fd$. The centre of gravity o of the triangle $A\,D\,d$ is in the interſection of a line drawn from A to the middle of $D\,d$ with a line drawn from d to the middle of AD; and therefore the line $o\,O$ will make AO $=\frac{2}{3}$ of A D. Therefore the actual momentum of coheſion is $f \times \frac{1}{2}d \times \frac{2}{3}d, = f \times d \times \frac{1}{3}d, = fd \times \frac{1}{3}d$, or equal to the abſolute coheſion acting by means of the lever $\frac{d}{3}$. If the ſection of fracture is a rectangle, as in a common joiſt, whoſe breadth $a\,a$ is $= b$, it is plain that all the vertical lines will be equal to AD, and their coheſions will be repreſented by triangles like $A\,D\,d$; and the whole actual coheſion will be repreſented by a wedge whoſe baſes are vertical planes, and which is equal to half of the parallelopiped $AD \times D\,d \times a\,a$, and will therefore be $= \frac{1}{2}fbd$; and the diſtance A O of its centre of gravity from the horizontal line A A′ will be $\frac{2}{3}$ of A D. The momentum of coheſion of a joiſt will therefore be $\frac{1}{2}fbd \times \frac{2}{3}d$, or $fbd\,\frac{1}{3}d$, as we have determined in the other way.

The beam repreſented in the figure is a triangular priſm. The pyramid $D\,a\,a\,d$ is $\frac{1}{3}$ of the priſm $a\,a\,D\,d\,a'\,a'$. If we make s repreſent the ſurface of the triangle $a\,D\,a$, the pyramid is $\frac{1}{3}$ of fs. The diſtance AO of its centre of gravity from the horizontal line A A′ is $\frac{1}{2}$ of A D, or $\frac{1}{2}d$. Therefore the momentum of actual coheſion is $\frac{1}{3}fs \times \frac{1}{2}d, = fs\,\frac{1}{6}d$; that is, it is the ſame as if the full coheſion of all the fibres were accumulated at a point I whoſe diſtance from A is $\frac{1}{6}$th of AD or d; or (that we may ſee its value in every point of view) it is $\frac{1}{6}$th of the momentum of the full coheſion of all the fibres when accumulated at the point D, or acting at the diſtance $d = $ A D.

This is a very convenient way of conceiving the momentum of actual coheſion, by comparing it with the momentum of abſolute coheſion applied at the diſtance AD from the axis of fracture. The momentum of the abſolute coheſion applied at D is to the momentum of actual coheſion in the inſtant of fracture as AD to AI. Therefore the length of AI, or its proportion to AD, is a ſort of index of the ſtrength of the beam. We ſhall call it the INDEX, and expreſs it by the ſymbol i.

Its value is eaſily obtained. The product of the abſolute coheſion by AI muſt be equal to that of the actual coheſion by AO. Therefore ſay, "as the priſmatic ſolid $a\,a\,D\,d\,a'\,a'$ is to the pyramidal ſolid $a\,a\,D\,d$, ſo is AO to AI." We are aſſiſted in this determination by a very convenient circumſtance. In this hypotheſis of the actual coheſions being as the diſtances of the fibres from A, the point O is the centre of oſcillation or percuſſion of the ſurface $D\,a\,a$ turning round the axis $a\,a$: for the momentum of coheſion of the line F F is $FF \times Ff \times EA = FF \times EA^2$, becauſe Ff is equal to E A. Now A O, by the nature of the centre of gravity, is equal to the ſum of all theſe momenta divided by the pyramid $a\,a\,D\,d$; that is, by the ſum of all the $FF \times Ff$; that is, by the ſum of all the $FF \times EA$. Therefore $AO = \frac{\text{ſum of } FF \times EA^2}{\text{ſum of } FF \times EA}$, which is juſt the value of the diſtance of the centre of percuſſion of the triangle $a\,a\,D$ from A: (See ROTATION). Moreover, if G be the centre of gravity of the triangle $a\,D\,a$, we ſhall have D A to G A as the abſolute coheſion to the ſum of the coheſions actually exerted in the inſtant of fracture; for, by the nature of this centre of gravity, A G is equal to $\frac{\text{ſum of } FF \times EA}{\text{ſum of } FF}$, and the ſum of $FF \times AG$ is equal to the ſum of $FF \times EA$. But the ſum of all the lines F F is the triangle $a\,D\,a$, and the ſum of all the $FF \times EA$ is the ſum of all the rectangles $F\,F\,f\,f$; that is, the pyramid $d\,D\,a\,a$. Therefore a priſm whoſe baſe is the triangle $a\,D\,a$, and whoſe height is AG, is equal to the pyramid, or will expreſs the ſum of the actual coheſions; and a priſm, whoſe baſe is the ſame triangle, and whoſe height is $D\,d$ or $D\,a$, expreſſes the abſolute coheſion. Therefore D A is to G A as the abſolute coheſion to the ſum of the actual coheſions.

Therefore we have $DA : GA = OA : IA$.

Therefore, whatever be the form of the beam, that is, whatever be the figure of its ſection, find the centre of oſcillation O, and the centre of gravity G of this ſection.

Call their diſtances from the axis of fracture o and g. Then A I or $i = \frac{og}{d}$, and the momentum of coheſion is $fs \times \frac{og}{d}$, where s is the area of fracture.

This index is eaſily determined in all the caſes which generally occur in practice. In a rectangular beam A I is $\frac{1}{3}$d of AD; in a cylinder (circular or elliptic) AI is $\frac{5}{16}$ths of AD, &c. &c.

In this hypotheſis, that the coheſion actually exerted by each fibre is as its extenſion, and that the extenſions of the fibres are as their diſtances from A (fig. 5. n° 1.), it is plain that the forces exerted by the fibres D, E, &c. will be repreſented by the ordinates D *d*, E *e*, &c. to a ſtraight line A *d*. And we learn from the principles of Rotation that the centre of percuſſion O is in the ordinate which paſſes through the centre of gravity of the triangle A D *d*, or (if we conſider the whole ſection having breadth as well as depth) through the centre of gravity of the ſolid bounded by the planes DA, *d*A; and we found that this point O was the centre of effort of the coheſions *actually* exerted in the inſtant of fracture, and that I was the centre of an *equal* momentum, which would be produced if all the fibres were accumulated there and exerted their *full* coheſion.

This conſideration enables us to determine, with equal facility and neatneſs, the ſtrength of a beam in any hypotheſis of forces. The above hypotheſis was introduced with a cautious limitation to moderate ſtrains, which produced no permanent change of form, or no ſet as the artiſts call it: and this ſuffices for all purpoſes of practice, ſeeing that it would be imprudent to expoſe materials to more violent ſtrains. But when we compare this theory with experiments in which the pieces are really broken, conſiderable deviations may be expected, becauſe it is very probable that in the vicinity of rupture the forces are no longer proportional to the extenſions.

61 How the relative ſtrength may be determined by any other hypotheſis.

That no doubt may remain as to the juſtneſs and completeneſs of the theory, we muſt ſhow how the relative ſtrength may be determined in any other hypotheſis. Therefore ſuppoſe that it has been eſtabliſhed by experiment on any kind of ſolid matter, that the forces actually exerted in the inſtant of fracture by the fibres at D, E, &c. are as the ordinates D *d'*, E *e'*, &c. of any curve line A *e' d'*. We are ſuppoſed to know the form of this curve, and that of the ſolid which is bounded by the vertical plane through AD, and by the ſurface which paſſes through this curve A *e' d'* perpendicularly to the length of the beam. We know the place of the centre of gravity of this curve ſurface or ſolid, and can draw a line through it parallel to A B, and cutting the ſurface of fracture in ſome point O. This point is alſo the centre of effort of all the coheſions actually exerted; and the product of A O and of the ſolid which expreſſes the actual coheſions will give the momentum of coheſion equivalent to the former $fs \frac{og}{d}$. Or we may find an index A I, by making A I a fourth proportional to the full coheſion of the ſurface of fracture, to the accumulated actual coheſions, and to AO; and then $fs \times i$ (= A I) will be the momentum of coheſion; and we ſhall ſtill have I for the point in which all the fibres may be ſuppoſed to exert their full coheſion f, and to produce a momentum of coheſion equal to the real momentum of the coheſions actually exerted, and the relative ſtrength of the beam will ſtill be $p = \frac{fsi}{l}$ or $\frac{fsgo}{dl}$. Thus, if the forces be as the ſquares of the extenſions (ſtill ſuppoſed to be as the diſtances from A), the curve A *e' d'* will be a common parabola, having A B for its axis and A D for the tangent at its vertex. The area A D *d'* will be $\frac{1}{3}$d A D × D *d*; and in the caſe of a rectangular beam, A O will be $\frac{3}{4}$ths A D, and A I will be $\frac{1}{4}$th of A D.

We may obſerve here in general, that if the forces actually exerted in the inſtant of fracture be as any power q of the diſtance from A, the index A I will be $= \frac{AD}{q+2}$ for a rectangular beam, and the momentum of coheſion will always be (*cæteris paribus*) as the breadth and as the ſquare of the depth; nay, this will be the caſe whenever the action of the fibres D and E is expreſſed by any *ſimilar functions* of *d* and *x*. This is evident to every reader acquainted with the fluxionary calculus.

As far as we can judge from experience, no ſimple algebraic power of the diſtance will expreſs the actual coheſions of the fibres. No curve which has either AD or AB for its tangent will ſuit. The obſervations which we made in the beginning ſhow, that although the curve of fig. 2. muſt be ſenſibly ſtraight in the vincinity of the points of interſection with the axis, in order to agree with our obſervations which ſhow the moderate extenſions to be as the extending forces, the curve *muſt* be concave towards the axis in all its attractive branches, becauſe it cuts it again. Therefore the curve A *e' d'* of fig. 5. (n° 1.) muſt make a finite angle with AD or AB, and it muſt, in all probability, be alſo concave towards AD in the neighbourhood of *d'*. It may however be convex in ſome part of the intermediate arch. We have made experiments on the extenſions of different bodies, and find great diverſities in this reſpect: But in all, the moderate extenſions were as the forces, and this with great accuracy till the body took a ſet, and remained longer than formerly when the extending force was removed.

We muſt now remark, that this correction of the Galilean hypotheſis of equal forces was ſuggeſted by the bending which is obſerved in all bodies which are ſtrained tranſverſely. Becauſe they are bent, the fibres on the convex ſide have been extended. We cannot ſay in what proportion this obtains in the different fibres. Our moſt diſtinct notions of the internal equilibrium between the particles render it highly probable that their extenſion is proportional to their diſtance from the fibre which retains its former dimenſions. But by whatever law this is regulated, we ſee plainly that the actions of the ſtretched fibres muſt follow the proportions of ſome function of this diſtance, and that therefore the relative ſtrength of a beam is in all caſes ſuſceptible of mathematical determination.

62 Bernoulli's problem of the elaſtic curve.

We alſo ſee an intimate connection between the ſtrain and the curvature. This ſuggeſted to the celebrated James Bernoulli the problem of the Elastic Curve, *i. e.* the curve into which an extenſible rigid body will be bent by a tranſverſe ſtrain. His ſolution in the *Acta Lipſiæ* 1694 and 1695 is a very beautiful ſpecimen of mathematical diſcuſſion; and we recommend it to the peruſal of the curious reader. He will find it very perſpicuouſly treated in the firſt volume of his works, publiſhed after his death, where the wide ſteps which he had taken in his inveſtigation are explained ſo as to be eaſily comprehended. His nephew Dan. Bernoulli has given an elegant abridgment in the Peterſburg Memoirs for 1729. The problem is too intricate to be fully diſcuſſed in a work like ours; but it is alſo too intimately connected with our preſent ſubject to be entirely omitted. We muſt content ourſelves with ſhowing the leading mechanical property of this curve, from which the mathematician may deduce all its geometrical properties.

When a bar of uniform depth and breadth, and of a given length, is bent into an arch of a circle, the extenſion of the outer

63
Its leading mechanical property deſcribed.

outer fibres is proportional to the curvature; for, becauſe the curves formed by the inner and outer ſides of the beam are ſimilar, the circumferences are as the radii, and the radius of the inner circle is to the difference of the radii as the length of the inner circumference is to the difference of the circumferences. The difference of the radii is the depth of the beam, the difference of the circumferences is the extenſion of the outer fibres, and the inner circumference is ſuppoſed to be the primitive length of the beam. Now the ſecond and third quantities of the above analogy, viz. the depth and length of the beam, are conſtant quantities, as is alſo their product. Therefore the product of the inner radius and the extenſion of the outer fibre is alſo a conſtant quantity, and the whole extenſion of the outer fibre is inverſely as the radius of curvature, or is directly as the curvature of the beam.

The mathematical reader will readily ſee, that into whatever curve the elaſtic bar is bent, the whole extenſion of the outer fibre is equal to the length of a ſimilar curve, having the ſame proportion to the thickneſs of the beam that the length of the beam has to the radius of curvature.

Now let ADCB (fig. 5. n° 3) be ſuch a rod, of uniform breadth and thickneſs, firmly fixed in a vertical poſition, and bent into a curve AEFB by a weight W ſuſpended at B, and of ſuch magnitude that the extremity B has its tangent perpendicular to the action of the weight, or parallel to the horizon. Suppoſe too that the extenſions are proportional to the extending forces. From any two points E and F draw the horizontal ordinates EG, FH. It is evident that the exterior fibres of the ſections E *e* and F *f* are ſtretched by forces which are in the proportion of EG to FH (theſe being the long arms of the levers, and the equal thickneſſes E *e*, F *f* being the ſhort arms). Therefore (by the hypotheſis) their extenſions are in the ſame proportion. But becauſe the extenſions are proportional to ſome ſimilar functions of the diſtance from the axes of fracture E and F, the extenſion of any fibre in the ſection E *e* is to the contemporaneous extenſion of the ſimilarly ſituated fibre in the ſection F *f*, as the extenſion of the exterior fibre in the ſection E *e* is to the extenſion of the exterior fibre in the ſection F *f*: therefore the whole extenſion of E *e* is to the whole extenſion of F *f* as EG to FH, and EG is to FH as the curvature in E to the curvature in F.

Here let it be remarked, that this proportionality of the curvature to the extenſion of the fibres is not limited to the hypotheſis of the proportionality of the extenſions to the extending forces. It follows from the extenſion in the different ſections being as ſome ſimilar function of the diſtance from the axis of fracture; an aſſumption which cannot be refuſed.

This then is the fundamental property of the elaſtic curve, from which its equation, or relation between the abſciſſa and ordinate, may be deduced in the uſual forms, and all its other geometrical properties. Theſe are foreign to our purpoſe; and we ſhall notice only ſuch properties as have an immediate relation to the ſtrain and ſtrength of the different parts of a flexible body, and which in particular ſerve to explain ſome difficulties in the valuable experiments of Mr Buffon on the Strength of Beams.

64
It is not a circle.

We obſerve, in the firſt place, that the elaſtic curve cannot be a circle, but is gradually more incurvated as it recedes from the point of application B of the ſtraining forces. At B it has no curvature; and if the bar were extended beyond B there would be no curvature there. In like manner, when a beam is ſupported at the ends and loaded in the middle, the curvature is greateſt in the middle; but at the props, or beyond them, if the beam extend farther, there is no curvature. Therefore when a beam projecting 20 feet from a wall is bent to a certain curvature at the wall by a weight ſuſpended at the end, and a beam of the ſame ſize projecting 20 feet is bent to the very ſame curvature at the wall by a greater weight at 10 feet diſtance, the figure and the mechanical ſtate of the beam in the vicinity of the wall is different in theſe two caſes, though the curvature at the very wall is the ſame in both. In the firſt caſe every part of the beam is incurvated; in the ſecond, all beyond the 10 feet is without curvature. In the firſt experiment the curvature at the diſtance of five feet from the wall is ¾ths of the curvature at the wall; in the ſecond, the curvature at the ſame place is but ½ of that at the wall. This muſt weaken the long beam in this whole interval of five feet, becauſe the greater curvature is the reſult of a greater extenſion of the fibres.

65
Every beam has a certain determinate curvature.

In the next place, we may remark, that there is a certain determinate curvature for every beam which cannot be exceeded without breaking it; for there is a certain ſeparation of two adjoining particles that puts an end to their coheſion. A fibre can therefore be extended only a certain proportion of its length. The ultimate extenſion of the outer fibres muſt bear a certain determinate proportion to its length, and this proportion is the ſame with that of the thickneſs (or what we have hitherto called the depth) to the radius of ultimate curvature, which is therefore determinate.

66
And when of uniform breadth and depth is moſt incurvated where the ſtrain is greateſt.

A beam of uniform breadth and depth is therefore moſt incurvated where the ſtrain is greateſt, and will break in the moſt incurvated part. But by changing its form, ſo as to make the ſtrength of its different ſections in the ratio of the ſtrain, it is evident that the curvature may be the ſame throughout, or may be made to vary according to any law. This is a remark worthy of the attention of the watchmaker. The moſt delicate problem in practical mechanics is ſo to taper the balance-ſpring of a watch that its wide and narrow vibrations may be iſochronous. Hooke's principle *ut tenſio ſic vis* is not ſufficient when we take the *inertia* and motion of the ſpring itſelf into the account. The figure into which it bends and unbends has alſo an influence. Our readers will take notice that the artiſt aims at an accuracy which will not admit an error of $\frac{1}{86400}$th, and that Harriſon and Arnold have actually attained it in ſeveral inſtances. The taper of a ſpring is at preſent a noſtrum in the hands of each artiſt, and he is careful not to impart his ſecret.

Again, ſince the depth of the beam is thus proportional to the radius of ultimate curvature, this ultimate or breaking curvature is inverſely as the depth. It may be expreſſed by $\frac{1}{d}$.

67
To what the curvature is proportional.

When a weight is hung on the end of a priſmatic beam, the curvature is nearly as the weight and the length directly, and as the breadth and the cube of the depth inverſely; for the ſtrength is $=f\frac{b\,d^2}{3\,l}$. Let us ſuppoſe that this produces the ultimate curvature $\frac{1}{d}$. Now let the beam be loaded with a ſmaller weight w, and let the curvature produced be C, we have this analogy $f\frac{b\,d^2}{3\,l} : w = \frac{1}{d} : C$, and $C = \frac{3\,l\,w}{f\,b\,d^3}$. It is evident that this is alſo true of a beam ſupported at the ends and loaded between the props; and we ſee how to determine the curvature in its different parts, whether ariſing from the load, or from its own weight, or from both

When a beam is thus loaded at the end or middle, the loaded point is pulled down, and the ſpace through which it is drawn may be called the DEFLECTION. This may be conſidered as the ſub-tenſe of the angle of contact, or as the verſed ſine of the arch into which the beam is bent, and is therefore as the curvature when the length of the arches is given (the flexure being moderate), and as the ſquare of the length of the arch when the curvature is given. The deflection therefore is as the curvature and as the ſquare of the length of the arch jointly; that is, as $\frac{3\,l\,w}{f\,b\,d^3}\times l^2$, or as $\frac{3\,l^3\,w}{f\,b\,d^3}$. The deflection from the primitive ſhape is therefore as the bending weight and the cube of the length directly, and as the breadth and cube of the depth inverſely. 68 Deflection.

In beams juſt ready to break, the curvature is as the depth inverſely, and the deflection is as the ſquare of the length divided by the depth; for the ultimate curvature at the breaking part is the ſame whatever is the length; and in this caſe the deflection is as the ſquare of the length.

69 The theorems reſulting from this ſubject afford the fineſt methods of examining the laws of corpuſcular action.

We have been the more particular in our conſideration of this ſubject, becauſe the reſulting theorems afford us the fineſt methods of examining the laws of corpuſcular action, that is, for diſcovering the variation of the force of coheſion by a change of diſtance. It is true it is not the atomical law, or HYLARCHIC PRINCIPLE as it may juſtly be called, which is thus made acceſſible, but the ſpecific law of the particles of the ſubſtance or kind of matter under examination. But even this is a very great point; and coincidences in this reſpect among the different kinds of matter are of great moment. We may thus learn the nature of the corpuſcular action of different ſubſtances, and perhaps approach to a diſcovery of the *mechaniſm* of chemical affinities. For that chemical actions are inſenſible cauſes of local motion is undeniable, and local motion is the province of mechanical diſcuſſion; nay, we ſee that theſe hidden changes are produced by mechanical forces in many important caſes, for we ſee them promoted or prevented by means purely mechanical. The converſion of bodies into elaſtic vapour by heat can at all times be prevented by a *ſufficient* external preſſure. A ſtrong ſolution of Glauber's ſalt will congeal in an inſtant by agitation, giving out its latent heat; and it will remain fluid for ever, and return its latent heat in a cloſe veſſel which it completely fills. Even water will by ſuch treatment freeze in an inſtant by agitation, or remain fluid for ever by confinement. We know that heat is produced or extricated by friction, that certain compounds of gold or ſilver with ſaline matters explode with irreſiſtible violence by the ſmalleſt preſſure or agitation. Such facts ſhould rouſe the mathematical philoſopher, and excite him to follow out the conjectures of the illuſtrious Newton, encouraged by the ingenious attempts of Boſcovich; and the proper beginning of this ſtudy is to attend to the laws of attraction and repulſion exerted by the particles of cohering bodies, diſcoverable by experiments made on their actual extenſions and compreſſions. The experiments of ſimple extenſions and compreſſions are quite inſufficient, becauſe the total ſtretching of a wire is ſo ſmall a quantity, that the miſtake of the 1000th part of an inch occaſions an irregularity which deranges any progreſſion ſo as to make it uſeleſs. But by the bending of bodies, a diſtenſion of $\frac{1}{100}$th of an inch may be eaſily magnified in the deflection of the ſpring ten thouſand times. We know that the inveſtigation is intricate and difficult, but not beyond the reach of our preſent mathematical attainments; and it will give very fine opportunities of employing all the addreſs of analyſis. In the laſt century and the beginning of the preſent this was a ſufficient excitement to the firſt geniuſes of Europe. The cycloid, the catenaria, the elaſtic curve, the velaria, the cauſtics, were reckoned an abundant recompence for much ſtudy; and James Bernoulli requeſted, as an honourable monument, that the logarithmic ſpiral might be inſcribed on his tombſtone. The reward for the ſtudy to which we now preſume to incite the mathematicians is the almoſt unlimited extenſion of natural ſcience, important in every particular branch. To go no further than our preſent ſubject, a great deal of important practical knowledge reſpecting the ſtrength of bodies is derived from the ſingle obſervation, that in the moderate extenſions which happen before the parts are overſtrained the forces are nearly in the proportion of the extenſions or ſeparations of the particles. To return to our ſubject.

70 Bernoulli calls in queſtion this law.

James Bernoulli in his ſecond diſſertation on the elaſtic curve, calls in queſtion this law, and accommodates his inveſtigation to any hypotheſis concerning the relation of the forces and extenſions. He relates ſome experiments of lute ſtrings where the relation was conſiderably different. Strings of three feet long,

Stretched by	2,	4,	6,	8,	10	pds.
Were lengthened	9,	17,	23,	27,	30	lines.

But this is a moſt exceptionable form of the experiment. The ſtrings were twiſted, and the mechaniſm of the extenſions is here exceedingly complicated, combined with compreſſions and with tranſverſe twiſts, &c. We made experiments on fine ſlips of the gum caoutchouc, and on the juice of the berries of the white bryony, of which a ſingle grain will draw to a thread of two feet long, and again return into a perfectly round ſphere. We meaſured the diameter of the thread by a microſcope, with a micrometer, and thus could tell in every ſtate of extenſion the proportional number of particles in the ſections. We found, that though the whole range in which the diſtance of the particles was changed in the proportion of 13 to 1, the extenſions did not *ſenſibly* deviate from the proportion of the forces. The ſame thing was obſerved in the caoutchouc as long as it perfectly recovered its firſt dimenſions. And it is on the authority of theſe experiments that we preſume to announce this as a law of nature.

71 Which was firſt aſſumed by Dr Hooke.

Dr Robert Hooke was undoubtedly the firſt who attended to this ſubject, and aſſumed this as a law of nature. Mariotte indeed was the firſt who expreſly uſed it for determining the ſtrength of beams: this he did about the year 1679, correcting the ſimple theory of Galileo. Leibnitz indeed, in his diſſertation in the *Acta Eruditorum* 1684 *de Reſiſtentia Solidorum*, introduces this conſideration, and wiſhes to be conſidered as the diſcoverer; and he is always acknowledged as ſuch by the Bernoullis and others who adhered to his peculiar doctrines. But Marriotte had publiſhed the doctrine in the moſt expreſs terms long before; and Eulfinger, in the *Comment. Petropol.* 1729, completely vindicates his claim. But Hooke was unqueſtionably the diſcoverer of this law. It made the foundation of his theory of ſprings, announced to the Royal Society about the year 1661, and read in 1666. On this occaſion he mentions many things on the ſtrength of bodies as quite familiar to his thoughts, which are immediate deductions from this principle; and among theſe *all* the facts which John Bernoulli ſo vauntingly adduces in ſupport of Leibnitz's finical dogmas about the force of bodies in motion; a doctrine which Hooke might have claimed as his own, had he not perceived its frivolous inanity.

72 Though corrected by Mariotte it does not properly explain the mechaniſm of tranſverſe ſtrain,

But even with this firſt correction of Marriotte, the mechaniſm of tranſverſe ſtrain is not fully nor juſtly explained. The force acting in the direction BP (fig. 5. n° 1.), and bending the body ABCD, not only ſtretches the fibres on the ſide oppoſite to the axis of fracture, but compreſſes the ſide AB, which becomes concave by the ſtrain. Indeed it cannot do the one without doing the other: For in order to ſtretch the fibres at D, there muſt be ſome fulcrum, ſome ſupport, on which the virtual lever BAD may preſs, that it may tear aſunder the ſtretched fibres. This fulcrum muſt ſuſtain both the preſſure ariſing from the coheſion of the diſtended fibres, and alſo the action of the external force, which immediately tends to cauſe the prominent part of the beam to ſlide along the ſection D A. Let BAD (fig. 5. nº 1.) be conſidered as a crooked lever, of which A is the fulcrum. Let an external force be applied at B in the direction B P, and let a force equal to the accumulated coheſion of A D be applied at O in the direction oppoſite to A B, that is, perpendicular to A O; and let theſe two forces be ſuppoſed to balance each other by the intervention of the lever. In the firſt place, the force at O muſt be to the force at B as AB to AO: Therefore, if we make AK equal and oppoſite to AO, and AL equal and oppoſite to AB, the common principles of mechanics inform us that the fulcrum A is affected in the ſame manner as if the two forces AK and AL were immediately applied to it, the force AK being equal to the weight P, and AL equal to the accumulated coheſion actually exerted in the inſtant of fracture. The fulcrum is therefore really preſſed in the direction AM, the diagonal of the parallelogram, and it muſt reſiſt in the direction and with the force MA; and this power of reſiſtance, this ſupport, muſt be furniſhed by the repulſive forces exerted by *thoſe particles only* which are in a ſtate of actual compreſſion. The force AK, which is equal to the external force P, muſt be reſiſted in the direction KA by the lateral coheſion of the whole particles between D and A (the particle D is not only drawn forward but downward). This prevents the part CDAB from ſliding down along the ſection DA.

73 As is fully verified by experiment.

This is fully verified by experiment. If we attempt to break a long ſlip of cork, or any ſuch very compreſſible body, we always obſerve it to bulge out on the concave ſide before it cracks on the other ſide. If it is a body of fibrous or foliated texture, it ſeldom fails ſplintering off on the concave ſide; and in many caſes this ſplintering is very deep, even reaching half way through the piece. In hard and granulated bodies, ſuch as a piece of freeſtone, chalk, dry clay, ſugar, and the like, we generally ſee a conſiderable ſplinter or ſhiver fly off from the hollow ſide. If the fracture be ſlowly made by a force at B gradually augmented, the formation of the ſplinter is very diſtinctly ſeen. It forms a triangular piece like *a* I *b*, which generally breaks in the middle. We doubt not but that attentive obſervation would ſhow that the direction of the crack on each ſide of I is not very different from the direction AM and its correſpondent on the other ſide. This is by no means a circumſtance of idle curioſity, but intimately connected with the mechaniſm of coheſion.

74 Conſequences reſulting from the ſtate of the caſe.

Let us ſee what conſequences reſult from this ſtate of the caſe reſpecting the ſtrength of bodies. Let D Δ K C (fig. 6.) repreſent a vertical ſection of a priſm of compreſſible materials, ſuch as a piece of timber. Suppoſe it loaded with a weight P hung at its extremity. Suppoſe it of ſuch a conſtitution that all the fibres in AD are in a ſtate of dilatation, while thoſe in A Δ are in a ſtate of compreſſion. In the inſtant of fracture the particles at D and E are with-held by forces D *d*, E *e*, and the particles at Δ and E repel, reſiſt, or ſupport, with forces Δ δ, E ε.

Some line, ſuch as *d e* A ε δ, will limit all theſe ordinates, which repreſent the forces actually exerted in the inſtant of fracture. If the forces are as the extenſions and compreſſions, as we have great reaſon to believe, *d e* A and A ε δ will be two ſtraight lines. They will form *one* ſtraight line *d* A δ, if the forces which reſiſt a certain dilatation are equal to the forces which reſiſt an equal compreſſion. But this is quite accidental, and is not ſtrictly true in any body. In moſt bodies which have any conſiderable firmneſs, the compreſſions made by any external force are not ſo great as the dilatations which the ſame force would produce; that is, the repulſions which are excited by any ſuppoſed degree of compreſſion are greater than the attractions excited by the ſame degree of dilatation. Hence it will generally follow, that the angle *d* AD is leſs than the angle δ A Δ, and the ordinates D *d*, E *e*, &c. are leſs than the correſponding ordinates Δ δ, E ε, &c.

But whatever be the nature of the line *d* A δ, we are certain of this, that the whole area AD *d* is equal to the whole area A Δ δ: for as the force at B is gradually increaſed, and the parts between A and D are more extended, and greater coheſive forces are excited, there is always ſuch a degree of repulſive forces excited in the particles between A and Δ that the one ſet preciſely balances the other. The force at B, acting perpendicularly to AB, has no tendency to puſh the whole piece cloſer on the part next the wall or to pull it away. The ſum of the attractive and repulſive force, actually excited muſt therefore be equal. Theſe ſums are repreſented by the two triangular areas, which are therefore equal.

The greater we ſuppoſe the repulſive forces correſponding to any degree of compreſſion, in compariſon with the attractive forces correſponding to the ſame degree of extenſion, the ſmaller will A Δ be in the compariſon of AD. In a piece of cork or ſponge, A Δ may chance to be equal to AD, or even to exceed it; but in a piece of marble, A Δ will perhaps be very ſmall in compariſon of AD.

75 An important conſequence of the compreſſibility of body fully proved.

Now it is evident that the repulſive forces excited between A and Δ have no ſhare in preventing the fracture. They rather contribute to it, by furniſhing a fulcrum to the lever, by whoſe energy the coheſion of the particles in AD is overcome. Hence we ſee an important conſequence of the compreſſibility of the body. Its power of reſiſting this tranſverſe ſtrain is diminiſhed by it, and ſo much the more dimiſhed as the ſtuff is more compreſſible.

This is fully verified by ſome very curious experiments made by Du Hamel. He took 16 bars of willow 2 feet long and $\frac{1}{2}$ an inch ſquare, and ſupporting them by props under the ends, he broke them by weights hung on the middle. He broke 4 of them by weights of 40, 41, 47, and 52 pounds: the mean is 45. He then cut 4 of them $\frac{1}{3}$d through on the upper ſide, and filled up the cut with a thin piece of harder wood ſtuck in pretty tight. Theſe were broken by 48, 54, 50, and 52 pouuds; the mean of which is 51. He cut other four $\frac{1}{2}$ through, and they were broken by 47, 49, 50, 46; the mean of which is 48. The remaining four were cut $\frac{2}{3}$ds; and their mean ſtrength was 42.

Another ſet of his experiments is ſtill more remarkable.

Six battens of willow 36 inches long and $1\frac{1}{2}$ ſquare were broken by 525 pounds at a medium.

Six bars were cut $\frac{1}{3}$d through, and the cut filled with a wedge of hard wood ſtuck in with a little force: theſe broke with 551

Six bars were cut half through, and the cut was filled in the ſame manner: they broke with 542.

Six bars were cut $\frac{3}{4}$ths through: theſe broke with 530.

A batten cut $\frac{3}{4}$ths through, and loaded till nearly broken, was unloaded, and the wedge taken out of the cut. A thicker wedge was put in tight, ſo as to make the batten ſtraight again by filling up the ſpace left by the compreſſion of the wood: this batten broke with 577 pounds.

From this it is plain that more than $\frac{2}{3}$ds of the thickneſs (perhaps nearly $\frac{3}{4}$ths) contributed nothing to the ſtrength.

The point A is the centre of fracture in this caſe; and in order to eſtimate the ſtrength of the piece, we may ſuppoſe trength of Materials.

Strength of Materials.

poſe that the crooked lever virtually concerned in the ſtrain is DAB. We muſt find the point I, which is the centre of effort of all the attractive forces, or that point where the full coheſion of AD muſt be applied, ſo as to have a momentum equal to the accumulated momenta of all the variable forces. We muſt in like manner find the centre of effort i of the repulſive or ſupporting forces exerted by the fibres lying between A and Δ.

It is plain, and the remark is important, that this laſt centre of effort is the real fulcrum of the lever although A is the point where there is neither extenſion nor contraction; for the lever is ſupported in the ſame manner as if the repulſions of the whole line A Δ were exerted at that point. Therefore let S repreſent the ſurface of fracture from A to D, and f repreſent the abſolute coheſion of a fibre at D in the inſtant of fracture. We ſhall have $fS \times \overline{I + i} = p\,l$, or $l : I + i = fS : p$; that is, the length AB is to the diſtance between the two centres of effort I and i, as the abſolute coheſion of the ſection between A and D is to the relative ſtrength of the ſection.

It would be perhaps more accurate to make A I and A i equal to the diſtances of A from the horizontal lines paſſing through the centres of gravity of the triangles d A D and δ A Δ. It is only in this conſtruction that the points I and i are the centres of real effort of the accumulated attractions and repulſions. But I and i, determined as we have done, are the points where the full, equal, actions may be all applied, ſo as to produce the ſame momenta. The final reſults are the ſame in both caſes. The attentive and duly informed reader will ſee that Mr Bulfinger, in a very elaborate diſſertation on the ſtrength of beams in the *Comment. Petropolitan.* 1729, has committed ſeveral miſtakes in his eſtimation of the actions of the fibres. We mention this becauſe his reaſonings are quoted and appealed to as authorities by Muſchenbroek and other authors of note. The ſubject has been conſidered by many authors on the continent. We recommend to the reader's peruſal the very minute diſcuſſions in the Memoirs of the Academy of Paris for 1702 by Varignon, the Memoirs for 1708 by Parent, and particularly that of Coulomb in the *Mem. par les Sçavans Etrangers*, tom. vii.

It is evident, from what has been ſaid above, that if S and s repreſent the ſurfaces of the ſections above and below A, and if G and g are the diſtances of their centres of gravity from A, and O and o the diſtances of their centres of oſcillation, and D and d their whole depths, the momentum of coheſion will be $\frac{fS \cdot G \cdot O}{D} + \frac{fs \cdot g \cdot o}{d} = p\,l$.

If (as is moſt likely) the forces are proportional to the extenſions and compreſſions, the diſtances AI and Ai, which are reſpectively $= \frac{G \cdot O}{D}$ and $\frac{g \cdot o}{d}$, are reſpectively $= \frac{1}{3}$ D A, and $\frac{1}{3}\,\Delta$ A; and when taken together are $= \frac{1}{3}$ D Δ. If, moreover, the extenſions are equal to the compreſſions in the inſtant of fracture, and the body is a rectangular priſm like a common joiſt or beam, then D A and Δ A are alſo equal; and therefore the momentum of coheſion is $f\,b \times \frac{1}{2}d \times \frac{1}{3}d, = \frac{f\,b\,d^2}{6}, = f\,b\,d \times \frac{1}{6}d = p\,l$. Hence we obtain this analogy, "Six times the length is to the depth as the abſolute coheſion of the ſection is to its relative ſtrength."

76 This conſequence farther explained.

Thus we ſee that the compreſſibility of bodies has a very great influence on their power of withſtanding a tranſverſe ſtrain. We ſee that in this moſt favourable ſuppoſition of equal dilatations and compreſſions, the ſtrength is reduced to one half of the value of what it would have been had the body been incompreſſible. This is by no means obvious; for it does not readily appear how compreſſibility, which does not diminiſh the coheſion of a ſingle fibre, ſhould impair the ſtrength of the whole. The reaſon, however, is ſufficiently convincing when pointed out. In the inſtant of fracture a ſmaller portion of the ſection is actually exerting coheſive forces, while a part of it is only ſerving as a fulcrum to the lever, by whoſe means the ſtrain on the ſection is produced. We ſee too that this diminution of ſtrength does not ſo much depend on the ſenſible compreſſibility, as on its proportion to the dilatability by equal forces. When this proportion is ſmall, A Δ is ſmall in compariſon of AD, and a greater portion of the whole fibre is exerting attractive forces. The experiments already mentioned of Du Hamel de Monceau on battens of willow ſhow that its compreſſibility is nearly equal to its dilatability. But the caſe is not very different in tempered ſteel. The famous Harriſon, in the delicate experiments which he made while occupied in making his longitude watch, diſcovered that a rod of tempered ſteel was nearly as much diminiſhed in its length as it was augmented by the ſame external force. But it is not by any means certain that this is the proportion of dilatation and compreſſion which obtains in the very inſtant of fracture. We rather imagine that it is not. The forces are nearly as the dilatations till very near breaking; but we think that they diminiſh when the body is juſt going to break. But it ſeems certain that the forces which reſiſt compreſſion increaſe faſter than the compreſſions, even before fracture. We know inconteſtably that the ultimate reſiſtances to compreſſion are inſuperable by any force which we can employ. The repulſive forces therefore (in their whole extent) increaſe faſter than the compreſſions, and are expreſſed by an aſſymptotic branch of the Boſcovician curve formerly explained. It is therefore probable, eſpecially in the more ſimple ſubſtances, that they increaſe faſter, even in ſuch compreſſions as frequently obtain in the breaking of hard bodies. We are diſpoſed to think that this is always the caſe in ſuch bodies as do not fly off in ſplinters on the concave ſide; but this muſt be underſtood with the exception of the permanent changes which may be made by compreſſion, when the bodies are crippled by it. This always increaſes the compreſſion itſelf, and cauſes the neutral point to ſhift ſtill more towards D. The effect of this is ſometimes very great and fatal.

Experiment alone can help us to diſcover the proportion between the dilatability and compreſſibility of bodies. The ſtrain now under conſideration ſeems the beſt calculated for this reſearch. Thus if we find that a piece of wood an inch ſquare requires 12,000 pounds to tear it aſunder by a direct pull, and that 200 pounds will break it tranſverſely by acting 10 inches from the ſection of fracture, we muſt conclude that the neutral point A is in the middle of the depth, and that the attractive and repulſive forces are equal. Any notions that we can form of the conſtitution of ſuch fibrous bodies as timber, make us imagine that the *ſenſible* compreſſions, including what ariſes from the bending up of the compreſſed fibres, is much greater than the real corpuſcular extenſions. One may get a general conviction of this unexpected propoſition by reflecting on what muſt happen during the fracture. An undulated fibre can only be drawn ſtraight, and then the corpuſcular extenſion begins; but it may be bent up by compreſſion to any degree, the corpuſcular compreſſion being little affected all the while. This obſervation is very important; and though the forces of corpuſcular repulſion may be almoſt inſuperable by any compreſſion that we can employ, a *ſenſible* compreſſion may be produced by forces not enormous, ſufficient to cripple the beam. Of this we ſhall ſee very important inſtances afterwards.

77 The proportional ſtrengths of different pieces follow the ſame ratio.

It deſerves to be noticed, that although the relative ſtrength of a priſmatic ſolid is extremely different in the three hypotheſes now conſidered, yet the proportional ſtrengths of different pieces follow the ſame ratio; namely, the direct ratio of the breadth, the direct ratio of the ſquare of the depth, and the inverſe ratio of the length. In the firſt hypotheſis (of equal forces) the ſtrength of a rectangular beam was $\frac{f b d^2}{2 l}$; in the ſecond (of attractive forces proportional to the extenſions) it was $\frac{f b d^2}{3 l}$; and in the third (equal attractions and repulſions proportional to the extenſions and compreſſions) it was $\frac{f b d^2}{6 l}$, or more generally $\frac{f b d^2}{m l}$, where m expreſſes the unknown proportion between the attractions and repulſions correſponding to an equal extenſion and compreſſion.

78 The ſtrength of a piece dependschiefly on its depth,

Hence we derive a piece of uſeful information, which is confirmed by unexcepted experience, that the ſtrength of a piece depends chiefly on its depth, that is, on that dimenſion which is in the direction of the ſtrain. A bar of timber of one inch in breadth and two inches in depth is four times as ſtrong as a bar of only one inch deep, and it is twice as ſtrong as a bar two inches broad and one deep; that is, a joiſt or lever is always ſtrongeſt when laid on its edge.

79 And therefore a choice in the manner in which the coheſion is oppoſed to the ſtrain.

There is therefore a choice in the manner in which the coheſion is oppoſed to the ſtrain. The general aim muſt be to put the centre of effort I as far from the fulcrum or the neutral point A as poſſible, ſo as to give the greateſt energy or momentum to the coheſion. Thus if a triangular bar projecting from a wall is loaded with a weight at its extremity, it will bear thrice as much when one of the ſides is uppermoſt as when it is undermoſt. The bar of fig. 5. n° 2. would be three times as ſtrong if the ſide AB were uppermoſt and the edge DC undermoſt.

80 The ſtrongeſt joiſt has not the greateſt quantity of timber.

Hence it follows that the ſtrongeſt joiſt that can be cut out of a round tree is not the one which has the greateſt quantity of timber in it, but ſuch that the product of its breadth by the ſquare of its depth ſhall be the greateſt poſſible. Let ABCD (fig. 7.) be the ſection of this joiſt inſcribed in the circle, AB being the breadth and AD the depth. Since it is a rectangular ſection, the diagonal BD is a diameter of the circle, and BAD is a right angled triangle. Let BD be called a, and BA be called x; then AD is $= \sqrt{a^2 - x^2}$. Now we muſt have AB × AD², or $x \times \overline{a^2 - x^2}$, or $a^2 x - x^3$, a maximum. Its fluxion $a^2 \dot{x} - 3x^2 \dot{x}$ muſt be made $= 0$, or $a^2 = 3 x^2$, or $x^2 = \frac{a^2}{3}$. If therefore we make DE $= \frac{1}{3}$ DB, and draw EC perpendicular to BD, it will cut the circumference in the point C, which determines the depth BC and the breadth CD.

Becauſe BD : BC = CD : CE, we have the area of the ſection BC·CD = BD·CE. Therefore the different ſections having the ſame diagonal BD are proportional to their heights CE. Therefore the ſection BCDA is leſs than the ſection B c D a, whoſe four ſides are equal. The joiſt ſo ſhaped, therefore, is both ſtronger, lighter, and cheaper.

The ſtrength of ABCD is to that of a B c D as 10,000 to 9186, and the weight and expence as 10,000 to 10,607; ſo that ABCD is preferable to a B c D in the proportion of 10,607 to 9186, or nearly 115 to 100.

81 A hollow tube ſtronger than a ſolid rod containing the ſame quantity of matter,

From the ſame principles it follows that a hollow tube is ſtronger than a ſolid rod containing the ſame quantity of matter. Let fig. 8. repreſent the ſection of a cylindric tube, of which AF and BE are the exterior and interior diameters and C the centre. Draw BD perpendicular to BC, and join DC. Then, becauſe BD² = CD² − CB², BD is the radius of a circle containing the ſame quantity of matter with the ring. If we eſtimate the ſtrength by the firſt hypotheſis, it is evident that the ſtrength of the tube will be to that of the ſolid cylinder, whoſe radius is BD, as BD² × AC to BD² × BD; that is, as AC to BD: for BD² expreſſes the coheſion of the ring or the circle, and AC and DB are equal to the diſtances of the centres of effort (the ſame with the centres of gravity) of the ring and circle from the axis of fracture.

The proportion of theſe ſtrengths will be different in the other hypotheſes, and it is not eaſily expreſſed by a general formula; but in both it is ſtill more in favour of the ring or hollow tube.

The following very ſimple ſolution will be readily underſtood by the intelligent reader. Let O be the centre of oſcillation of the exterior circle, o the centre of oſcillation of the inner circle, and w the centre of oſcillation of the ring included between them. Let M be the quantity of ſurface of the exterior circle, m that of the inner circle, and μ that of the ring.

We have $\mathrm{F}w = \frac{\mathrm{M \cdot FO} - m \cdot \mathrm{F}o}{\mu}, = \frac{5\mathrm{FC}^2 + \mathrm{EC}^2}{4\mathrm{FC}}$, and the ſtrength of the ring $= \frac{f \mu \times \mathrm{F}w}{2}$, and the ſtrength of the ſame quantity of matter in the form of a ſolid cylinder is $f \mu \times \frac{5}{8}$ BD; ſo that the ſtrength of the ring is to that of the ſolid rod of equal weight as Fw to $\frac{5}{4}$ B D, or nearly as FC to BD. This will eaſily appear by recollecting that FO is $= \frac{\text{ſum of } p \cdot r^2}{m \cdot \mathrm{FC}}$ (ſee ROTATION), and that the momentum of coheſion is $\frac{f m \cdot \mathrm{FC} \cdot \mathrm{F}a}{2\mathrm{FC}} = \frac{f m \cdot \mathrm{F}o}{2}$ for the inner circle, &c.

Emerſon has given a very inaccurate approximation to this value in his *Mechanics*, 4to.

82 And more ſtiff.

This property of hollow tubes is accompanied alſo with greater ſtiffneſs; and the ſuperiority in ſtrength and ſtiffneſs is ſo much the greater as the ſurrounding ſhell is thinner in proportion to its diameter.

83 Hence the wiſdom of God in forming the bones, &c. hollow.

Here we ſee the admirable wiſdom of the Author of nature in forming the bones of animal limbs hollow. The bones of the arms and legs have to perform the office of levers, and are thus oppoſed to very great tranſverſe ſtrains. By this form they become incomparably ſtronger and ſtiffer, and give more room for the inſertion of muſcles, while they are lighter and therefore more agile; and the ſame Wiſdom has made uſe of this hollow for other valuable purpoſes of the animal economy. In like manner the quills in the wings of birds acquire by their thinneſs the very great ſtrength which is neceſſary, while they are ſo light as to give ſufficient buoyancy to the animal in the rare medium in which it muſt live and fly about. The ſtalks of many plants, ſuch as all the graſſes, and many reeds, are in like manner hollow, and thus poſſeſs an extraordinary ſtrength. Our beſt engineers now begin to imitate nature by making many parts of their machines hollow, ſuch as their axles of caſt iron, &c.; and the ingenious Mr Ramſden now makes the axes and framings of his great aſtronomical inſtruments in the ſame manner.

In the ſuppoſition of homogeneous texture, it is plain that the fracture happens as ſoon as the particles at D are ſeparated beyond their utmoſt limit of coheſion. This is a determined quantity, and the piece bends till this degree of extenſion is produced in the outermoſt fibre. It follows, that the ſmaller we ſuppoſe the diſtance between A and D, the

g. 6.
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the greater will be the curvature which the beam will acquire before it breaks. Greater depth therefore makes a beam not only ſtronger but alſo ſtiffer. But if the parallel fibres can ſlide on each other, both the ſtrength and the ſtiffneſs will be diminiſhed. Therefore if, inſtead of one beam D Δ KC, we ſuppoſe two, DABC and A Δ KB, not cohering, each of them will bend, and the extenſion of the fibres AB of the under beam will not hinder the compreſſion of the adjoining fibres AB of the upper beam. The two together therefore will not be more than twice as ſtrong as one of them (ſuppoſing DA = A Δ) inſtead of being four times as ſtrong; and they will bend as much as either of them alone would bend by half the load. This may be prevented, if it were poſſible to unite the two beams all along the ſeam AB, ſo that the one ſhall not ſlide on the other. This may be done in ſmall works, by gluing them together with a cement as ſtrong as the natural lateral coheſion of the fibres. If this cannot be done (as it cannot in large works), the ſliding is prevented by JOGGLING the beams together; that is, by cutting down ſeveral rectangular notches in the upper ſide of the lower beam, and making ſimilar notches in the under ſide of the upper beam, and filling up the ſquare ſpaces with pieces of very hard wood firmly driven in, as repreſented in fig. 9. Some employ iron bolts by way of joggles. But when the joggle is much harder than the wood into which it is driven, it is very apt to work looſe, by widening the hole into which it is lodged. The ſame thing is ſometimes done by ſcarfing the one upon the other, as repreſented in fig. 9. (n° 2.); but this waſtes more timber, and is not ſo ſtrong, becauſe the mutual hooks which this method forms on each beam are very apt to tear each other up. By one or other of theſe methods, or ſomething ſimilar, may a compound beam be formed, of any depth, which will be almoſt as ſtiff and ſtrong as an entire piece.

85
How
ſtrength
may be
combined
with plia-
blenefs,

On the other hand, we may combine ſtrength with pliableneſs, by compoſing our beam of ſeveral thin planks laid on each other, till they make a proper depth, and leaving them at full liberty to ſlide on each other. It is in this manner that coach-ſprings are formed, as is repreſented in fig. 10. In this aſſemblage there muſt be no joggles nor bolts of any kind put through the planks or plates; for this would hinder their mutual ſliding. They muſt be kept together by ſtraps which ſurround them, or by ſomething equivalent.

86
Maxims of
conſtruc-
tion.

The preceding obſervations ſhow the propriety of ſome maxims of conſtruction, which the artiſts have derived from long experience.

Thus, if a mortiſe is to be cut out of a piece which is expoſed to a croſs ſtrain, it ſhould be cut out from that ſide which becomes concave by the ſtrain, as in fig. 11. but by no means as in fig. 12.

If a piece is to be ſtrengthened by the addition of another, the added piece muſt be joined to the ſide which grows convex by the ſtrain, as in fig. 13. and 14.

Before we go any farther, it will be convenient to recal the reader's attention to the analogy between the ſtrain on a beam projecting from a wall and loaded at the extremity, and a beam ſupported at both ends and loaded in ſome intermediate point. It is ſufficient on this occaſion to read attentively what is delivered in the article ROOF, n° 19.— We learn there that the ſtrain on the middle point C (fig. 14. of the preſent article) of a rectangular beam AB, ſupported on props at A and B, is the ſame as if the part CA projected from a wall, and were loaded with the half of the weight W ſuſpended at A. The monumentum of the ſtrain is therefore $\frac{1}{2}\,W \times \frac{1}{2}\,AB, = W \times \frac{1}{4}\,AB = p\,\frac{1}{4}\,l$, or $\frac{p\,l}{4}$. The momentum of coheſion muſt be equal to this in every hypotheſis.

Having now conſidered in ſufficient detail the circumſtances which affect the ſtrength of any ſection of a ſolid body that is ſtrained tranſverſely, it is neceſſary to take notice of ſome of the chief modifications of the ſtrain itſelf. We ſhall conſider only thoſe that occur moſt frequently in our conſtructions.

The ſtrain depends on the external force, and alſo on the lever by which it acts.

87
The ſtrain
depends on
the exter-
nal force,

It is evidently of importance, that ſince the ſtrain is exerted in any ſection by means of the coheſion of the parts intervening between the ſection under conſideration and the point of application of the external force, the body muſt be able in all theſe intervening parts to propagate or excite the ſtrain in the remote ſection. In every part it muſt be able to reſiſt the ſtrain excited in that part. It ſhould therefore be equally ſtrong; and it is uſeleſs to have any part ſtronger, becauſe the piece will nevertheleſs break where it is not ſtronger throughout; and it is uſeleſs to make it ſtronger (relatively to its ſtrain) in any part, for it will nevertheleſs equally fail in the part that is too weak.

Suppoſe then, in the firſt place, that the ſtrain ariſes from a weight ſuſpended at one extremity, while the other end is firmly fixed in a wall. Suppoſing alſo the croſs ſections to be all rectangular, there are ſeveral ways of ſhaping the beam ſo that it ſhall be equally ſtrong throughout. Thus it may be equally deep in every part, the upper and under ſurfaces being horizontal planes. The condition will be fulfilled by making all the horizontal ſections triangles, as in fig. 15. The two ſides are vertical planes meeting in an edge at the extremity L. For the equation expreſſing the balance of ſtrain and ſtrength is $p\,l = f\,b\,d^2$. Therefore ſince d^2 is the ſame throughout, and alſo p, we muſt have $f\,b = l$, and b (the breadth AD of any ſection ABCD) muſt be proportional to l (or AL), which it evidently is.

Or, if the beam be of uniform breadth, we muſt have d^2 everywhere proportional to l. This will be obtained by making the depths the ordinates of a common parabola, of which L is the vertex and the length is the axis. The upper or under ſide may be a ſtraight line, as in fig. 16. or the middle line may be ſtraight, and then both upper and under ſurfaces will be curved. It is almoſt indifferent what is the ſhape of the upper and under ſurfaces, provided the diſtances between them in every part be as the ordinates of a common parabola.

Or, if the ſections are all ſimilar, ſuch as circles, ſquares, or any other ſimilar polygons, we muſt have d^3 or b^3 proportional to l, and the depths or breadths muſt be as the ordinates of a cubical parabola.

88
And on the
form of the
levers by
which it
acts.

It is evident that theſe are alſo the proper forms for a lever moveable round a fulcrum, and acted on by a force at the extremity. The force comes in the place of the weight ſuſpended in the caſes already conſidered; and as ſuch levers always are connected with another arm, we readily ſee that both arms ſhould be faſhioned in the ſame manner. Thus in fig. 15. the piece of timber may be ſuppoſed a kind of ſteelyard, moveable round a horizontal axis OP, in the front of the wall, and having the two weights P and π in equilibrio. The ſtrain occaſioned by each at the ſection in which the axis OP is placed muſt be the ſame, and each arm OL and O λ muſt be equally ſtrong in all its parts. The longitudinal ſections of each arm muſt be a triangle, a common parabola, or a cubic parabola, according to the conditions previouſly given.

And, moreover, all theſe forms are equally ſtrong: For any one of them is equally ſtrong in all its parts, and they are all ſuppoſed to have the ſame ſection at the front of the wall or at the fulcrum. They are not, however, equally ſtiff. The firſt, repreſented in fig. 15. will bend leaſt upon the whole, and the one formed by the cubic parabola will bend moſt. But their curvature at the very fulcrum will be the ſame in all.

It is alſo plain, that if the lever is of the ſecond or third kind, that is, having the fulcrum at one extremity, it muſt ſtill be of the ſame ſhape; for in abſtract mechanics it is indifferent which of the three points is conſidered as the axis of motion. In every lever the two forces at the extremities act in one direction, and the force in the middle acts in the oppoſite direction, and the great ſtrain is always at that point. Therefore a lever ſuch as fig. 15. moveable round an axis paſſing horizontally through λ, and acting againſt an obſtacle at OP, is equally able in all its parts to reſiſt the ſtrains excited in thoſe parts.

The ſame principles and the ſame conſtruction will apply to beams, ſuch as joiſts, ſupported at the ends L and λ (fig. 15.), and loaded at ſome intermediate part OP. This will appear evident by merely inverting the directions of the forces at theſe three points, or by recurring to the article Roofs, nº 19.

89 The external ſtraining force may be diſtributed over the beam.

Hitherto we have ſuppoſed the external ſtraining force as acting only in one point of the beam. But it may be uniformly diſtributed all over the beam. To make a beam in ſuch circumſtances equally ſtrong in all its parts, the ſhape muſt be conſiderably different from the former.

Thus ſuppoſe the beam to project from a wall.

90 To make a beam ſtrong which projects from a wall.

If it be equal breadth throughout, its ſides being vertical planes parallel to each other and to the length, the vertical ſection in the direction of its length muſt be a triangle inſtead of a common parabola; for the weight uniformly diſtributed over the part lying beyond any ſection, is as the length beyond that ſection: and ſince it may all be conceived as collected at its centre of gravity, which is the middle of that length, the lever by which this load acts or ſtrains the ſection is alſo proportional to the ſame length. The ſtrain on the ſection (or momentum of the load) is as the ſquare of that length. The ſection muſt have ſtrength in the ſame proportion. Its ſtrength being as the breadth and the ſquare of the depth, and the breadth being conſtant, the ſquare of the depth of any ſection muſt be as the ſquare of its diſtance from the end, and the depth muſt be as that diſtance; and therefore the longitudinal vertical ſection muſt be a triangle.

But if all the tranſverſe ſections are circles, ſquares, or any other ſimilar figures, the ſtrength of every ſection, or the cube of the diameter, muſt be as the ſquare of the lengths beyond that ſection, or the ſquare of its diſtance from the end; and the ſides of the beam muſt be a ſemicubical parabola.

If the upper and under ſurfaces are horizontal planes, it is evident that the breadth muſt be as the ſquare of the diſtance from the end, and the horizontal ſections may be formed by arches of the common parabola, having the length for their tangent at the vertex.

By recurring to the analogy ſo often quoted between a projecting beam and a joiſt, we may determine the proper form of joiſts which are uniformly loaded through their whole length.

91 The ſtrain upon a beam ſupported at both ends.

This is a frequent and important caſe, being the office of joiſts, rafters, &c. and there are ſome circumſtances which muſt be particularly noticed, becauſe they are not ſo obvious, and have been miſunderſtood. When a beam AB (fig. 17.) is ſupported at the ends, and a weight is laid on any point P, a ſtrain is excited in every part of the beam. The load on P cauſes the beam to preſs on A and B, and the props react with forces equal and oppoſite to theſe preſſures. The load at P is to the preſſures at A and B as AB to PB and PA, and the preſſures at A is to that at B as PB to PA; the beam therefore is in the ſame ſtate, with reſpect to ſtrain in every part of it, as if it were reſting on a prop at P, and were loaded at the ends with weights equal to the two preſſures on the props: and obſerve, theſe preſſures are ſuch as will balance each other, being inverſely as their diſtances from P. Let P repreſent the weight or load at P. The preſſure on the prop P muſt be $P \times \frac{PA}{AB}$. This is therefore the reaction of the prop B, and is the weight which we may ſuppoſe ſuſpended at B, when we conceive the beam reſting on a prop at P, and carrying the balancing weights at A and B.

The ſtrain occaſioned at any other point C, by the load P at P, is the ſame with the ſtrain at C, by the weight $P \times \frac{PA}{B}$ hanging at B, when the beam reſts on P, in the manner now ſuppoſed; and it is the ſame if the beam, inſtead of being balanced on a prop at P, had its part AP fixed in a wall. This is evident. Now we have ſhown at length that the ſtrain at C, by the weight $P \times \frac{PA}{AB}$ hanging at B, is $P \times \frac{PA}{AB} \times BC$. We deſire it to be particularly remarked that the preſſure at A has no influence on the ſtrain at C, ariſing from the action of any load between A and C; for it is indifferent how the part AP of the projecting beam PB is ſupported. The weight at A juſt performs the ſame office with the wall in which we ſuppoſe the beam to be fixed. We are thus particular, becauſe we have ſeen even perſons not unaccuſtomed to diſcuſſions of this kind puzzled in their conceptions of this ſtrain.

Now let the load P be laid on ſome point p between C and B. The ſame reaſoning ſhows us that the point is (with reſpect to ſtrain) in the ſame ſtate as if the beam were fixed in a wall, embracing the part pB, and a weight $= P \times \frac{pB}{AB}$ were hung on at A, and the ſtrain at C is $P \times \frac{pB}{AB} \times AC$.

92 A general propoſition.

In general, therefore, the ſtrain on any point C, ariſing from a load P laid on another point P, is proportional to the rectangle of the diſtances of P and C from the ends neareſt to each. It is $P \times \frac{PA \times CB}{AB}$, or $P \times \frac{pB \times CA}{AB}$, according as the load lies between C and A or between C and B.

Cor. 1. The ſtrains which a load on any point P occaſions on the points C, *c*, lying on the ſame ſide of P, are as the diſtances of theſe points from the end B. In like manner the ſtrains on E and *e* are as EA and *e* A.

Cor. 2. The ſtrain which a load occaſions in the part on which it reſts is as the rectangle of the parts on each ſide. Thus the ſtrain occaſioned at C by a load is to that at D by the ſame load as AC × CB to AD × DB. It is therefore greateſt in the middle.

93 The ſtrain ariſing from a load diſtributed along the beam.

Let us now conſider the ſtrain on any point C ariſing from a load uniformly diſtributed along the beam. Let AP be repreſented by x, and Pp by $\dot{x}$, and the whole weight on the beam by a. Then

The weight on Pp is $= a\frac{\dot{x}}{AB}$,

Preſſure on B by the weight on Pp $= a\frac{\dot{x}}{AB} \times \frac{x}{AB}$.

Or . . . $=\frac{a x\dot{x}}{AB^2}$

Preſ. on B by the whole wt. on AC $= a\frac{\frac{1}{2}AC^2}{AB^2} = a\frac{AC^2}{2AB^2}$.

Strain at C by the weight on AC $= a\frac{AC^2\times BC}{2AB^2}$.

Strain at C by the weight on BC $= a\frac{BC^2\times AC}{2AB^2}$.

Do. by the whole weight on AB $= a\frac{AC^2\times BC+BC^2\times AC}{2AB^2}$,

$= a\frac{AC\times BC\times\overline{AC+CB}}{2AB^2}, = a\frac{AC+BC}{2AB}$.

Thus we ſee that the ſtrain is proportional to the rectangle of the parts, in the ſame manner as if the load *a* had been laid directly on the point C, and is indeed equal to one-half of the ſtrain which would be produced at C by the load *a* laid on there.

94
Miſtakes in this ſubject committed by authors of reputa- ion.

It was neceſſary to be thus particular, becauſe we ſee in ſome elementary treatiſes of mechanics, publiſhed by authors of reputation, miſtakes which are very plauſible, and miſlead the learner. It is there ſaid, that the preſſure at B from a weight uniformly diffuſed along AB is the ſame as if it were collected at its centre of gravity, which would be the middle of AB; and then the ſtrain at C is ſaid to be this preſſure at B multiplied by BC. But ſurely it is not difficult to ſee the difference of theſe ſtrains. It is plain that the preſſure of gravity downwards on any point between the end A and the point C has no tendency to diminiſh the ſtrain at C, ariſing from the upward reaction of the prop B; whereas the preſſure of gravity between C and B is almoſt in direct oppoſition to it, and muſt diminiſh it. We may however avoid the fluxionary calculus with ſafety by the conſideration of the centre of gravity, by ſuppoſing the weights of AC and BC to be collected at their reſpective centres of gravity; and the reſult of this computation will be the ſame as above: and we may uſe either method, although the weight is not uniformly diſtributed, provided only that we know in what manner it is diſtributed.

This inveſtigation is evidently of importance in the practice of the engineer and architect, informing them what ſupport is neceſſary in the different parts of their conſtructions. We conſidered ſome caſes of this kind in the article Roofs.

95
To form a joiſt which may have the ſame relative ſtrength in all its parts.

It is now eaſy to form a joiſt, ſo that it ſhall have the ſame relative ſtrength in all its parts.

I. To make it equally able in all its parts to carry a given weight laid on any point C taken at random or uniformly diffuſed over the whole length, the ſtrength of the ſection at the point C muſt be as AC × CB. Therefore

1. If the ſides are parallel vertical planes, the ſquare of the depth (which is the only variable dimenſion) or CD^2, muſt be as AC × CB, and the depths muſt be ordinates of an ellipſe,

2. If the tranſverſe ſections are ſimilar, we muſt make CD^3 as AC × CB.

3. If the upper and under ſurfaces are parallel, the breadth muſt be as AC × CB.

II. If the beam is neceſſarily loaded at ſome given point C, and we would have the beam equally able in all its parts to reſiſt the ſtrain ariſing from the weight at C, we muſt make the ſtrength of every tranſverſe ſection between C and either end as its diſtance from that end. Therefore

1. If the ſides are parallel vertical planes, we muſt make $CD^2 : EF^2 = AC : AE$.

2. If the ſections are ſimilar, then $CD^3 : EF^3 = AC : AE$.

3. If the upper and under ſurfaces are parallel, then, breadth at C : breadth at E = AC : AE.

96
The ſtrain and ſtrength of ſquare or circular plates of different extent, but of equal thickneſs, may be determined from the ſame principles.

The ſame principles enable us to determine the ſtrain and ſtrength of ſquare or circular plates, of different extent, but equal thickneſs. This may be comprehended in this general propoſition.

Similar plates of equal thickneſs ſupported all round will carry the ſame abſolute weight, uniformly diſtributed, or reſting on ſimilar points, whatever is their extent.

Suppoſe two ſimilar oblong plates of equal thickneſs, and let their lengths and breadths be L, *l*, and B, *b*. Let their ſtrength or momentum of coheſion be C, *c*, and the ſtrains from the weights W, *w*, be S, *s*.

Suppoſe the plates ſupported at the ends only, and reſiſting fracture tranſverſely. The ſtrains, being as the weights and lengths, are as WL and *w l*, but their coheſion are as the breadths; and ſince they are of equal relative ſtrength, we have $WL : wl = B : b$, and $WLb = wlB$ and $L : l = wB : Wb$: but ſince they are of ſimilar ſhapes $L : l = B : b$, and therefore $w = W$.

The ſame reaſoning holds again when they are alſo ſupported along the ſides, and therefore holds when they are ſupported all round (in which caſe the ſtrength is doubled).

And if the plates are of any other figure, ſuch as circles or ellipſes, we need only conceive ſimilar rectangles inſcribed in them. Theſe are ſupported all round by the continuity of the plates, and therefore will ſuſtain equal weights; and the ſame may be ſaid of the ſegments which lie without them, becauſe the ſtrengths of any ſimilar ſegments are equal, their lengths being as their breadths.

Therefore the thickneſs of the bottoms of veſſels holding heavy liquors or grains ſhould be as their diameters, and as the ſquare root of their depths jointly.

Alſo the weight which a ſquare plate will bear is to that which a bar of the ſame matter and thickneſs will bear as twice the length of the bar to its breadth.

97
The ſtrain of a beam ariſing from its own weight.

There is yet another modification of the ſtrain which tends to break a body tranſverſely, which is of very frequent occurrence, and in ſome caſes muſt be very carefully attended to, viz. the ſtrain ariſing from its own weight.

When a beam projects from a wall, every ſection is ſtrained by the weight of all that projects beyond it. This may be conſidered as all collected at its centre of gravity. Therefore the ſtrain on any ſection is in the joint ratio of the weight of what projects beyond it, and the diſtance of its centre of gravity from the ſection.

98
General principle reſpecting it.

The determination of this ſtrain and of the ſtrength neceſſary for withſtanding it muſt be more complicated than the former, becauſe the form of the piece which reſults from this adjuſtment of ſtrain and ſtrength influences the ſtrain. The general principle muſt evidently be, that the ſtrength or momentum of coheſion of every ſection muſt be as the product of the weight beyond it multiplied by the diſtance of its centre of gravity. For example:

Plate CCCCLXXXV.

Suppoſe the beam DLA (fig. 18.) to project from the wall, and that its ſides are parallel vertical planes, ſo that the depth is the only variable dimenſion. Let $LB = x$ and $Bb = y$. The element $BbcC$ is $= y\dot{x}$. Let G be the centre of gravity of the part lying without B*b*, and *g* be its diſtance from the extremity L. Then $x - g$ is the arm of the lever by which the ſtrain is excited in the ſection B*b*. Let B*b* or *y* be as ſome power *m* of L B; that is, let $y = x^m$. Then the contents of LB*b* is $\frac{x^{m+1}}{m+1}$. The momentum of gravity round a horizontal axis at L is $yx\dot{x} = x^{m+1}\dot{x}$, and the whole momentum round the axis is $\frac{x^{m+2}}{m+2}$. The diſtance of the centre of gravity from L is had by dividing this momentum by the whole weight, which is $\frac{x^{m+1}}{m+1}$. The quotient or g is $\frac{x \times \overline{m+1}}{m+2}$. And the diſtance of the centre of gravity from the ſection B b is $x - \frac{x \times \overline{m+1}}{m+2}, = \frac{x \times \overline{m+2} - x \times \overline{m+1}}{m+2}, = \frac{x}{m+2}$. Therefore the ſtrain on the ſection B b is had by multiplying $\frac{x^{m+1}}{m+1}$ by $\frac{x}{m+2}$. The product is $\frac{x^{m+2}}{\overline{m+2} \times \overline{m+1}}$. This muſt be as the ſquare of the depth, or as y^2. But y is as x^m, and y^2 as x^{2m}. Therefore we have $m + 2 = 2\,m$, and $m = 2$; that is, the depth muſt be as the ſquare of the diſtance from the extremity, and the curve L b A is a parabola touching the horizontal line in L.

99
A conoid equally able in every ſection to bear its own weight.

It is eaſy to ſee that a conoid formed by the rotation of this figure round D L will alſo be equally able in every ſection to bear its own weight.

We need not proſecute this farther. When the figure of the piece is given, there is no difficulty in finding the ſtrain; and the circumſtance of equal ſtrength to reſiſt the ſtrain is chiefly a matter of curioſity.

100
The more a beam projects, the leſs able it is to bear its own weight.

It is evident, from what has been already ſaid, that a projecting beam becomes leſs able to bear its own weight, as it projects farther. Whatever may be the ſtrength of the ſection DA, the length may be ſuch that it will break by its own weight. If we ſuppoſe two beams A and B of the ſame ſubſtance and ſimilar ſhapes, that is, having their lengths and diameters in the ſame proportion; and farther ſuppoſe that the ſhorter can juſt bear its own weight; then the longer beam will not be able to do the ſame: For the ſtrengths of the ſections are as the cubes of the diameters, while the ſtrains are as the biquadrates of the diameters; becauſe the weights are as the cubes, and the levers by which theſe weights act in producing the ſtrain are as the lengths or as the diameters.

101
Small bodies more able to withſtand the ſtrain produced by the weight of the machine than great bodies.

Theſe conſiderations ſhow us, that in all caſes where the ſtrain is affected by the weight of the parts of the machine or ſtructure of any kind, the ſmaller bodies are more able to withſtand it than the greater; and there ſeems to be bounds ſet by nature to the ſize of machines conſtructed of any given materials. Even when the weight of the parts of the machine is not taken into the account, we cannot enlarge them in the ſame proportion in all their parts. Thus a ſteam-engine cannot be doubled in all its parts, ſo as to be ſtill efficient. The preſſure on the piſton is quadrupled. If the lift of the pump be alſo doubled in height while it is doubled in diameter, the load will be increaſed eight times, and will therefore exceed the power. The depth of lift, therefore, muſt remain unchanged; and in this caſe the machine will be of the ſame relative ſtrength as before, independent of its own weight. For the beam being doubled in all its dimenſions, its momentum of coheſion is eight times greater, which is again a balance for a quadruple load acting by a double lever.—But if we now conſider the increaſe of the weight of the machine itſelf, which muſt be ſupported, and which muſt be put in motion by the intervention of its coheſion, we ſee that the large machine is weaker and leſs efficient than the ſmall one.

There is a ſimilar limit ſet by nature to the ſize of plants and animals formed of the ſame matter. The coheſion of an herb could not ſupport it if it were increaſed to the ſize of a tree, nor could an oak ſupport itſelf if 40 or 50 times bigger, nor could an animal of the make of a long-legged ſpider be increaſed to the ſize of a man; the articulations of its legs could not ſupport it.

102
Even ſmall animals are remarkable for ſtrength and agility.

Hence may be underſtood the prodigious ſuperiority of the ſmall animals both in ſtrength and agility. A man by falling twice his own height may break his firmeſt bones. A mouſe may fall 20 times its height without riſk; and even the tender mite or wood-louſe may fall unhurt from the top of a ſteeple. But their greateſt ſuperiority is in reſpect of nimbleneſs and agility. A flea can leap above 500 times its own length, while the ſtrength of the human muſcles could not raiſe the trunk from the ground on limbs of the ſame conſtruction.

The angular motions of ſmall animals (in which conſiſts their nimbleneſs or agility) muſt be greater than thoſe of large animals, ſuppoſing the force of the muſcular fibre to be the ſame in both. For ſuppoſing them ſimilar, the number of equal fibres will be as the ſquare of their linear dimenſions; and the levers by which they act are as their linear dimenſions. The energy therefore of the moving force is the cube of theſe dimenſions. But the momentum of inertia, or $\int p.\, r^2$, is as the 4th power: Therefore the angular velocity of the greater animals is ſmaller. The number of ſtrokes which a fly makes with its wings in a ſecond is aſtoniſhingly great; yet, being voluntary, they are the effects of its agility.

We have hitherto confined our attention to the ſimpleſt form in which this tranſverſe ſtrain can be produced. This was quite ſufficient for ſhowing us the mechaniſm of nature by which the ſtrain is reſiſted; and a very ſlight attention is ſufficient for enabling us to reduce to this every other way in which the ſtrain can be produced. We ſhall not take up the reader's time with the application of the ſame principles to other caſes of this ſtrain, but refer him to what has been ſaid in the article Roofs. In that article we have ſhown the analogy between the ſtrain on the ſection of a beam projecting from a wall and loaded at the extremity, and the ſtrain on the ſame ſection of a beam ſimply reſting on ſupports at the ends, and loaded at ſome intermediate point or points. The ſtrain on the middle C of a beam AB (fig. 19.) ſo ſupported, ariſing from a weight laid on there, is the ſame with the ſtrain which half that weight hanging at B would produce on the ſame ſection C if the other end of the beam were fixed in a wall. If therefore 1000 pounds hung on the end of the beam projecting 10 feet from a wall will juſt break it at the wall, it will require 4000 pounds on its middle to break the ſame beam reſting on two props 10 feet aſunder. We have alſo ſhown in that article the additional ſtrength which will be given to this beam by extending both ends beyond the props, and there framing it firmly into other pillars or ſupports. We can hardly add any thing to what has been ſaid in that article, except a few obſervations on the effect of the obliquity of the external force.

103
Effects of the obliquity of the external force.

We have hitherto ſuppoſed it to act in the direction BP (fig. 6.) perpendicular to the length of the beam. Suppoſe it to act in the direction B P', oblique to BA. In the article Roof we ſuppoſed the ſtrain to be the ſame as if the force p acted at the diſtance AB', but ſtill perpendicular to AB: ſo it is. But the ſtrength of the ſection AΔ is not the ſame in both caſes; for by the obliquity of the action the piece DCKΔ is preſſed to the other. We are not ſufficiently acquainted with the corpuſcular forces to ſay preciſely what will be the effect of the preſſure ariſing from this obliquity; but we can clearly ſee, in general, that the point A, which in the inſtant of fracture is neither ſtretched nor compreſſed, muſt now be farther up, or nearer to D; and therefore the number of particles which are exerting coheſive forces is ſmaller, and therefore the ſtrength is diminiſhed. Therefore, when we endeavour to proportion the ſtrength of a beam to the ſtrain ariſing from an external force acting obliquely, we make too liberal allowance by increaſing this external force in the ratio of AB to AB. We acknowledge our inability to aſſign the proper correction. But this circumſtance is of very great influence. In many machines, and many framings of carpentry, this oblique action of the ſtraining force is unavoidable; and the moſt enormous ſtrains to which materials are expoſed are generally of this kind. In the frames ſet up for carrying the ring-ſtones of arches, it is hardly poſſible to avoid them: for although the judicious engineer diſpoſes his beams ſo as to ſuſtain only preſſures in the direction of their lengths, tending either to cruſh them or to tear them aſunder, it frequently happens that, by the ſettling of the work, the pieces come to check and bear on each other tranſverſely, tending to break each other acroſs. This we have remarked upon in the article Roofs, with reſpect to a truſs by Mr Price (ſee Roofs, n° 40, 41, 45). Now when a croſs ſtrain is thus combined with an enormous preſſure in the direction of the length of the beam, it is in the utmoſt danger of ſnapping ſuddenly acroſs. This is one great cauſe of the carrying away of maſts. They are compreſſed in the direction of their length by the united force of the ſhrouds, and in this ſtate the tranſverſe action of the wind ſoon completes the fracture.

104 The ſtrain on columns.

When conſidering the compreſſing ſtrains to which materials are expoſed, we deferred the diſcuſſion of the ſtrain on columns, obſerving that it was not, in the caſes which uſually occur, a ſimple compreſſion, but was combined with a tranſverſe ſtrain, ariſing from the bending of the column. When the column ACB (fig. 20.) reſting on the ground at B, and loaded at top with a weight A, acting in the vertical direction AB, is bent into a curve ACB, ſo that the tangent at C is perpendicular to the horizon, its condition ſomewhat reſembles that of a beam firmly fixed between B and C, and ſtrongly pulled by the end A, ſo as to bend it between C and A. Although we cannot conceive how a force acting on a ſtraight column AB in the direction AB can bend it, we may ſuppoſe that the force acted firſt in the horizontal direction A *b*, till it was bent to this degree, and that the rope was then gradually removed from the direction A *b* to the direction AB, increaſing the force as much as is neceſſary for preſerving the ſame quantity of flexure.

105 Obſervations on Euler's theory of the ſtrength of columns.

The firſt author (we believe) who conſidered this important ſubject with ſcrupulous attention was the celebrated Euler, who publiſhed in the Berlin Memoirs for 1757 his Theory of the Strength of Columns. The general propoſition eſtabliſhed by this theory is, that the ſtrength of priſmatical columns is in the direct quadruplicate ratio of their diameters and the inverſe duplicate ratio of their lengths. He proſecuted this ſubject in the Peterſburg Commentaries for 1778, confirming his former theory. We do not find that any other author has beſtowed much attention on it, all ſeeming to acquieſce in the determinations of Euler, and to conſider the ſubject as of very great difficulty, requiring the application of the moſt refined mathematics. Muſchenbroek has compared the theory with experiment; but the compariſon has been very unſatisfactory, the difference from the theory being ſo enormous as to afford no argument for its juſtneſs. But the experiments do not contradict it, for they are ſo anomalous as to afford no concluſion or general rule whatever.

To ſay the truth, the theory can be conſidered in no other light than as a ſpecimen of ingenious and very artful algebraic analyſis. Euler was unqueſtionably the firſt analyſt in Europe for reſource and addreſs. He knew this, and enjoyed his ſuperiority, and without ſcruple admitted any phyſical aſſumptions which gave him an opportunity of diſplaying his ſkill. The inconſiſtency of his aſſumptions with the known laws of mechaniſm gave him no concern; and when his algebraic proceſſes led him to any concluſion which would make his readers ſtare, being contrary to all our uſual notions, he frankly owned the paradox, but went on in his analyſis, ſaying, "*Sed analyſi magis fidendum.*" Mr. Robins has given ſome very riſible inſtances of this confidence in his analyſis, or rather of his confidence in the indolent ſubmiſſion of his readers. Nay, ſo fond was he of this kind of amuſement, that after having publiſhed an untenable Theory of Light and Colours, he publiſhed ſeveral Memoirs, explaining the aberration of the heavenly bodies, and deducing ſome very wonderful conſequences, fully confirmed by experience, from the Newtonian principles, which were oppoſite and totally inconſiſtent with his own theory, merely becauſe the Newtonian theory gave him "*occaſionem analyſeos promovendæ.*" We are thus ſevere in our obſervations, becauſe his theory of the ſtrength of columns is one of the ſtrongeſt inſtances of this wanton kind of proceeding, and becauſe his followers in the Academy of St. Peterſburg, ſuch as Mr Fuſs, Lexill, and others, adopt his concluſions, and merely echo his words. Since the death of Dan. Bernoulli no member of that academy has controverted any thing advanced by their *Profeſſor ſublimis geometriæ*, to whom they had been indebted for their places and for all their knowledge, having been (moſt of them) his amanuenſes, employed by this wonderful man during his blindneſs to make his computations and carry on his algebraic inveſtigations. We are not a little ſupriſed to ſee Mr Emerſon, a conſiderable mathematician, and a man of very independent ſpirit, haſtily adopting the ſame theory, of which we doubt not but our readers will eaſily ſee the falſity.

Euler conſiders the column ACB as in a condition preciſely ſimilar to that of an elaſtic rod bent into the curve by a cord AB connecting its extremities.—In this he is not miſtaken.—But he then draws CD perpendicular to AB, and conſiders the ſtrain on the ſection C as equal to the momentum or mechanical energy of the weight A acting in the direction DB upon the lever *x c* D, moveable round the fulcrum *c*, and tending to tear aſunder the particles which cohere along the ſection *c* C *x*. This is the ſame principle (as Euler admits) employed by James Bernoulli in his inveſtigation of the elaſtic curve ACB. Euler conſiders the ſtrain on the ſection *c x* as the ſame with what it would ſuſtain if the ſame power acted in the horizontal direction EF on a point E as far removed from C as the point D is. We reaſoned in the ſame manner (as has been obſerved) in the article Roofs, where the obliquity of action was inconſiderable. But in the preſent caſe, this ſubſtitution leads to the greateſt miſtakes, and has rendered the whole of this theory falſe and uſeleſs. It would be juſt if the column were of materials which are incompreſſible. But it is evident, by what has been ſaid above, that by the compreſſion of the parts the real fulcrum of the lever ſhifts away from the point *c*, ſo much the more as the compreſſion is greater. In the great compreſſions of loaded columns, and the almoſt unmeaſurable compreſſions of the truſs beams in the centres of bridges, and other caſes of chief importance, the fulcrum is ſhifted far over towards *x*, ſo that very few fibres reſiſt the fracture by their coheſion; and theſe few have a very feeble energy or momentum, on account of the ſhort arm of the lever by which they act. This is a moſt important conſideration in carpentry, yet makes no element of Euler's theory. The conſequence of this is, that a very ſmall degree of curvature is ſufficient to cauſe the column

lumn or ſtrutt to ſnap in an inſtant, as is well known to every experienced carpenter. The experiment by Muſchenbroek, which Euler makes uſe of in order to obtain a meaſure of ſtrength in a particular inſtance, from which he might deduce all others by his theorem, is an inconteſtible proof of this. The force which broke the column is not the twentieth part of what is neceſſary for breaking it by acting at E in the direction EF. Euler takes no notice of this immenſe diſcrepancy, becauſe it muſt have cauſed him to abandon the ſpeculation with which he was then amuſing himſelf.

106 This theory falſe and uſeleſs. The limits of this Work do not afford room to enter minutely upon the refutation of this theory; but we can eaſily ſhow its uſeleſſneſs, by its total inconſiſtency with common obſervation. It reſults legitimately from this theory, that if CD have no magnitude, the weight A can have no momentum, and the column cannot be broken—True,—it cannot be broken in this way, ſnapped by a tranſverſe fracture, if it do not bend; but we know very well that it can be cruſhed or crippled, and we ſee this frequently happen. This circumſtance or event does not enter into Euler's inveſtigation, and therefore the theory is imperfect at leaſt and uſeleſs. Had this crippling been introduced in the form of a phyſicial aſſumption, every topic of reaſoning employed in the proceſs muſt have been laid aſide, as the intelligent reader will eaſily ſee. But the theory is not only imperfect, but falſe. The ordinary reader will be convinced of this by another legitimate conſequence of it. Fig. 20. nº 2. is the ſame with fig. 106 of *Emerſon's Mechanics*, where this ſubject is treated on Euler's principles, and repreſents a crooked piece of matter reſting on the ground at F, and loaded at A with a weight acting in the vertical direction AF. It reſults from Euler's theory that the ſtrains at *b*, B, D, E, &c. are as *bc*, BC, DI, EK, &c. Therefore the ſtrains at G and H are nothing; and this is aſſerted by Emerſon and Euler as a ſerious truth; and the piece may be thinned *ad infinitum* in theſe two places, or even cut through, without any diminution of its ſtrength. The abſurdity of this aſſertion ſtrikes at firſt hearing. Euler aſſerts the ſame thing with reſpect to a point of contrary flexure. Farther diſcuſſion is (we apprehend) needleſs.

107 Yet Euler's diſſertations deſerve a peruſal. This theory muſt therefore be given up. Yet theſe diſſertations of Euler in the Peterſburg Commentaries deſerve a peruſal, both as very ingenious ſpecimens of analyſis, and becauſe they contain maxims of practice which are important. Although they give an erroneous meaſure of the comparative ſtrength of columns, they ſhow the immenſe importance of preventing all bendings, and point out with accuracy where the tendencies to bend are greateſt, and how this may be prevented by very ſmall forces, and what a prodigious acceſſion of force this gives the column. There is a valuable paper in the ſame volume by Fuſs *on the Strains on framed Carpentry*, which may alſo be read with advantage.

108 A new theory cannot be ſubſtituted in place of Euler's, till many experiments be made. It will now be aſked, What ſhall be ſubſtituted in place of this erroneous theory? What is the true proportion of the ſtrength of columns? We acknowledge our inability to give a ſatisfactory anſwer. Such can be obtained only by a previous knowledge of the proportion between the extenſions and compreſſions produced by equal forces, by the knowledge of the abſolute compreſſions producible by a given force, and by a knowledge of the degree of that derangement of parts which is termed crippling. Theſe circumſtances are but imperfectly known to us, and there lies before us a wide field of experimental inquiry. Fortunately the force requiſite for crippling a beam is prodigious, and a very ſmall lateral ſupport is ſufficient to prevent that bending which puts the beam in imminent danger. A judicious engineer will always employ tranſverſe bridles, as they are called, to ſtay the middle of long beams, which are employed as pillars, ſtrutts, or truſs beams, and are expoſed, by their poſition, to enormous preſſures in the direction of their lengths. Such ſtays may be obſerved, diſpoſed with great judgment and economy, in the centres employed by Mr Perronet in the erection of his great ſtone arches. He was obliged to correct this omiſſion made by his ingenious predeceſſor in the beautiful centres of the bridge of Orleans, which we have no heſitation in affirming to be the fineſt piece of carpentry in the world.

It only remains on this head to compare theſe theoretical deductions with experiment.

Experiments on the tranſverſe ſtrength of bodies are eaſily made, and accordingly are very numerous, eſpecially thoſe made on timber, which is the caſe moſt common and moſt intereſting. But in this great number of experiments there are very few from which we can draw much practical information. The experiments have in general been made on ſuch ſmall ſcantlings, that the unavoidable natural inequalities bear too great a proportion to the ſtrength of the whole piece. Accordingly, when we compare the experiments of different authors, we find them differ enormouſly, and even the experiments by the ſame author are very anomalous. The completeſt ſeries that we have yet ſeen is that detailed by Belidor in his *Science des Ingenieurs*. They are contained in the following table. The pieces were ſound, even-grained oak. The column *b* contains the breadths of the pieces in inches; the column *d* contains their depths; the column *l* contains their lengths; column *p* contains the weights (in pounds) which broke them when hung on their middles; and *m* is the column of averages or mediums. 109 Table of experiments made by Belidor.

N	*b*	*d*	*l*	*p*	*m*	
1	1	1	18	400 415 405	406	The ends lying looſe.
2	1	1	18	600 600 624	608	The ends firmly fixed.
3	2	1	18	810 795 812	805	Looſe.
4	1	2	18	1570 1580 1590	1580	Looſe.
5	1	1	36	185 195 180	187	Looſe.
6	1	1	36	285 280 285	283	Fixed.
7	2	2	36	1550 1620 1585	1585	Looſe.
8	$1\frac{2}{3}$	$2\frac{1}{3}$	36	1665 1675 1640	1660	Looſe.

110 Corollaries deduced from them.

By comparing Experiments 1ſt and 3d, the ſtrength appears proportional to the breadth.

Experiments 3d and 4th ſhew the ſtrength proportional to the ſquare of the depth

Experiments 1ſt and 5th ſhew the ſtrength nearly in the inverſe proportions of the lengths, but with a ſenſible deficiency in the longer pieces.

Experiments 5th and 7th ſhew the ſtrengths proportional to the breadths and the ſquare of the depth.

Experiments 1ſt and 7th ſhew the ſame thing, compounded with the inverſe proportion of the length: the deficiency relative to the length is not ſo remarkable here.

Experiments 1ſt and 2d and experiments 5th and 6th ſhew the increaſe of ſtrength, by faſtening the ends, to be in the proportion of 2 to 3. The theory gives the proportion of 2 to 4. But a difference in the manner of fixing may produce this deviation from the theory, which only ſuppoſed them to be held down at places beyond the props, as when a joiſt is held in the walls, and alſo reſts on two pillars between the walls. (See what is ſaid on this ſubject in the article ROOF, § 19.); where note, that there is a miſtake, when it is ſaid that a beam ſupported at both ends and loaded in the middle will carry twice as much as if one end were fixed in the wall and the weight ſuſpended at the other end. The reaſoning employed there ſhows that it will carry four times as much.

The chief ſource of irregularity in ſuch experiments is the fibrous, or rather plated texture of timber. It conſiſts of annual additions, whoſe coheſion with each other is vaſtly weaker than that of their own fibres. Let fig. 21. repreſent the ſection of a tree, and ABCD, *a b c d* the ſection of two battens that are to be cut out of it for experiment, and let AD and *a d* be the depths, and DC, *d c* the breadths. The batten ABCD will be the ſtrongeſt, for the ſame reaſon that an aſſemblage of planks ſet edgewiſe will form a ſtronger joiſt than planks laid above each other like the plates of a coach-ſpring. Mr Buffon found by many trials that the ſtrength of ABCD was to that of *a b c d* (in oak) nearly as 8 to 7. The authors of the different experiments were not careful that their battens had their plates all diſpoſed ſimilarly with reſpect to the ſtrain. But even with this precaution they would not have afforded ſure grounds of computation for large works; for great beams occupy much, if not the whole, of the ſection of the tree; and from this it has happened that their ſtrength is leſs than in proportion to that of a ſmall lath or batten. In ſhort, we can truſt no experiments but ſuch as have been made on large beams. Theſe muſt be very rare, for they are moſt expenſive and laborious, and exceed the abilities of moſt of thoſe who are diſpoſed to ſtudy this matter.

But we are not wholly without ſuch authority. Mr Buffon and Mr Du Hamel, two of the firſt philoſophers and mechanicians of the age, were directed by government to make experiments on this ſubject, and were ſupplied with ample funds and apparatus. The relation of their experiments is to be found in the Memoirs of the French Academy for 1740, 1741, 1742, 1768; as alſo in Du Hamel's valuable performances *ſur l'Exploitation des Arbres, et ſur la Conſervation et le Tranſport de Bois*. We earneſtly recommend theſe diſſertations to the peruſal of our readers, as containing much uſeful information relative to the ſtrength of timber, and the beſt methods of employing it. We ſhall here give an abſtract of Mr Buffon's experiments.

111 Mr Buffon's experiments on bars of ſound oak.

He relates a great number which he had proſecuted during two years on ſmall battens. He found that the odds of a ſingle layer, or part of a layer, more or leſs, or even a different diſpoſition of them, had ſuch influence that he was obliged to abandon this method, and to have recourſe to the largeſt beams that he was able to break. The following table exhibits one ſeries of experiments on bars of ſound oak, clear of knots, and four inches ſquare. This is a ſpecimen of all the reſt.

Column 1ſt is the length of the bar in feet clear between the ſupports.

Column 2d is the weight of the bar (the 2d day after it was felled) in pounds. Two bars were tried of each length. Each of the firſt three pairs conſiſted of two cuts of the ſame tree. The one next the root was always found the heavieſt, ſtiffeſt, and ſtrongeſt. Indeed Mr Buffon ſays that this was invariably true, that the heavieſt was always the ſtrongeſt; and he recommends it as a certain (or ſure) rule for the choice of timber. He finds that this is always the caſe when the timber has grown vigorouſly, forming very thick annual layers. But he alſo obſerves that this is only during the advances of the tree to maturity; for the ſtrength of the different circles approaches gradually to equality during the tree's healthy growth, and then it decays in theſe parts in a contrary order. Our tool-makers aſſert the ſame thing with reſpect to beech: yet a contrary opinion is very prevalent; and wood with a fine, that is, a ſmall grain, is frequently preferred. Perhaps no perſon has ever made the trial with ſuch minuteneſs as Mr Buffon, and we think that much deference is due to his opinion.

Column 3d is the number of pounds neceſſary for breaking the tree in the courſe of a few minutes.

Column 4th is the inches which it bent down before breaking.

Column 5th is the time at which it broke.

1	2	3	4	5
7	60 56	5350 5275	3,5 4,5	29 22
8	68 63	4600 4500	3,75 4,7	15 13
9	77 71	4100 3950	4,85 5,5	14 12
10	84 82	3625 3600	5,83 6,5	15 15
12	100 98	3050 2925	7, 8,	

The experiments on other ſizes were made in the ſame way. A pair at leaſt of each length and ſize was taken. The mean reſults are contained in the following table. The beams were all ſquare, and their ſizes in inches are placed at the head of the columns, and their lengths in feet are in the firſt column.

	4	5	6	7	8	A
7	5312	11525	18950	32200	47649	11525
8	4550	9787	15525	26050	39750	10085
9	4025	8308	13150	22350	32800	8964
10	3612	7125	11250	19475	27750	8068
12	2987	6075	9100	16175	23450	6723
14		5300	7475	13225	19775	5763
16		4350	6362	11000	16375	5042
18		3700	5562	9245	13200	4482
20		3225	4950	8375	11487	4034
22		2975				3667
24		2162				3362
28		1775				2881

Mr Buffon had found by numerous trials that oak-timber loſt much of its ſtrength in the courſe of drying or ſeaſoning; and therefore, in order to ſecure uniformity, his trees were all felled in the ſame ſeaſon of the year, were ſquared the day after, and tried the third day. Trying them in this green ſtate gave him an opportunity of obſerving a very curious and unaccountable phenomenon. When the weights were laid briſkly on, nearly ſufficient to break the log, a very ſenſible ſmoke was obſerved to iſſue from the two ends with a ſharp hiſſing noiſe. This continued all the while the tree was bending and cracking. This ſhows that the log is affected or ſtrained through its whole length; indeed this muſt be inferred from its bending through its whole length. It alſo ſhows us the great effects of the compreſſion. It is a pity Mr Buffon did not take notice whether this ſmoke iſſued from the upper or compreſſed half of the ſection only, or whether it came from the whole.

112
Obſervations on Mr Buffon's experiments.

We muſt now make ſome obſervations on theſe experiments, in order to compare them with the theory which we have endeavoured to eſtabliſh.

Mr Buffon conſiders the experiments with the 5-inch bars as the ſtandard of comparison, having both extended theſe to greater lengths, and having tried more pieces of each length.

Our theory determines the relative ſtrength of bars of the ſame ſection to be inverſely as their lengths. But (if we except the five experiments in the firſt column) we find a very great deviation from this rule. Thus the 5-inch bar of 28 feet long ſhould have half the ſtrength of that of 14 feet, or 2650; whereas it is but 1775. The bar of 14 feet ſhould have half the ſtrength of that of 7 feet, or 5762; whereas it is but 5300. In like manner, the fourth of 11525 is 2881; but the real ſtrength of the 28 feet bar is 1775. We have added a column A, which exhibits the ſtrength which each of the 5-inch bars ought to have by the theory. This deviation is moſt diſtinctly ſeen in fig. 22. where BK is the ſcale of lengths, B being at the point 7 of the ſcale and K at 28. The ordinate CB is $= 11525$, and the other ordinates DE, GK, &c. are reſpectively $= \frac{7\,CB}{\text{Length}}$. The lines DF, GH, &c. are made $= 4350$, 1775, &c. expreſſing the ſtrengths given by experiment. The 10-feet bar and the 24-feet bar are remarkably anomalous. But all are deficient, and the defect has an evident progreſſion from the firſt to the laſt. The ſame thing may be ſhown of the other columns, and even of the firſt, though it is very ſmall in that column. It may alſo be obſerved in the experiments of Belidor, and in all that we have ſeen. We cannot doubt therefore of its being a law of nature, depending on the true principles of coheſion and the laws of mechanics.

But it is very puzzling, and we cannot pretend to give a ſatisfactory explanation of the difficulty. The only effect which we can conceive the length of a beam to have, is to increaſe the ſtrain at the ſection of fracture by employing the intervening beam as a lever. But we do not diſtinctly ſee what change this can produce in the mode of action of the fibres in this ſection, ſo as either to change their coheſion or the place of its centre of effort: yet ſomething of this kind muſt happen.

We ſee indeed ſome circumſtances which muſt contribute to make a ſmaller weight ſufficient, in Mr Buffon's experiments, to break a long beam than in the exact inverſe proportion of its length.

In the firſt place, the weight of the beam itſelf augments the ſtrain as much as if half of it were added in form of a weight. Mr Buffon has given the weights of every beam on which he made experiments, which is very nearly 74 pounds *per* cubic foot. But they are much too ſmall to account for the deviation from the theory. The half weights of the 5-inch beams of 7, 14, and 28 feet length are only 45, 92, and 182 pounds; which makes the real ſtrains in the experiments 11560, 5390, and 1956; which are far from having the proportions of 4, 2, and 1.

Buffon ſays that healthy trees are univerſally ſtrongeſt at the root end; therefore, when we uſe a longer beam, its middle point, where it is broken in the experiment, is in a weaker part of the tree. But the trials of the 4-inch beams ſhow that the difference from this cauſe is almoſt inſenſible.

The length muſt have ſome mechanical influence which the theory we have adopted has not yet explained. It may not however be inadequate to the taſk. The very ingenious inveſtigation of the elaſtic curve by James Bernoulli and other celebrated mathematicians is perhaps as refined an application of mathematical analyſis as we know. Yet in this inveſtigation it was neceſſary, in order to avoid almoſt inſuperable difficulties, to take the ſimpleſt poſſible caſe, viz. where the thickneſs is exceedingly ſmall in compariſon with the length. If the thickneſs be conſiderable, the quantities neglected in the calculus are too great to permit the concluſion to be accurate, or very nearly ſo. Without being able to define the form into which an elaſtic body of conſiderable thickneſs will be bent, we can ſay with confidence, that in an extreme caſe, where the compreſſion in the concave ſide is very great, the curvature differs conſiderably from the Bernoullian curve. But as our inveſtigation is incomplete and very long, we do not offer it to the reader. The following more familiar conſiderations will, we apprehend, render it highly probable that the relative ſtrength of beams decreaſes faſter than in the inverſe ratio of their length. The curious obſervation by Mr Buffon of the vapour which iſſued with a hiſſing noiſe from the ends of a beam of green oak, while it was breaking by the load on its middle, ſhows that the whole length of the piece was affected: indeed it muſt be, ſince it is bent throughout. We have ſhown above, that a certain definite curvature of a beam of a given form is always accompanied by rupture. Now ſuppoſe the beam A of 10 feet long, and the beam B of 20 feet long, bent to the ſame degree, at the place of their fixture in the wall; the weight which hangs on A is nearly double of that which muſt hang on B. The form of any portion, ſuppoſe 5 feet, of theſe two beams, immediately adjoining to the wall is conſiderably different. At the diſtance of 5 feet the curvature of A is $\frac{1}{2}$ of its curvature at the wall. The curvature of B in the correſponding point is $\frac{3}{4}$ths of the ſame curvature at the wall. Through the whole of the intermediate 5 feet, therefore, the curvature of B is greater than that of A. This muſt make it weaker throughout. It muſt occaſion the fibres to ſlide more on each other (that it may acquire *this* greater curvature), and thus affect their lateral union;

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Probable that the relative ſtrength of beams decreaſes faſter than in the inverſe ratio of their length.

union; and therefore thoſe which are ſtronger will not aſſiſt their weaker neighbours. To this we muſt add, that in the ſhorter beams the force with which the fibres are preſſed laterally on each other is double. This muſt impede the mutual ſliding of the fibres which we mentioned a little ago; nay, this lateral compreſſion may change the law of longitudinal coheſion (as will readily appear to the reader who is acquainted with Boſcovich's doctrines), and increaſe the ſtrength of the very ſurface of fracture, in the ſame way (however inexplicable) as it does in metals when they are hammered or drawn into wire.

The reader muſt judge how far theſe remarks are worthy of his attention. The engineer will carefully keep in mind the important fact, that a beam of quadruple length, inſtead of having $\frac{1}{4}$th of the ſtrength, has only about $\frac{1}{6}$th; and the philoſopher ſhould endeavour to diſcover the cauſe of this diminution, that he may give the artiſt a more accurate rule of computation.

114
We cannot diſcover the preciſe relation between the curvature and the momentum of coheſion.

Our ignorance of the law by which the coheſion of the particles changes by a change of diſtance, hinders us from diſcovering the preciſe relation between the curvature and the momentum of coheſion; and all we can do is to multiply experiments, upon which we may eſtabliſh ſome *empirical* rules for calculating the ſtrength of ſolids. Thoſe from which we muſt reaſon at preſent are too few and too anomalous to be the foundation of ſuch an empirical formula. We may, however, obſerve, that Mr Buffon's experiments give us conſiderable aſſiſtance in this particular: For if to each of the numbers of the column for the 5 inch beams, corrected by adding half the weight of the beam, we add the conſtant number 1245, we ſhall have a ſet of numbers which are very nearly reciprocals of the lengths. Let 1245 be called *c*, and let the weight which is known by experiment to be neceſſary for breaking the 5-inch beam of the length *a* be called P. We ſhall have $\frac{\overline{P+c}\times a}{l}-c=p$. Thus the weight neceſſary for breaking the 7-foot bar is 11560. This added to 1245, and the ſum multiplied by 7, gives $\overline{P+c}\times a=89635$. Let *l* be 18; then $\frac{89635}{18}-1245=3725,=p$, which differs not more than $\frac{1}{40}$th from what experiment gives us. This rule holds equally well in all the other lengths except the 10 and 24 foot beams, which are very anomalous. Such a formula is abundantly exact for practice, and will anſwer through a much greater variety of length, though it cannot be admitted as a true one; becauſe, in a certain very great length, the ſtrength will be nothing. For other ſizes the conſtant number muſt change in the proportion of d^3, or perhaps of *p*.

115
Relation between the ſtrength and the ſquare of the depth of the ſection.

The next compariſon which we have to make with the theory is the relation between the ſtrength and the ſquare of the depth of the ſection. This is made by comparing with each other the numbers in any horizontal line of the table. In making this compariſon we find the numbers of the five-inch bars uniformly greater than the reſt. We imagine that there is ſomething peculiar to theſe bars: They are in general heavier than in the proportion of their ſection, but not ſo much ſo as to account for all their ſuperiority. We imagine that this ſet of experiments, intended as a ſtandard for the reſt, has been made at one time, and that the ſeaſon has had a conſiderable influence. The fact however is, that if this column be kept out, or uniformly diminiſhed about $\frac{1}{16}$th in their ſtrength, the different ſizes will deviate very little from the ratio of the ſquare of the depth, as determined by theory. There is however a ſmall deficiency in the bigger beams.

We have been thus anxious in the examination of theſe experiments, becauſe they are the only ones which have been related in ſufficient detail, and made on a proper ſcale for giving us data from which we can deduce confidential maxims for practice. They are ſo troubleſome and expenſive that we have little hopes of ſeeing their number greatly increaſed; yet ſurely the navy board would do an unſpeakable ſervice to the public by appropriating a fund for ſuch experiments under the management of ſome man of ſcience.

116
Proportion between the abſolute coheſion and the relative ſtrength.

There remains another compariſon which is of chief importance, namely, the proportion between the ABSOLUTE COHESION and the RELATIVE STRENGTH. It may be gueſſed, from the very nature of the thing, that this muſt be very uncertain. Experiments on the abſolute ſtrength muſt be confined to very ſmall pieces, by reaſon of the very great forces which are required for tearing them aſunder. The values therefore deduced from them muſt be ſubject to great inequalities. Unfortunately we have got no detail of any experiments; all that we have to depend on is two paſſages of Muſchenbroek's *Eſſais de Phyſique;* in one of which he ſays that a piece of ſound oak $\frac{27}{100}$ths of an inch ſquare is torn aſunder by 1150 pounds; and in the other, that an oak plank 12 inches broad and 1 thick will juſt ſuſpend 189163 pounds. Theſe give for the coheſion of an inch ſquare 15,755 and 15,763 pounds. Bouguer, in his *Traité du Navire,* ſays that it is very well known that a rod of ſound oak $\frac{1}{4}$th of an inch ſquare will be torn aſunder by 1000 pounds. This gives 16000 for the coheſion of a ſquare inch. We ſhall take this as a round number, eaſily uſed in our computations. Let us compare this with Mr Buffon's trials of beams four inches ſquare.

The abſolute coheſion of this ſection is $16,000\times16=256,000$. Did every fibre exert its whole force in the inſtant of fracture, the momentum of coheſion would be the ſame as if it had all acted at the centre of gravity of the ſection at 2 inches from the axis of fracture, and is therefore 512000. The 4-inch beam, 7 feet long, was broken by 5312 pounds hung on its middle. The half of this, or 2656 pounds, would have broken it, if ſuſpended at its extremity, projecting $3\frac{1}{2}$ feet or 42 inches from a wall. The momentum of this ſtrain is therefore $2656\times42,=111552$. Now this is in equilibrio with the actual momentum of coheſion, which is therefore 111552, inſtead of 512000. The ſtrength is therefore diminiſhed in the proportion of 512000 to 111552, or very nearly of 4,59 to 1.

As we are quite uncertain as to the place of the centre of effort, it is needleſs to conſider the full coheſion as acting at the centre of gravity, and producing the momentum 512,000; and we may convert the whole into a ſimple multiplier *m* of the length, and ſay, *as* m *times the length is to the depth, ſo is the abſolute coheſion of the ſection to the relative ſtrength.* Therefore let the abſolute coheſion of a ſquare inch be called *f*, the breadth *b*, the depth *d*, and the length *l* (all in inches), the relative ſtrength, or the external force *p*, which balances it, is $\frac{fbd^2}{9,18l}$, or in round numbers $\frac{fbd^2}{9l}$; for $m=2\times4,59$.

This great diminution of ſtrength cannot be wholly accounted for by the inequality of the coheſive forces exerted in the inſtant of fracture; for in this caſe we know that the centre of effort is at $\frac{1}{3}$d of the height in a rectangular ſection (becauſe the forces really exerted are as the extenſions of the fibres). The relative ſtrength would be $\frac{fbd^2}{3l}$, and *p* would have been 8127 inſtead of 2656.

We muſt aſcribe this diminution (which is three times greater than that produced by the inequality of the coheſive

ſive

five forces) to the compreſſion of the under part of the beam; and we muſt endeavour to explain in what manner this compreſſion produces an effect which ſeems ſo little explicable by ſuch means.

As we have repeatedly obſerved, it is a matter of nearly univerſal experience that the forces *actually* exerted by the particles of bodies, when ſtretched or compreſſed, are very nearly in the proportion of the diſtances to which the particles are drawn from their natural poſitions. Now, altho' we are certain that, in enormous compreſſions, the forces increaſe faſter than in this proportion, this makes no ſenſible change in the preſent queſtion, becauſe the body is broken before the compreſſions have gone ſo far; nay, we imagine that the compreſſed parts are crippled in moſt caſes even before the extended parts are torn aſunder. Muſchenbroek aſſerts this with great confidence with reſpect to oak, on the authority of his own experiments. He ſays, that although oak will ſuſpend half as much again as fir, it will not ſupport, as a pillar, two thirds of the load which fir will ſupport in that form.

We imagine therefore that the mechaniſm in the *preſent* caſe is nearly as follows:

Let the beam DCK Δ (fig. 23.) be loaded at its extremity with the weight P, acting in the direction KP perpendicular to DC. Let D Δ be the ſection of fracture. Let DA be about $\frac{1}{3}$d of D Δ. A will be the particle or fibre which is neither extended nor compreſſed. Make Δ δ : D *d* = DA : A Δ. The triangles DA *d*, Δ A δ, will repreſent the accumulated attracting and repelling forces. Make AI and A *i* = $\frac{1}{3}$DA and $\frac{1}{3}$ Δ A. The point I will be that to which the full coheſion D *d* or *f* of the particles in AD muſt be applied, ſo as to produce the ſame momentum which the variable forces at I, D, &c. really produce at their ſeveral points of application. In like manner, *i* is the centre of ſimilar effort of the repulſive forces excited by the compreſſion between A and Δ, and it is the real fulcrum of a bended lever I *i* K, by which, the whole effect is produced. The effect is the ſame as if the full coheſion of the ſtretched fibres in AD were accumulated in I, and the full repulſion of all the compreſſed fibres in AΔ were accumulated in *i*. The forces which are balanced in the operation are the weight P, acting by the arm *k i*, and the full coheſion of AD acting by the arm I *i*. The forces exerted by the compreſſed fibres between A and Δ only ſerve to give ſupport to the lever, that it may exert its ſtrain.

We imagine that this does not differ much from the real procedure of nature. The poſition of the point A may be different from what we have deduced from Mr Buffon's experiments, compared with Muſchenbroek's value of the abſolute coheſion of a ſquare inch. If this laſt ſhould be only 12000, DA muſt be greater than we have here made it, in the proportion of 12000 to 16000. For I *i* muſt ſtill be made = $\frac{1}{3}$ A Δ, ſuppoſing the forces to be proportional to the extenſions and compreſſions. There can be no doubt that a part only of the coheſion of D Δ operates in reſiſting the fracture in all ſubſtances which have any compreſſibility; and it is confirmed by the experiments of Mr Du Hamel on willow, and the inferences are by no means confined to that ſpecies of timber. We ſay therefore, that when the beam is broken, the coheſion of AD alone is exerted, and that each fibre exerts a force proportional to its extenſion; and the accumulated momentum is the ſame as if the full coheſion of AD were acting by the lever I *i* = $\frac{1}{3}$d of D Δ.

It may be ſaid, that if only $\frac{1}{3}$ of the coheſion of oak be exerted, it may be cut $\frac{2}{3}$ds through without weakening it. But this cannot be, becauſe the coheſion of the whole is employed in preventing the lateral ſlide ſo often mentioned. We have no experiments to determine that it *may not* be cut through $\frac{1}{3}$d without loſs of its ſtrength.

This muſt not be conſidered as a ſubject of mere ſpeculative curioſity: It is intimately connected with all the practical uſes which we can make of this knowledge; for it is almoſt the only way that we can learn the compreſſibility of timber. Experiments on the direct coheſion are indeed difficult, and exceedingly expenſive if we attempt them in large pieces. But experiments on compreſſion are almoſt impracticable. The moſt inſtructive experiments would be, firſt to eſtabliſh, by a great number of trials, the tranſverſe force of a modern batten; and then to make a great number of trials of the diminution of its ſtrength, by cutting it through on the concave ſide. This would very nearly give us the proportion of the coheſion which really operates in reſiſting fractures. Thus if it be found that one-half of the beam may be cut on the under ſide without diminution of its ſtrength (taking care to drive in a ſlice of harder wood), we may conclude that the point A is at the middle, or ſomewhat above it.

Much lies before the curious mechanician, and we are as yet very far from a ſcientific knowledge of the ſtrength of timber.

117
A uſeful practical rule may be deduced from Mr Buffon's experiments.

In the mean time, we may derive from theſe experiments of Buffon a very uſeful practical rule, without relying on any value of the abſolute coheſion of oak. We ſee that the ſtrength is nearly as the breadth, as the ſquare of the depth, and as the inverſe of the length. It is moſt convenient to meaſure the breadth and depth of the beam in inches, and its length in feet. Since, then, a beam four inches ſquare and ſeven feet between the ſupports is broken by 5312 pounds, we muſt conclude that a batten one inch ſquare and one foot between the ſupports will be broken by 581 pounds. Then the ſtrength of any other beam of oak, or the weight which will juſt break it when hung on its middle, is $581\frac{d^2}{l}$.

But we have ſeen that there is a very conſiderable deviation from the inverſe proportion of the lengths, and we muſt endeavour to accommodate our rule to this deviation. We found, that by adding 1245 to each of the ordinates or numbers in the column of the five-inch bars, we had a ſet of numbers very nearly reciprocal of the lengths; and if we make a ſimilar addition to the other columns in the proportion of the cubes of the ſixes, we have nearly the ſame reſult. The greateſt error (except in the caſe of experiments which are very irregular) does not exceed $\frac{1}{15}$th of the whole. Therefore, for a radical number, add to the 5312 the number 640, which is to 1245 very nearly as 4^3 to 5^3. This gives 5952. The 64th of this is 93, which correſponds to a bar of one inch ſquare and ſeven feet long. Therefore 93 × 7 will be the reciprocal correſponding to a bar of one foot. This is 651. Take from this the preſent empirical correction, which is $\frac{b\,40}{b\,4}$, or 10, and there remains 641 for the ſtrength of the bar. This gives us for a general rule $p=651\frac{b\,d^2}{l}-10\,b\,d^2$.

Example. Required the weight neceſſary to break an oak beam eight inches ſquare and 20 feet between the props, $p=651\times\frac{8\times8^2}{20}-10\times8\times8^2$. This is 11545, whereas the experiment gives 11487. The error is very ſmall indeed. The rule is moſt deficient in compariſon with the five-inch bars, which we have already ſaid appear ſtronger than the reſt.

Fig. 1.

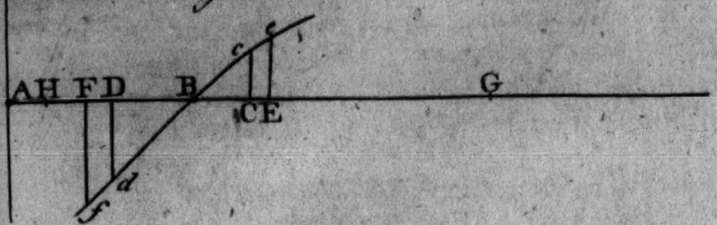
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Fig. 3.

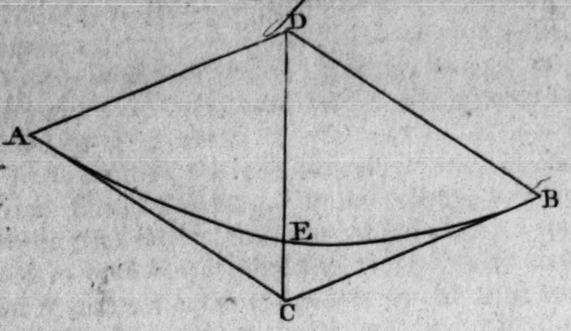

Fig. 2.

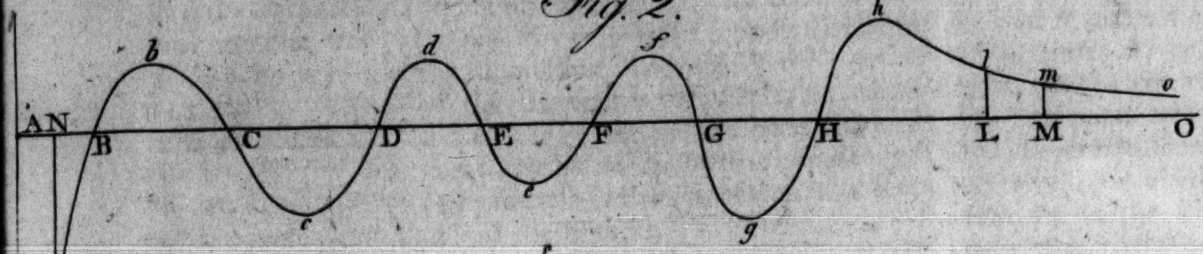
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Fig. 4.

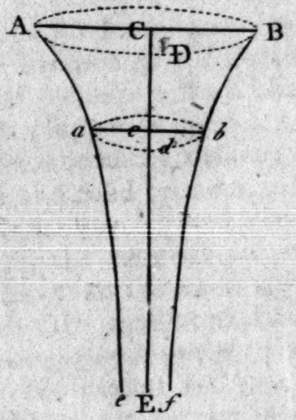
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Fig. 5. N.º 1.

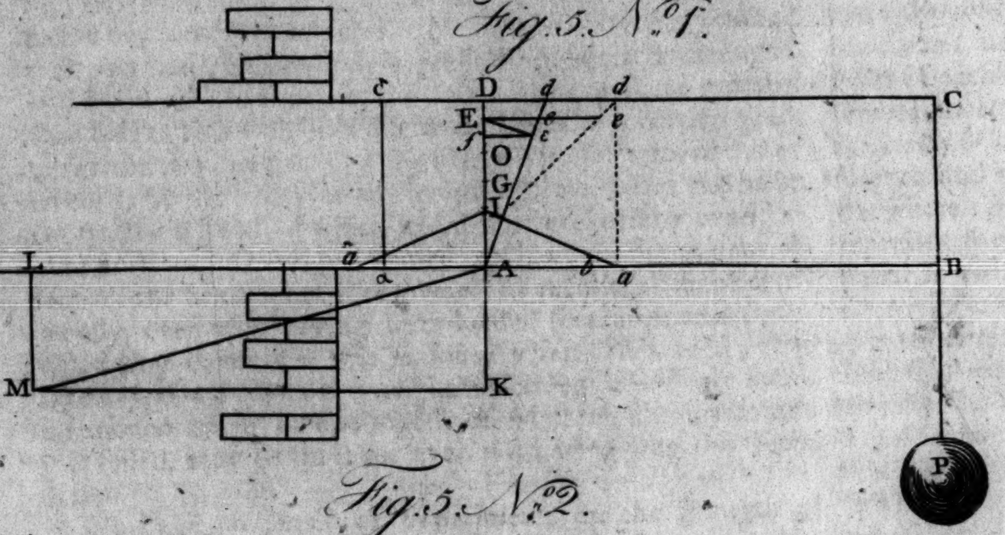
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Fig. 5. N.º 2.

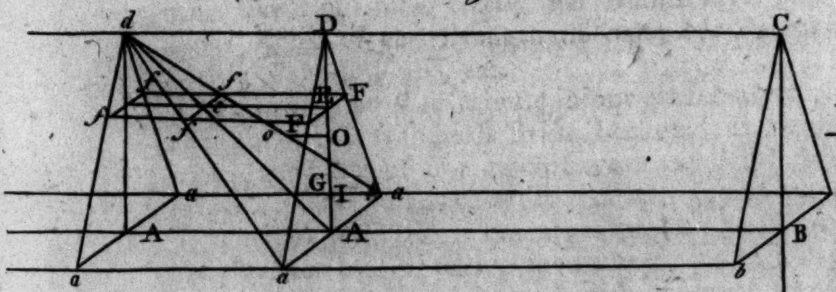
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Fig. 6.

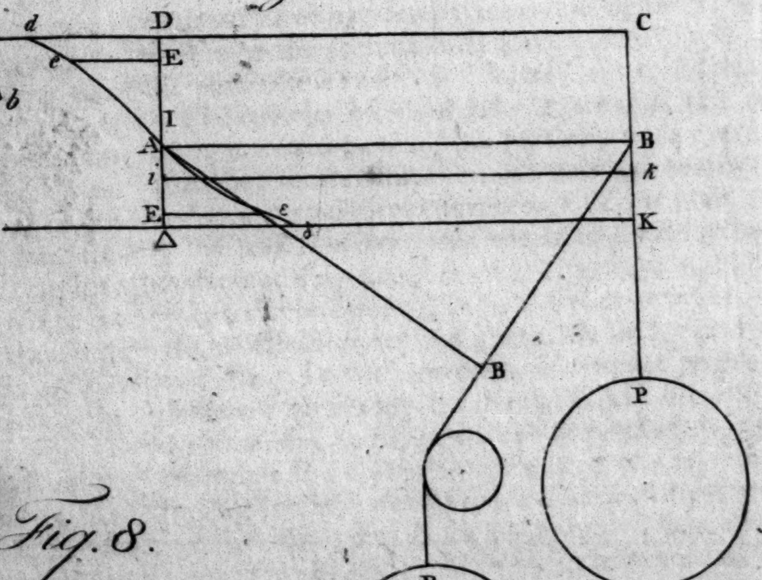
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Fig. 5. N.º 3.

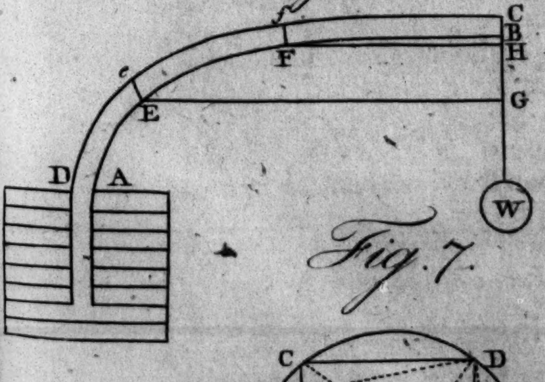
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Fig. 7.

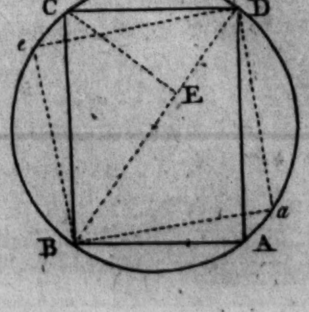
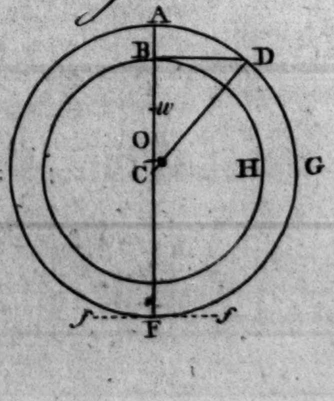


Fig. 8.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The following proceſs is eaſily remembered by ſuch as are not algebraiſts.

Multiply the breadth in inches twice by the depth, and call this product *f*. Multiply *f* by 651, and divide by the length in feet. From the quotient take 10 times *f*. The remainder is the number of pounds which will break the beam.

We are not ſufficiently ſenſible of our principles to be confident that the correction 10 *f* ſhould be in the proportion of the ſection, although we think it moſt probable. It is quite empirical, founded on Buffon's experiments. Therefore the ſafe way of uſing this rule is to ſuppoſe the beam ſquare, by increaſing or diminiſhing its breadth till equal to the depth. Then find the ſtrength by this rule, and diminiſh or increaſe it for the change which has been made in its breadth. Thus, there can be no doubt that the ſtrength of the beam given as an example is double of that of a beam of the ſame depth and half the breadth.

The reader cannot but obſerve that all this calculation relates to the very greateſt weight which a beam will bear for a very few minutes. Mr Buffon uniformly found that two-thirds of this weight ſenſibly impaired its ſtrength, and frequently broke it at the end of two or three months. One-half of this weight brought the beam to a certain bend, which did not increaſe after the firſt minute or two, and may be borne by the beam for any length of time. But the beam contracted a bend, of which it did not recover any conſiderable portion. One-third ſeemed to have no permanent effect on the beam; but it recovered its rectilineal ſhape completely, even after having been loaded ſeveral months, provided that the timber was ſeaſoned when firſt loaded; that is to ſay, one-third of the weight which would quickly break a ſeaſoned beam, or one-fourth of what would break one juſt felled, may lie on it for ever without giving the beam a ſet.

We have no detail of experiments on the ſtrength of other kinds of timber: only Mr Buffon ſays, that fir has about $\frac{6}{10}$ths of the ſtrength of oak; Mr Parent makes it $\frac{10}{12}$ths; Emerſon, $\frac{2}{3}$ds, &c.

We have been thus minute in our examination of the mechaniſm of this tranſverſe ſtrain, becauſe it is the greateſt to which the parts of our machines are expoſed. We wiſh to impreſs on the minds of artiſts the neceſſity of avoiding this as much as poſſible. They are improving in this reſpect, as may be ſeen by comparing the centres on which ſtone arches of great ſpan are now turned with thoſe of former times. They were formerly a load of mere joiſts reſting on a multitude of poſts, which obſtructed the navigation, and were frequently loſing their ſhape by ſome of the poſts ſinking into the ground. Now they are more generally truſſes, where the beams abutt on each other, and are relieved from tranſverſe ſtrains. But many performances of eminent artiſts are ſtill very injudiciouſly expoſed to croſs ſtrains. We may inſtance one which is conſidered as a fine work, viz. the bridge at Walton on Thames. Here every beam of the great arch is a joiſt, and it hangs together by framing. The fineſt piece of carpentry that we have ſeen is the centre employed in turning the arches of the bridge at Orleans, deſcribed by Perronet. In the whole there is not one croſs ſtrain. The beam, too, of Hornblower's ſteam-engine, deſcribed in that article, is very ſcientifically conſtructed.

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Strain produced by twiſting.

IV. The laſt ſpecies of ſtrain which we are to examine is that produced by twiſting. This takes place in all axles which connect the working parts of machines.

Although we cannot pretend to have a very diſtinct conception of that modification of the coheſion of a body by which it reſiſts this kind of ſtrain, we can have no doubt that, when all the particles act alike, the reſiſtance muſt be proportional to the number. Therefore if we ſuppoſe that two parts ABCD, ABFE (fig. 24.), of the body EFCD to be of inſuperable ſtrength, but cohering more weakly in the common ſurface AB and that one part ABCD is puſhed laterally in the direction AB, there can be no doubt that it will yield only there, and that the reſiſtance will be proportional to the ſurface.

119
The reſiſtance muſt be proportional to the number of particles.

In like manner, we can conceive a thin cylindrical tube, of which KAH (fig. 25.) is the ſection, as cohering more weakly in that ſection than any where elſe. Suppoſe it to be graſped in both hands, and the two parts twiſted round the axis in oppoſite directions, as we would twiſt the two joints of a flute, it is plain that it will firſt fail in this ſection, which is the circumference of a circle, and the particles of the two parts which are contiguous to this circumference will be drawn from each other laterally. The total reſiſtance will be as the number of equally reſiſting particles, that is, as the circumference (for the tube being ſuppoſed very thin, there can be no ſenſible difference between the dilatation of the external and internal particles). We can now ſuppoſe another tube within this, and a third within the ſecond, and ſo on till we reach the centre. If the particles of each ring exerted the ſame force (by ſuffering the ſame dilatation in the direction of the circumference), the reſiſtance of each ring of the ſection would be as its circumference and its breadth (ſuppoſed indefinitely ſmall), and the whole reſiſtance would be as the ſurface; and this would repreſent the reſiſtance of a ſolid cylinder. But when a cylinder is twiſted in this manner by an external force applied to its circumference, the external parts will ſuffer a greater circular extenſion than the internal; and it appears that this extenſion (like the extenſion of a beam ſtrained tranſverſely) will be proportional to the diſtance of the particles from the axis. We cannot ſay that this is demonſtrable, but we can aſſign no proportion that is more probable. This being the caſe, the forces ſimultaneouſly exerted by each particle will be as its diſtance from the axis. Therefore the whole force exerted by each ring will be as the ſquare of its radius, and the accumulated force actually exerted will be as the cube of its radius; that is, the accumulated force exerted by the whole cylinder, whoſe radius is CA, is to the accumulated force exerted *at the ſame time* by the part whoſe radius is CE, as CA^3 to CE^3.

The whole coheſion now exerted is juſt two-thirds of what it would be if all the particles were exerting the ſame attractive forces which are juſt now exerted by the particles in the external circumference. This is plain to any perſon in the leaſt familiar with the fluxionary calculus. But ſuch as are not may eaſily ſee it in this way.

Let the rectangle A C *c a* be ſet upright on the ſurface of the circle along the line CA, and revolve round the axis C *c*. It will generate a cylinder whoſe height is C *c* or A *a*, and having the circle KAH for its baſe. If the diagonal C *a* be ſuppoſed alſo to revolve, it is plain that the triangle *c* C *a* will generate a cone of the ſame height, and having for its baſe the circle deſcribed by the revolution of *c a*, and the point C for its apex. The cylindrical ſurface generated by A *a* will expreſs the whole coheſion exerted by the circumference AHK, and the cylindrical ſurface generated by E *e* will repreſent the coheſion exerted by the circumference ELM, and the ſolid generated by the triangle C A *a* will repreſent the coheſion exerted by the whole circle AHK, and the cylinder generated by the rectangle A C *c a* will repreſent the coheſion exerted by the ſame ſurface if each particle had ſuffered the extenſion A *a*.

Now it is plain, in the firſt place, that the ſolid generated by the triangle *e* E C is to that generated by *a* A C as EC^3 to AC^3. In the next place, the ſolid generated by *a* AC is two thirds of the cylinder, becauſe the cone generated by *c* C *a* is one-third of it.

120
With what force a body of a homogeneous texture reſiſts a ſimple twiſt.

We may now ſuppoſe the cylinder twiſted till the particles in the external circumference loſe their coheſion. There can be no doubt that it will now be wrenched aſunder, all the inner circles yielding in ſucceſſion. Thus we obtain one uſeful information, viz. that a body of homogeneous texture reſiſts a *ſimple twiſt* with two-thirds of the force with which it reſiſts an attempt to force one part laterally from the other, or with one-third part of the force which will cut it aſunder by a ſquare-edged tool. For to drive a ſquare-edged tool through a piece of lead, for inſtance, is the ſame as forcing a piece of the lead as thick as the tool laterally away from the two pieces on each ſide of the tool. Experiments of this kind do not ſeem difficult, and they would give us very uſeful information.

121
The forces exerted in breaking two cylinders are as the ſquares of the diameters.

When two cylinders AHK and BNO are wrenched aſunder, we muſt conclude that the external particles of each are juſt put beyond their limits of coheſion, are equally extended, and are exerting equal forces. Hence it follows, that in the inſtant of fracture the ſum total of the forces actually exerted are as the ſquares of the diameters.

For drawing the diagonal C *e*, it is plain that E *e*, = A *a*, expreſſes the diſtenſion of the circumference ELM, and that the ſolid generated by the triangle CE *e* expreſſes the coheſion exerted by the ſurface of the circle ELM, when the particles in the circumference ſuffer the extenſion E *e* equal to A *a*. Now the ſolids generated by CA *a* and CE *e* being reſpectively two-thirds of the correſponding cylinders, are as the ſquares of the diameters.

122
Relative ſtrength of the ſection to the external force employed to break it.

Having thus aſcertained the real ſtrength of the ſection, and its relation to its abſolute lateral ſtrength, let us examine its ſtrength relative to the external force employed to break it. This examination is very ſimple in the caſe under conſideration. The ſtraining force muſt act by ſome lever, and the coheſion muſt oppoſe it by acting on ſome other lever. The centre of the ſection may be the neutral point, whoſe poſition is not diſturbed.

Let F be the force exerted laterally by an exterior particle. Let *a* be the radius of the cylinder, and *x* the indeterminate diſtance of any circumference, and $\dot{x}$ the indefinitely ſmall interval between the concentric arches; that is, let $\dot{x}$ be the breadth of a ring and *x* its radius. The forces being as the extenſions, and the extenſions as the diſtances from the axis, the coheſion actually exerted at any part of any ring will be $f\frac{x\dot{x}}{a}$. The force exerted by the whole ring (being as the circumference or as the radius) will be $f\frac{x^2\dot{x}}{a}$. The momentum of coheſion of a ring, being as the force mutiplied by its lever, will be $f\frac{x^3\dot{x}}{a}$. The accumulated momentum will be the ſum or fluent of $f\frac{x^3\dot{x}}{a}$; that is, when $x = a$, it will be $\frac{1}{4}f\frac{a^4}{a}, = \frac{1}{4}fa^3$.

123
The reſiſtance of the axle is as the cube of its diameter.

Hence we learn that the ſtrength of an axle, by which it reſiſts being wrenched aſunder by a force acting at a given diſtance from the axis, is as the cube of its diameter.

But farther, $\frac{1}{4}fa^3$ is $= fa^2 \times \frac{1}{4}a$. Now fa^2 repreſents the full lateral coheſion of the ſection. The momentum therefore is the ſame as if the full lateral coheſion were accumulated at a point diſtant from the axis by $\frac{1}{4}$th of the radius or $\frac{1}{8}$th of the diameter of the cylinder.

Therefore let F be the number of pounds which meaſures the lateral coheſion of a circular inch, *d* the diameter of the cylinder in inches, and *l* the length of the lever by which the ſtraining force *p* is ſuppoſed to act, we ſhall have $F \times \frac{1}{8}d^3 = pl$, and $F\frac{d^3}{8l} = p$.

We ſee in general that the ſtrength of an axle, by which it reſiſts being wrenched aſunder by twiſting, is as the cube of its diameter.

124
Hollow axles more proper than ſolid ones.

We ſee alſo that the internal parts are not acting ſo powerfully as the external. If a hole be bored out of the axle of half its diameter, the ſtrength is diminiſhed only $\frac{1}{8}$th, while the quantity of matter is diminiſhed $\frac{1}{4}$th. Therefore hollow axles are ſtronger than ſolid ones containing the ſame quantity of matter. Thus let the diameter be 5 and that of the hollow 4: then the diameter of another ſolid cylinder having the ſame quantity of matter with the tube is 3. The ſtrength of the ſolid cylinder of the diameter 5 may be expreſſed by 5^3 or 125. Of this the internal part (of the diameter 4) exerts 64; therefore the ſtrength of the tube is $125 - 64, = 61$. But the ſtrength of the ſolid axle of the ſame quantity of matter and diameter 3 is 3^3, or 27, which is not half that of the tube.

125
And now generally uſed.

Engineers, therefore, have of late introduced this improvement in their machines, and the axles of caſt iron are all made hollow when their ſize will admit it. They have the additional advantage of being much ſtiffer, and of affording much better fixure for the flanches, which are uſed for connecting them with the wheels or levers by which they are turned and ſtrained. The ſuperiority of ſtrength of hollow tubes over ſolid cylinders is much greater in this kind of ſtrain than in the former or tranſverſe. In this laſt caſe the ſtrength of this tube would be to that of the ſolid cylinder of equal weight as 61 to $32\frac{1}{2}$ nearly.

126
The ratio of reſiſtance to twiſting to the ſimple lateral reſiſtance appears different.

The apparatus which we mentioned on a former occaſion for trying the lateral ſtrength of a ſquare inch of ſolid matter, enabled us to try this theory of twiſt with all deſirable accuracy. The bar which hung down from the pin in the former trials was now placed in a horizontal poſition, and loaded with a weight at the extremity. Thus it acted as a powerful lever, and enabled us to wrench aſunder ſpecimens of the ſtrongeſt materials. We found the reſults perfectly conformable to the theory, in as far as it determined the proportional ſtrength of different ſizes and forms: but we found the ratio of the reſiſtance to twiſting to the ſimple lateral reſiſtance conſiderably different; and it was ſome time before we diſcovered the cauſe.

We had here taken the ſimpleſt view that is poſſible of the action of coheſion in reſiſting a twiſt. It is frequently exerted in a very different way. When, for inſtance, an iron axle is joined to a wooden one by being driven into one end of it, the extenſions of the different circles of particles are in a very different proportion. A little conſideration will ſhow that the particles in immediate contact with the iron axle are in a ſtate of violent extenſion; ſo are the particles of the exterior ſurface of the wooden part, and the intermediate parts are leſs ſtrained. It is almoſt impoſſible to aſſign the exact proportion of the coheſive forces exerted in the different parts. Numberleſs caſes can be pointed out where parts of the axle are in a ſtate of compreſſion, and where it is ſtill more difficult to determine the ſtate of the other particles. We muſt content ourſelves with the deductions made from this ſimple caſe, which is fortunately the moſt common.

127
But when the experiment was altered, it was exactly the ſame.

In the experiments juſt now mentioned the centre of the circle is by no means the neutral point, and it is very difficult to aſcertain its place; but when this conſideration occurred to us, we eaſily freed the experiments from this uncertainty, by extending the lever to both ſides, and by means of a pulley applied equal force to each arm, acting in oppoſite directions. Thus the centre

became

Strength of Materials ‖ Stretto.

became the neutral point, and the reſiſtance to twiſt was found to be $\frac{2}{3}$ds of the ſimple lateral ſtrength.

128 Experiments on chalk, clay, and wax, ſatisfactory; but thoſe on timber irregular.

We beg leave to mention here that our ſucceſs in theſe experiments encouraged us to extend them much farther. We hoped by theſe means to diſcover the abſolute coheſion of many ſubſtances, which would have required an enormous apparatus and a moſt unmanageable force to tear them aſunder directly. But we could reaſon with confidence from the reſiſtance to twiſt (which we could eaſily meaſure), provided that we could aſcertain the proportion of the direct and the lateral ſtrengths. Our experiments on chalk, finely prepared clay, and white bees-wax (of one melting and one temperature), were very conſiſtent and ſatisfactory. But we have hitherto found great irregularities in this proportion in bodies of a fibrous texture like timber. Theſe are the moſt important caſes, and we ſtill hope to be able to accompliſh our project, and to give the public ſome valuable information. This being our ſole object, it was our duty to mention the method which promiſes ſucceſs, and thus excite others to the taſk; and it will be no mortification to us to be deprived of the honour of being the firſt who thus add to the ſtock of experimental knowledge.

When the matter of the axle is of the moſt ſimple texture, ſuch as that of metals, we do not conceive that the length of the axle has any influence on the fracture. It is otherwiſe if it be of a fibrous texture like timber: the fibres are bent before breaking, being twiſted into ſpirals like a cork-ſcrew. The length of the axle has ſomewhat of the influence of a lever in this caſe, and it is eaſier wrenched aſunder if long. Accordingly we have found it ſo; but we have not been able to reduce this influence to calculation.

122 Concluding remarks.

Our readers are requeſted to accept of theſe endeavours to communicate information on this important and difficult ſubject. We are duly ſenſible of their imperfection, but flatter ourſelves that we have in many inſtances pointed out the method which muſt be purſued for improving our knowledge on this ſubject; and we have given the Engliſh reader a more copious liſt of experiments on the ſtrength of materials than he will meet with in our language. Many uſeful deductions might be made from theſe premiſes reſpecting the manner of diſpoſing and combining the ſtrength of materials in our ſtructures. The beſt form of joints, mortiſes, tenons, ſcarphs; the rules for joggling, tabling, ſaying, fiſhing, &c. practiſed in the delicate art of maſt-making, are all founded on this doctrine: but the diſcuſſion of theſe would be equivalent to writing a complete treatiſe of carpentry. We hope that this will be executed by ſome intelligent mechanician, for there is nothing in our language on this ſubject but what is almoſt contemptible; yet there is no mechanic art that is more ſuſceptible of ſcientific treatment. Such a treatiſe, if well executed, could not fail of being well received by the public in this age of mechanical improvement.

STRENGTHENERS, or CORROBORANTS, ſuch medicines as add to the bulk and firmneſs of the ſolids; and ſuch are all agglutinant and aſtringent medicines. See MATERIA MEDICA, p. 649. art. 6.

STRETCHING, in navigation, is generally underſtood to imply the progreſſion of a ſhip under a great ſurface of ſail, when cloſe-hauled. The difference between this term and *ſtanding*, conſiſts apparently in the quantity of ſail; which in the latter may be very moderate; but ſtretching generally ſignifies exceſs: as, we ſaw the enemy at day break ſtretching to the ſouthward under a croud of ſail, &c. *Falconer.*

STRETTO, in Italian muſic, is ſometimes uſed to ſignify that the meaſure is to be ſhort and conciſe, and conſequently quick. In this ſenſe it ſtands oppoſed to LARGO.

Striated ‖ Strix.

STRIATED LEAF, among botaniſts, one that has a number of longitudinal furrows on its ſurface.

STRIKE, a meaſure of capacity, containing four buſhels. Alſo an inſtrument uſed in meaſuring corn.

STRIX, the OWL, in ornithology, a genus belonging to the order of *accipitres*. The bill is hooked, but has no cere or wax; the noſtrils are covered with ſetaceous feathers; the head is very large, as are alſo the ears and eyes; and the tongue is bifid. There are 46 ſpecies; the moſt remarkable are,

1. The *bubo*, or great-eared owl, in ſize is almoſt equal to an eagle. Irides bright yellow; head and whole body finely varied with lines, ſpots, and ſpecks of black, brown, cinereous, and ferruginous. Wings long; tail ſhort, marked with duſky bars. Legs thick, covered to the very end of the toes with a cloſe and full down of a teſtaceous colour. Claws great, much hooked, and duſky.—It has been ſhot in Scotland and in Yorkſhire. It inhabits inacceſſible rocks and deſert places; and preys on hares and feathered game. Its appearance in cities was deemed an unlucky omen. Rome itſelf once underwent a luſtration becauſe one of them ſtrayed into the capitol. The ancients had them in the utmoſt abhorrence; and thought them, like the ſcreech-owls, the meſſengers of death. Pliny ſtyles it *bubo funebris*, and *noctis monſtrum.*

> *Solaque culminibus* ferali *carmine* bubo
> *Sæpe queri et longas in fletum ducere voces.* VIRGIL.
>
> Perch'd on the roof, the bird of night complains,
> In lengthen'd ſhrieks and dire funereal ſtrains.

2. The *otus*, or long-eared owl, is found, though not frequently, in the north of England, in Cheſhire, and in Wales. Mr Haſſelquiſt ſaw it alive in Cairo, and it is not unfrequent all over Egypt. Its weight, according to Dr Latham, is nine ounces; the length 14 inches and a half; the breadth 34; the irides are of a bright yellow; the bill black; the breaſt and belly are of a dull yellow, marked with ſlender brown ſtrokes pointing downwards; the thighs and vent-feathers of the ſame colour, but unſpotted. The back and coverts of the wings are varied with deep brown and yellow; the quill-feathers of the ſame colour, but near the ends of the outmoſt is a broad bar of red; the tail is marked with duſky and reddiſh bars, but beneath appears aſh-coloured; the horns or ears are about an inch long, and conſiſt of ſix feathers variegated with yellow and black; the feet are feathered down to the claws.

3. The *brachyotos*, or ſhort-eared owl, is 14 inches long; three feet broad; the head is ſmall and hawk-like; the bill is duſky; weight 14 ounces; the circle of feathers that immediately ſurrounds the eyes is black; the larger circle white, terminated with tawny and black; the feathers on the head, back, and coverts of the wings, are brown, edged with pale dull yellow; the breaſt and belly are of the ſame colour marked with a few long narrow ſtreaks of brown pointing downwards; the quill-feathers, are duſky, barred with red; the tail is of a very deep brown, adorned on each ſide of the ſhaft of the four middle feathers with a yellow circle which contains a brown ſpot; the tip of the tail is white. The horns of this ſpecies are very ſmall, and each conſiſts of only a ſingle feather; theſe it can raiſe or depreſs at pleaſure; and in a dead bird are with difficulty diſcovered. This kind is ſcarcer than the former; both are ſolitary birds, avoiding inhabited places. Theſe ſpecies may be called *long-winged owls;* the wings when cloſed reaching beyond the end of the tail; whereas in the common kinds they fall ſhort of it.—This is a bird of paſſage, and has been obſervest to viſit Lincolnſhire in the beginning of October, and

to retire early in the ſpring; ſo probably, as it performs its migrations with the woodcock, its ſummer-retreat is Norway. During day it lies hid in long old glaſs; when diſturbed, it ſeldom flies far, but will light, and ſit looking at one, at which time the horns may be ſeen very diſtinctly. It has not been obſerved to perch on trees like other owls; it uſually flies in ſearch of prey in cloudy hazy weather. Farmers are fond of ſeeing theſe birds in the fields, as they clear them from mice. It is found frequently on the hill of Hoy in the Orkneys, where it flies about and preys by day like a hawk. It is found alſo, as we mentioned before, in Lancaſhire, which is a hilly and woody country; and in New England and Fewfoundland.

4. The *flammea*, or common white owl. The elegant plumage of this bird makes amends for the uncouthneſs of its form: a circle of ſoft white feathers ſurround the eyes. The upper part of the body, the coverts, and ſecondary feathers of the wings, are of a fine pale yellow: on each ſide of the ſhafts are two grey and two white ſpots placed alternate: the exterior ſides of the quill-feathers are yellow; the interior white, marked on each ſide with four black ſpots: the lower ſide of the body is wholly white; the interior ſides of the feathers of the tail are white; the exterior marked with ſome obſcure duſky bars; the legs are feathered to the feet: the feet are covered with ſhort hairs: the edge of the middle claw is ſerrated. The uſual weight is 11 ounces; its length 14 inches; its breadth 3 feet.—This ſpecies is almoſt domeſtic; inhabiting, for the greateſt part of the year, barns, hay-lofts, and other out houſes; and is as uſeful in clearing thoſe places from mice as the congenial cat: towards twilight it quits its perch, and takes a regular circuit round the fields, ſkimming along the ground in queſt of field-mice, and then returns to its uſual reſidence: in the breeding-ſeaſon it takes to the eaves of churches, holes in lofty buildings, or hollows of trees. During the time the young are in the neſt, the male and female alternately ſally out in queſt of food, make their circuit, beat the fields with the regularity of a ſpaniel, and drop inſtantly on their prey in the graſs. They very ſeldom ſtay out above five minutes; return with their prey in their claws; but as it is neceſſary to ſhift it into their bill, they always alight for that purpoſe on the roof, before they attempt to enter their neſt. This ſpecies does not hoot; but ſnores and hiſſes in a violent manner; and while it flies along will often ſcream moſt tremendouſly. Its only food is mice. As the young of theſe birds keep their neſt for a great length of time, and are fed even long after they can fly, many hundreds of mice will ſcarcely ſuffice to ſupply them with food. Owls caſt up the bones, fur, or feathers of their prey, in form of ſmall pellets, after they have devoured it, in the ſame manner as hawks do. A gentleman, on grubbing up an old pollard aſh that had been the habitation of owls for many generations, found at the bottom many buſhels of this rejected ſtuff. Some owls, when they are ſatisfied, hide the remainder of their meat like dogs.

5. The *ſtridula*, or tawny owl. The female of this ſpecies weighs 19 ounces; the length in 15 inches; the breadth 2 feet 8 inches; the irides are duſky; the ears in this, as in all owls, very large; and their ſenſe of hearing very exquiſite. The colour of this kind is ſufficient to diſtinguiſh it from every other: that of the back, head, coverts of the wings, and on the ſcapular feathers, being a fine tawny red, elegantly ſpotted and powdered with the black or duſky ſpots of various ſizes: on the coverts of the wings and on the ſcapulars are ſeveral large white ſpots: the coverts of the tail are tawny, and quite free from any marks: the tail is variouſly blotched, barred and ſpotted with pale red and black; in the two middle feathers the red predominates: the breaſt and belly are yellowiſh, mixed with white, and marked with narrow black ſtrokes pointing downwards: the legs are covered with feathers down to the toes.—This is a hardier ſpecies than the former; and the young will feed on any dead thing, whereas thoſe of the white owl muſt have a conſtant ſupply of freſh meat. It is the ſtrix of Aldrovandus, and what we call the *ſcreech-owl*; to which the folly of ſuperſtition had given the power of preſaging death by its cries. The ancients believed that it ſucked the blood of young children: a fact ſome think not incredible: for Haſſelquiſt deſcribes a ſpecies found in Syria, which frequently in the evening flies in at the windows, and deſtroys the helpleſs infant.

Nocte volant, pueroſque petunt nutricis egentes
Et vitiant cuneis corpora rapta ſuis.
Carpere dicuntur lactentia viſcera roſtris,
Et plenum poto ſanguine guttur habent.
Eſt illis ſtrigibus nomen, ſed nominis hujus
Cauſa quod horrenda ſtridere nocte ſolent. Ovid Faſt. vi. 135.

6. The *ulula*, or brown owl, agrees with the former in its marks; differing only in the colours: in this, the head, wings, and back, are of a deep brown, ſpotted with black in the ſame manner as the former: the coverts of the wings and the ſcapulars are adorned with ſimilar white ſpots: the exterior edges of the four firſt quill-feathers in both are ſerrated: the breaſt in this is of a very pale aſh-colour mixed with tawny, and marked with oblong jagged ſpots: the feet too are feathered down to the very claws: the circle round the face is aſh-coloured, ſpotted with brown.—Both theſe ſpecies inhabit woods, where they reſide the whole day: in the night they are very clamorous; and when they hoot, their throats are inflated to the ſize of an hen's egg. In the duſk they approach our dwellings; and will frequently enter pigeon-houſes, and make great havoc in them. They deſtroy numbers of little leverets, as appears by the legs frequently found in their neſts. They alſo kill abundance of moles, and ſkin them with as much dexterity as a cook does a rabbit. They build in hollow trees or ruined edifices; lay four eggs, of an elliptic form, and of a whitiſh colour.

7. The *paſſerina*, or little owl, is very rare in England; it is ſometimes found in Yorkſhire, Flintſhire, and alſo near London: in ſize it ſcarcely exceeds a thruſh, though the fulneſs of its plumage makes it appear larger: the irides are of a light yellow; the bill of a paper colour; the feathers that encircle the face are white tipt with black; the head brown, ſpotted with white; on the breaſt is a mixture of white and brown; the belly is white, marked with a few brown ſpots; the tail of the ſame colour with the back; in each feather barred with white; in each adorned with circular white ſpots, placed oppoſite to one another on both ſides of the ſhaft; the legs and feet are covered with feathers down to the claws.—The Italians make uſe of this owl to decoy ſmall birds to the limed twig; the method of which is exhibited in Olina's *Uccelliera*, p. 65. Mr Steuart, author of the Antiquities of Athens, informed Mr Pennant, that this ſpecies of owl was very common in Attica; that they were birds of paſſage, and appeared there in the beginning of April in great numbers; that they bred there; and that they retired at the ſame time as the ſtorks, whoſe arrival they a little preceded.

8. The ſpectacle owl of Cayenne, which is accurately deſcribed by Dr Latham, is 21 inches in length: the upper parts of the body are of a reddiſh colour; the lower parts

Lath. Syn. vol. vii. p. 50.

of a rufous white: the head and neck are white, and not ſo full of feathers as thoſe of owls generally are, and from this circumſtance it appears not unlike a hawk: a large patch of dark brown ſurrounds each eye, giving the bird much the appearance of wearing ſpectacles; the legs are covered with feathers quite to the toes, and are or a yellowiſh colour. A ſpecimen of this curious bird may be ſeen in the Leverian muſeum.

STROBILUS, in botany, a pericarp formed from an amentum by the hardening of the ſcales.

STROKING, or rubbing gently with the hand, a method which has been employed by ſome perſons for curing diſeaſes.

Mr Greatrakes or Greatrix, the famous Iriſh ſtroker, is ſaid to have performed many wonderful cures. He gives the following account of his diſcovery of this art, and of the ſucceſs with which he practiſed it. "About 1662 I had an impulſe (ſays he), or a ſtrange perſuaſion in my own mind (of which I am not able to give any rational account to another), which did very frequently ſuggeſt to me, that there was beſtowed on me the gift of curing the king's evil; which, for the extraordinarineſs of it, I thought fit to conceal for ſome time; but at length I communicated this to my wiſe, and told her, that I did verily believe that God had given me the bleſſing of curing the king's evil; for whether I were in private or public, ſleeping or waking, ſtill I had the ſame impulſe. But her reply to me was, that ſhe conceived this was a ſtrange imagination; yet, to prove the contrary, a few days after there was one William Mather of Salterbridge in the pariſh of Liſmore, who brought his ſon William to my houſe, deſiring my wife to cure him, who was a perſon ready to afford her charity to her neighbours, according to her ſmall ſkill in chirurgery. On which my wife told me, there was one that had the king's evil very grievouſly in the eyes, cheek, and throat; whereupon I told her, that ſhe ſhould now ſee whether this were a bare fancy or imagination, as ſhe thought it, or the dictates of God's Spirit on my heart. Then I laid my hands on the places affected, and prayed to God for Jesus' ſake to heal him; and bid the parent two or three days afterwards to bring the child to me again, which accordingly he did; and I then ſaw the eye was almoſt quite whole; and the node, which was almoſt as big as a pullet's egg, was ſuppurated; and the throat ſtrangely amended; and, to be brief (to God's glory I ſpeak it) within a month diſcharged itſelf quite, and was perfectly healed, and ſo continues, God be praiſed."

See Brief Account of Mr Valentine Greatrakes, London, 1666, 4to.

Then there came to him one Margaret Macſhane of Ballinecly, in the pariſh of Liſmore, who had been afflicted with the evil above ſeven years, in a much more violent degree; and ſoon after, his fame increaſing, he cured the ſame diſeaſe in many other perſons for three years. He did not meddle all this time with any other diſtemper; till about the end of theſe three years, the ague growing epidemical, he found, as formerly, that there was beſtowed on him the gift of curing that diſeaſe. He cured Colonel Phaire, of Cahirmony in the county of Corke, of an ague, and afterwards many other perſons of different diſtempers, by ſtroking; ſo that his name was wonderfully cried up, as if ſome divine perſon had been ſent from above. January 1665-6, he came over to England, at the requeſt of the earl of Orrery; in order to cure the lady of the lord-viſcount Conway, of Ragley in Warwickſhire, who had for many years laboured under a moſt violent head-ache. He ſtaid at Ragley three weeks or a month; and though he failed in his endeavours to relieve that lady, he cured vaſt numbers of people in thoſe parts and at Worceſter.

Though we are no friends to the marvellous, nor believe it poſſible that either the king's evil or ague can be cured by ſtroking or friction of any kind, whether gentle or ſevere, we have no heſitation to acknowledge that many cures might be performed by Mr Greatrakes. Every reflecting perſon who reads the foregoing account which he gives of himſelf will ſee that he was an enthuſiaſt, and believed himſelf guided by a particular revelation; and ſuch is the credulity of mankind, that his pretenſions were readily admitted, and men crouded with eagerneſs to be relieved of their diſeaſes. But it is well known to phyſicians, that in many caſes the imagination has accompliſhed cures as wonderful as the force of medicine. It is owing chiefly to the influence of imagination that we have ſo many accounts from people of veracity of the wonderful effects of quack medicines. We are perfectly aſſured that theſe medicines, by their natural operation, can never produce the effects aſcribed to them; for there is no kind of proportion between the medicine and the effect produced, and often no connection between the medicine and the diſeaſe.

STROMATEUS, in ichthyology, a genus of fiſhes belonging to the order of *apodes*. The head is compreſſed; the teeth are placed in the jaws and palate; the body is oval and ſlippery; and the tail is forked. There are three ſpecies according to Gmelin, the fiatola, paru, and cumarca.

STROMBOLI, the moſt northern of the Lipari iſlands. It is a volcano, which conſtantly diſcharges much fire and ſmoke. It riſes in a conical form above the ſurface of the ſea. On the eaſt ſide it has three or four little craters ranged near each other, not at the ſummit, but on the declivity, nearly at two-thirds of its height. But as the ſurface of the volcano is very rugged, and interſected with hollow ways, it may be naturally concluded, that at the time of ſome great eruption, the ſummit and a part of this ſide fell in, as muſt have happened alſo to Veſuvius; conſequently, the common chimney is at this day on the declivity, although always in the centre of the whole baſe. It is inhabited notwithſtanding its fires; but care is taken to avoid the proximity of the crater, which is yet much to be feared. "I was aſſured (ſays M. de Luc) by an Engliſhman, who, like me, had the curioſity to viſit theſe iſles, that the fine weather having invited him and his company to land at Stromboli, they aſcended a volcano, whoſe craters at that time threw out nothing; but that while they were attentively viewing them, unapprehenſive of any danger, they were ſuddenly ſaluted by ſuch a furious diſcharge, as to be obliged to retreat with precipitation, and not without one of the company being wounded by a piece of ſcoria." Of all the volcanoes recorded in hiſtory, Stromboli ſeems to be the only one that burns without ceaſing. Etna and Veſuvius often lie quiet for many months, and even years, without the leaſt appearance of fire; but Stromboli is ever at work, and for ages paſt has been looked upon as the great lighthouſe of theſe ſeas. E. Long. 15. 45. N. Lat. 30. 0.

STROMBUS, in natural hiſtory, a genus of *vermes*, belonging to the order of *teſtacea*. The animal is a limax; the ſhell is univalve and ſpiral; the opening is much dilated, and ends in a canal which turns to the left. Gmelin enumerates 53 ſpecies; of which only one is peculiar to Britain, the pes pelecani. The ſpires are ten; the lip is fingered; the point very ſharp; the length two inches.

STRONGOLI, a town of the kingdom of Naples, with a biſhop's ſee. It is ſituated on a rugged mountain, is about three miles from the ſea, and ſeven north from St Severino. It is ſuppoſed to be the ancient *Petelia*, which made a conſpicuous figure in the ſecond Punic war by its obſtinate reſiſtance againſt Hannibal. Near its walls Marcellus the rival

val of Hannibal was ſlain in a ſkirmiſh. E. Long. 17. 26. N. Lat. 39. 20.

STRONTITES, or **STRONTIAN EARTH**, a new ſpecies of earth lately diſcovered at Strontian in Scotland.

Who the diſcoverer of this earth was we have not learned; but Dr Kirwan ſays, the firſt information he received of it was from Dr Crawford in the year 1790. In the Miners' Journal for February 1791 a good deſcription of its external appearance, with ſome account of its chemical properties, was publiſhed from the obſervations of Mr Sulzer. Dr Kirwan examined it in October 1793, and found it to be a new earth between the barytic and common limeſtone. Dr Hope, who is now joint profeſſor of chemiſtry with Dr Black in the univerſity of Edinburgh, read a paper on the 4th November 1793 before the Royal Society of Edinburgh, intitled "An Account of a Mineral from Strontian, and of a peculiar Species of Earth which it contains;" an abridgment of which is publiſhed in the third volume of the Edinburgh Philoſophical Tranſactions. Mr Schmeiſſer read a paper on the ſame ſubject before the Royal Society of London in May 1794, which is publiſhed in their Tranſactions for that year, p. 418, &c.

Tranſactions of the Iriſh Academy, vol. v.

Its external characters are theſe: Its colour is whitiſh or light green; its luſtre common; its tranſparency intermediate between the ſemitranſparent and opaque; its fracture ſtriated, preſenting oblong diſtinct concretions, ſomewhat uneven and bent; its hardneſs moderate, being eaſily ſcratched, but not ſcraped. It is very brittle; and its ſpecific gravity from 3,4 to 3,644.

For a full account of its chemical qualities we muſt refer to the books already mentioned, as all the accounts of it which we have ſeen are too long to inſert here, and as we do not conſider the circumſtance of its being a newly diſcovered earth a ſufficient reaſon for running into a tedious detail till its utility be aſcertained. We ſhall, however, mention ſome of its moſt remarkable qualities. It requires 180 times its weight of water at a low temperature to diſſolve it. When diſſolved in boiling water, and allowed to cool, it depoſits tranſparent cryſtals, which when expoſed to the air become white and powdery. It is not affected by the ſulphuric acid; but when diluted, 10,000 parts of it will diſſolve one of ſtrontites. Diluted nitric acid diſſolves it rapidly. The muriatic acid, whether diluted or oxygenated, diſſolves it in a ſimilar manner.

Tranſactions of the Royal Society of Edinburgh, vol. iii.

Strontites has a ſtrong reſemblance to barytes, but eſſentially differs from it. Its ſpecific gravity is leſs; it parts with its carbonic acid when urged by heat ſomewhat more readily, and without ſuffering fuſion; when calcined, it imbibes moiſture with vaſtly greater avidity, ſwelling and cracking with more heat and noiſe. Strontites diſſolves much more abundantly in hot water than barytes; and the form of the cryſtals of theſe pure earths is very diſſimilar. The compounds generated by ſtrontites differ from thoſe of barytes. It will ſuffice to mention the nitrate and muriate. This earth, united to nitric and muriatic acid, forms ſalts that ſuffer changes from expoſure to air, which do not happen to the nitrate and muriate of barytes. They are likewiſe much more ſoluble in water, and have cryſtals of a peculiar figure. The combinations of ſtrontites with acids are not, like thoſe of barytes, decompoſed by pruſſiate of lime or of potaſh. Strontites and its compounds tinge flame, which barytes does not. Laſtly, theſe earths diſagree in the order of their attractions. From theſe conſiderations it is concluded, that the mineral is not aerated barytes.

It alſo is diſtinguiſhed from calcareous ſpar or limeſtone: for it is much heavier, and retains its fixed air with more obſtinacy in the fire. The incomparably greater ſolubility of the pure earth in hot than in cold water, and the cryſtalline form it aſſumes, ſufficiently diſtinguiſh it from lime, which the diſpoſition of the nitrate and muriate to cryſtallize no leſs tends to do.

The moſt remarkable quality of ſtrontites is that of tinging flame of a red colour. The muriate has it in the moſt eminent degree, and its effects are well exhibited by putting a portion of the ſalt on the wick of a candle, which is thereby made to burn with a very beautiful blood-red flame. The nitrate ſtands next, then cryſtallized ſtrontites, and after it the acetate. A hundred parts of ſtrontites are compoſed of 61.21 of earth, 30.20 of carbonic acid, and 8.59 of water.

STROPHE, in ancient poetry, a certain number of verſes, including a perfect ſenſe, and making the firſt part of an ode. See POETRY, n° 130.

STRUMÆ, ſcrophulous tumors ariſing on the neck and throat, conſtituting what is commonly called the *king's evil*. See MEDICINE, n° 349.

STRUMPFIA, in botany; a genus of plants belonging to the claſs of *ſyngeneſia*, and to the order of *monogamia*. The calyx is quinquedentate and ſuperior; the corolla is pentapetalous; and the berry monoſpermous. There is only one ſpecies, the maritima.

STRUTHIO, in natural hiſtory; a genus of birds belonging to the order of *grallæ* of Linnæus; but, according to the new claſſification of Dr Latham, it forms, along with the dodo, caſſuarius, and rhea, a ſeparate order under the name of *ſtruthius*. As the dodo or didus, and rhea, have been already deſcribed in their proper place, we will now give ſome account of the oſtrich and caſſowary.

Plate CCCCLXXXVI.

I. The OSTRICH (the *Camelus* of Linnæus) has a bill ſomewhat conical; the wings are ſo ſhort as to be unfit for flying; the thighs and ſides of the body are naked; the feet are formed for running, having two toes, one only of which is furniſhed with a nail. In this reſpect it differs entirely from the caſſowary, which has three toes complete. The oſtrich is without doubt the largeſt of all birds: it is nearly eight feet in length, and when ſtanding upright from ſix to eight feet in height. We are told in the Gentleman's Magazine *, that two oſtriches were ſhown in London in the year 1750, and that the male was 10 feet in height, and weighed three hundred weight and a quarter. The head and bill ſomewhat reſemble thoſe of a duck; and the neck may be likened to that of a ſwan, but that it is much longer; the legs and thighs reſemble thoſe of an hen; though the whole appearance bears a ſtrong reſemblance to that of a camel. But though uſually ſeven feet high from the top of the head to the ground, from the back it is only four; ſo that the head and neck are above three feet long. From the top of the head to the rump, when the neck is ſtretched out in a right line, it is ſix feet long, and the tail is about a foot more. One of the wings, without the feathers, is a foot and an half; and being ſtretched out, with the feathers, is three feet.

The plumage is much alike in all; that is, generally black and white; though ſome of them are ſaid to be grey. There are no feathers on the ſides, nor yet on the thighs, nor under the wings. The lower part of the neck, about half way, is covered with ſtill ſmaller feathers than thoſe on the belly and back; and thoſe alſo are of different colours.

All theſe feathers are of the ſame kind, and peculiar to the oſtrich; for other birds have ſeveral ſorts, ſome of which are ſoft and downy, and others hard and ſtrong. Oſtrich-feathers are almoſt all as ſoft as down, being utterly unfit to ſerve the animal for flying, and ſtill leſs adapted to be a proper defence againſt external injury. The feathers of

* Vol. xx. p. 536.

of other birds have the webs broader on one ſide than the other, but thoſe of the oſtrich have their ſhaft exactly in the middle. The upper part of the head and neck are covered with a very fine clear white hair, that ſhines like the briſtles of a hog; and in ſome places there are ſmall tufts of it, conſiſting of about 12 hairs, which grow from a ſingle ſhaft about the thickneſs of a pin.

At the end of each wing there is a kind of ſpur almoſt like the quill of a porcupine. It is an inch long, being hollow and of an horny ſubſtance. There are two of theſe on each wing; the largeſt of which is at the extremity of the bone of the wing, and the other a foot lower. The neck ſeems to be more ſlender in proportion to that of other birds, from its not being furniſhed with feathers. The ſkin in this part is of a livid fleſh-colour, which ſome, improperly, would have to be blue. The bill is ſhort and pointed, and two inches and an half at the beginning. The external form of the eye is like that of a man, the upper eye-lid being adorned with eye-laſhes which are longer than thoſe on the lid below. The tongue is ſmall, very ſhort and compoſed of cartilages, ligaments, and membranes, intermixed with fleſhy fibres. In ſome it is about an inch long, and very thick at the bottom; in others it is but half an inch, being a little forked at the end.

The thighs are very fleſhy and large, being covered with a white ſkin inclining to redneſs, and wrinkled in the manner of a net, whoſe meſhes will admit the end of the finger. Some have very ſmall feathers here and there on the thighs; and others again have neither feathers nor wrinkles. What are called the legs of birds, in this are covered before with large ſcales. The end of the foot is cloven, and has two very large toes, which, like the leg, are covered with ſcales. Theſe toes are of unequal ſizes. The largeſt, which is on the inſide, is ſeven inches long, including the claw, which is near three-fourths of an inch in length, and almoſt as broad. The other toe is but four inches long, and is without a claw.

The internal parts of this animal are formed with no leſs ſurpriſing peculiarity. At the top of the breaſt, under the ſkin, the fat is two inches thick; and on the fore-part of the belly it is as hard as ſuet, and about two inches and an half thick in ſome places. It has two diſtinct ſtomachs. The firſt, which is lowermoſt, in its natural ſituation ſomewhat reſembles the crop in other birds; but it is conſiderably larger than the other ſtomach, and is furniſhed with ſtrong muſcular fibres, as well circular as longitudinal. The ſecond ſtomach or gizzard has outwardly the ſhape of the ſtomach of a man; and upon opening is always found filled with a variety of diſcordant ſubſtances; hay, graſs, barley, beans, bones, and ſtones, ſome of which exceed in ſize a pullet's egg. The kidneys are eight inches long and two broad, and differ from thoſe of other birds in not being divided into lobes. The heart and lungs are ſeparated by a midriff as in quadrupeds; and the parts of generation alſo bear a very ſtrong reſemblance and analogy.

The oſtrich is a native only of the torrid regions of Africa, and has long been celebrated by thoſe who have had occaſion to mention the animals of that region. Its fleſh is proſcribed in Scripture as unfit to be eaten; and moſt of the ancient writers deſcribe it as well known in their times. Like the race of the elephant, it is tranſmitted down without mixture; and has never been known to breed out of that country which firſt produced it. It ſeems formed to live among the ſandy and burning deſerts of the torrid zone; and, as in ſome meaſure it owes its birth to their genial influence, ſo it ſeldom migrates into tracts more mild or more fertile. The Arabians aſſert that the oſtrich never drinks; and the place of its habitation ſeems to confirm the aſſertion. In theſe formidable regions oſtriches are ſeen in large flocks, which to the diſtant ſpectator appear like a regiment of cavalry, and have often alarmed a whole caravan. There is no deſert, how barren ſoever, but what is capable of ſupplying theſe animals with proviſion; they eat almoſt every thing; and theſe barren tracts are thus doubly grateful, as they afford both food and ſecurity. The oſtrich is of all other animals the moſt voracious. It will devour leather, graſs, hair, iron, ſtones, or any thing that is given. Thoſe ſubſtances which the coats of the ſtomach cannot ſoften, paſs whole; ſo that glaſs, ſtones, or iron, are excluded in the form in which they were devoured. In an oſtrich diſſected by Ranby, there appeared ſuch a quantity of heterogeneous ſubſtances, that it was wonderful how any animal could digeſt ſuch an overcharge of nouriſhment. Valiſnieri alſo found the firſt ſtomach filled with a quantity of incongruous ſubſtances; graſs, nuts, cords, ſtones, glaſs, braſs, copper, iron, tin, lead, and wood; a piece of ſtone was found among the reſt that weighed more than a pound. He ſaw one of theſe animals that was killed by devouring a quantity of quicklime. It would ſeem that the oſtrich is obliged to fill up the great capacity of its ſtomach in order to be at eaſe; but that nutritious ſubſtances not occurring, it pours in whatever offers to ſupply the void.

In their native deſerts, however, it is probable they live chiefly upon vegetables, where they lead an inoffenſive and ſocial life; the male, as Thevenot aſſures us, aſſorting with the female with connubial fidelity. They are ſaid to be very much inclined to venery; and the make of the parts in both ſexes ſeem to confirm the report. It is probable alſo they copulate like other birds, by compreſſion. They lay very large eggs, ſome of them being above five inches in diameter, and weighing above fifteen pounds. Theſe eggs have a very hard ſhell, ſomewhat reſembling thoſe of the crocodile, except that thoſe of the latter are leſs and rounder.

The ſeaſon for laying depends on the climate where the animal is bred. In the northern parts of Africa, this ſeaſon is about the beginning of July; in the ſouth, it is about the latter end of December. Theſe birds are very prolific, and lay generally from 40 to 50 eggs at one clutch, which are as big as a child's head. It has been commonly reported, that the female depoſits them in the ſand, and covering them up, leaves them to be hatched by the heat of the climate, and then permits the young to ſhift for themſelves. Very little of this, however, is true: no bird has a ſtronger affection for her young than the oſtrich, nor none watches her eggs with greater aſſiduity. It happens, indeed, in thoſe hot climates, that there is leſs neceſſity for the continual incubation of the female; and ſhe more frequently leaves her eggs, which are in no danger of being chilled by the weather: but though ſhe ſometimes forſakes them by day, ſhe always carefully broods over them by night; and Kolben, who has ſeen great numbers of them at the Cape of Good Hope, affirms, that they ſit on their eggs like other birds, and that the male and the female take this office by turns, as he had frequent opportunities of obſerving. Nor is it more true what is ſaid of their forſaking their young after they are excluded the ſhell. On the contrary, the young ones are not even able to walk for ſeveral days after they are hatched. During this time the old ones are very aſſiduous in ſupplying them with graſs, and very careful to defend them from danger; nay, they encounter every danger in their defence. The young, when brought forth, are of an aſh-colour the firſt year, and are covered with feathers all over. But in time theſe feathers drop; and thoſe parts which are covered aſſume a different and more becoming plumage.

The beauty of a part of this plumage, particularly the long feathers that compoſe the wings and tail, is the chief reaſon that man has been ſo active in purſuing this harmleſs bird to its deſerts, and hunting it with no ſmall degree of expence and labour. The ancients uſed thoſe plumes in their helmets; our military wear them in their hats; and the ladies make them an ornament in their dreſs. Thoſe feathers which are plucked from the animal while alive are much more valued than thoſe taken when dead, the latter being dry, light, and ſubject to be worm-eaten.

Beſide the value of their plumage, ſome of the ſavage nations of Africa hunt them alſo for their fleſh; which they conſider as a dainty. They ſometimes alſo breed theſe birds tame, to eat the young ones, of which the females are ſaid to be the greateſt delicacy. Some nations have obtained the name of *Struthophagi*, or *oſtrich eaters*, from their peculiar fondneſs for this food; and even the Romans themſelves were not averſe to it. Even among the Europeans now, the eggs of the oſtrich are ſaid to the well taſted, and extremely nouriſhing; but they are too ſcarce to be fed upon, although a ſingle egg be a ſufficient entertainment for eight men.

As the ſpoils of the oſtrich are thus valuable, it is not to be wondered at that man has become their moſt aſſiduous purſuer. For this purpoſe, the Arabians train up their beſt and fleeteſt horſes, and hunt the oſtrich ſtill in view. Perhaps, of all other varieties of the chaſe, this, though the moſt laborious, is yet the moſt entertaining. As ſoon as the hunter comes within ſight of his prey, he puts on his horſe with a gentle gallop, ſo as to keep the oſtrich ſtill in ſight; yet not ſo as to terrify him from the plain into the mountains. Of all known animals, the oſtrich is by far the ſwifteſt in running; upon obſerving himſelf, therefore, purſued at a diſtance, he begins to run at firſt but gently; either inſenſible of his danger, or ſure of eſcaping. In this ſituation, he ſomewhat reſembles a man at full ſpeed; his wings, like two arms, keep working with a motion correſpondent to that of his legs; and his ſpeed would very ſoon ſnatch him from the view of his purſuers; but, unfortunately for the ſilly creature, inſtead of going off in a direct line, he takes his courſe in circles; while the hunters ſtill make a ſmall courſe within, relieve each other, meet him at unexpected turns, and keep him thus ſtill employed, ſtill followed, for two or three days together. At laſt, ſpent with fatigue and famine, and finding all power of eſcape impoſſible, he endeavours to hide himſelf from thoſe enemies he cannot avoid, and covers his head in the ſand or the firſt thicket he meets. Sometimes, however, he attempts to face his purſuers; and though in general the moſt gentle animal in nature, when driven to deſperation he defends himſelf with his beak, his wings, and his feet. Such is the force of his motion, that a man would be utterly unable to withſtand him in the ſhock.

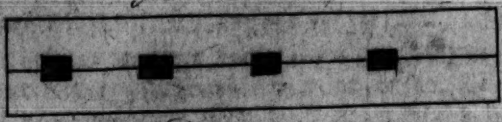
The Struthophagi have another method of taking this bird: they cover themſelves with an oſtrich's ſkin, and paſſing up an arm though the neck, thus counterfeit all the motions of this animal. By this artifice they approach the oſtrich, which becomes an eaſy prey. He is ſometimes alſo taken by dogs and nets; but the moſt uſual way is that mentioned above.

When the Arabians have thus taken an oſtrich, they cut its throat; and making a ligament below the opening, they ſhake the bird as one would rinſe a barrel; then taking off the ligature, there runs out from the wound in the throat a conſiderable quantity of blood mixed with the fat of the animal; and this is conſidered as one of their greateſt dainties. They next flea the bird; and of the ſkin, which is ſtrong and thick, ſometimes make a kind of veſt, which anſwers the purpoſes of a cuiraſs and a buckler.

There are others who, more compaſſionate or more provident, do not kill their captive, but endeavour to tame it, for the purpoſes of ſupplying thoſe feathers which are in ſo great requeſt. The inhabitants of Dara and Lybia breed up whole flocks of them, and they are tamed with very little trouble. But it is not for their feathers alone that they are prized in this domeſtic ſtate; they are often ridden upon and uſed as horſes. Moore aſſures us, that at Joar he ſaw a man travelling upon an oſtrich; and Adanſon aſſerts, that at the factory of Podore he had two oſtriches, which were then young, the ſtrongeſt of which ran ſwifter than the beſt Engliſh racer, although he carried two negroes on his back. As ſoon as the animal perceived that it was thus loaded, it ſet off running with all its force, and made ſeveral circuits round the village; till at length the people were obliged to ſtop it by barring up the way. How far this ſtrength and ſwiftneſs may be uſeful to mankind, even in a poliſhed ſtate, is a matter that perhaps deſerves inquiry.

II. The Cassowary (the *Caſuarius* of Linnæus, and *Galeated Caſſowary* of Dr Latham) was firſt brought into Europe from Java by the Dutch about the year 1597. It is nearly equal in ſize to the oſtrich, but its legs are much thicker and ſtronger in proportion. This conformation gives it an air of ſtrength and force, which the fierceneſs and ſingularity of its countenance conſpire to render formidable. It is five feet and an half long from the point of the bill to the extremity of the claws. The legs are two feet and an half high from the belly to the end of the claws. The head and neck together are a foot and an half; and the largeſt toe, including the claw, is five inches long. The claw alone of the leaſt toe is three inches and a half in length. The wing is ſo ſmall that it does not appear, it being hid under the feathers of the back. In other birds, a part of the feathers ſerve for flight, and are different from thoſe that ſerve merely for covering; but in the caſſowary all the feathers are of the ſame kind, and outwardly of the ſame colour. They are generally double, having two long ſhafts, which grow out of a ſhort one, which is fixed in the ſkin. Thoſe that are double are always of an unequal length; for ſome are 14 inches long, particularly on the rump, while others are not above three. The beards that adorn the ſtem or ſhaft are about half-way to the end, very long, and as thick as an horſe-hair, without being ſubdivided into fibres. The ſtem or ſhaft is flat, ſhining, black, and knotted below; and from each knot there proceeds a beard; likewiſe the beards at the end of the large feathers are perfectly black, and towards the root of a grey tawny colour; ſhorter, more ſoft, and throwing out fine fibres like down; ſo that nothing appears except the ends, which are hard and black; becauſe the other part, compoſed of down, is quite covered. There are faethers on the head and neck; but they are ſo ſhort and thinly ſown, that the bird's ſkin appears naked, except towards the hidder part of the head, where they are a little longer. The feathers which adorn the rump are extremely thick; but do not differ in other reſpects from the reſt, excepting their being longer. The wings, when they are deprived of their feathers, are but three inches long; and the feathers are like thoſe on other parts of the body. The ends of the wings are adorned with five prickles, of different lengths and thickneſs, which bend like a bow: theſe are hollow from the roots to the very points, having only that ſlight ſubſtance within which all quills are known to have. The longeſt of theſe prickles is 11 inches; and it is a quarter of an inch in diameter at the root, being thicker there than towards the extremity; the point ſeems broken off.

Fig. 9. No. 1.



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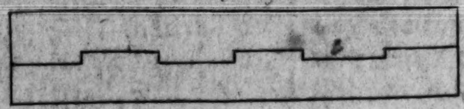

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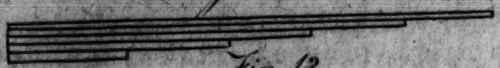

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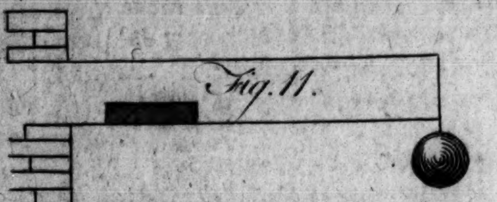

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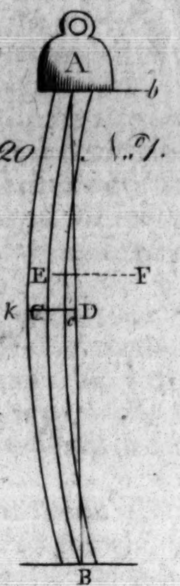

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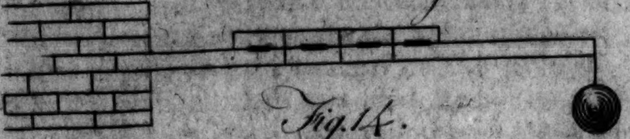

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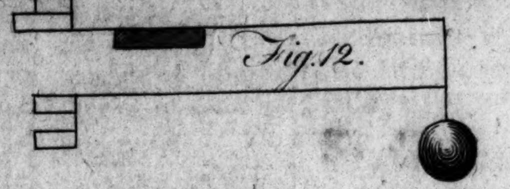

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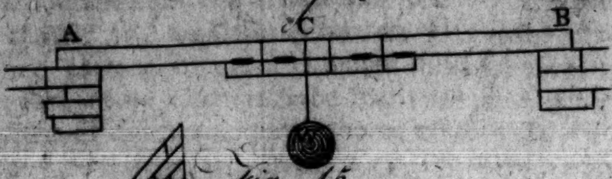

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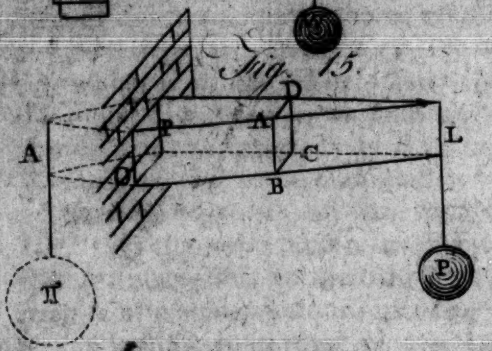
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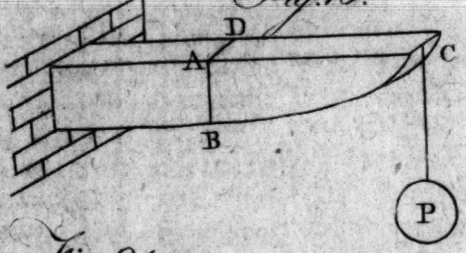
Fig. 16.



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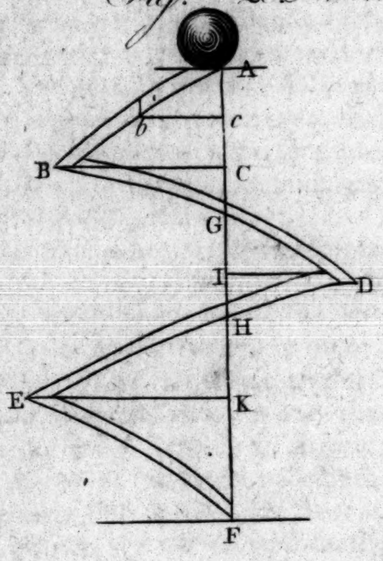
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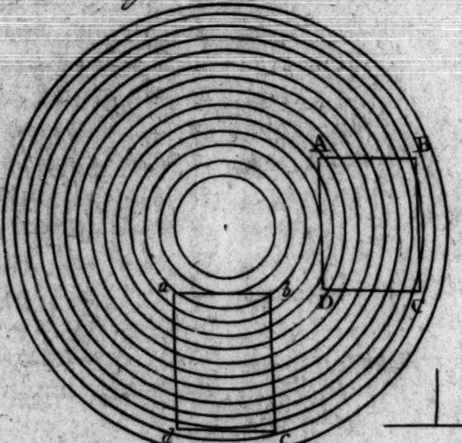
Fig. 21.



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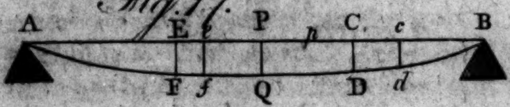
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Fig. 18.

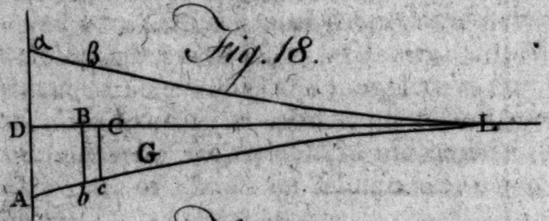
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Fig. 23.

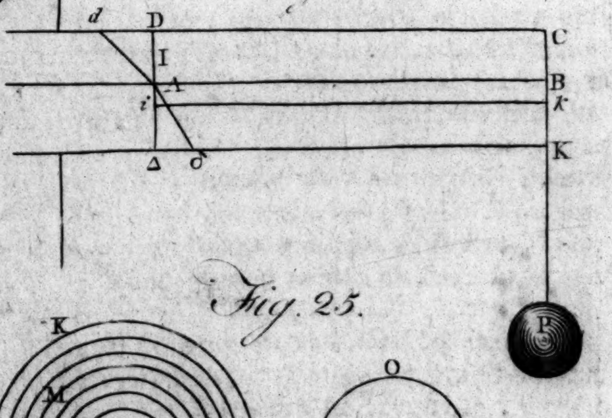
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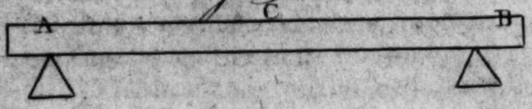
Fig. 19.



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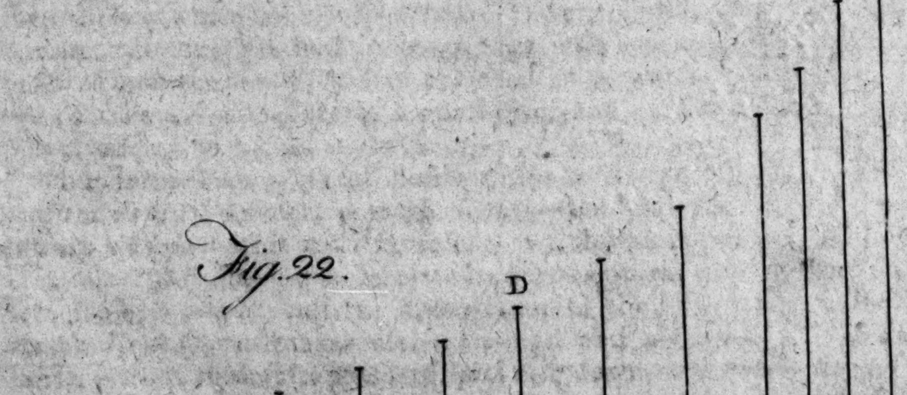

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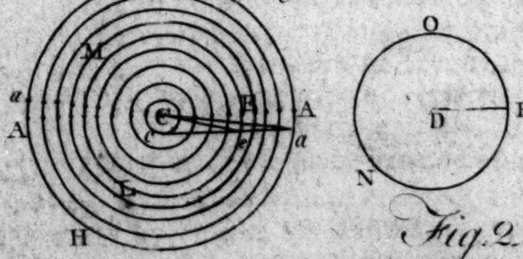
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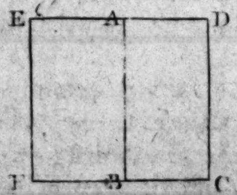
Fig. 24.



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The part, however, which moſt diſtinguiſhes this animal is the head; which, though ſmall, like that of an oſtrich, does not fail to inſpire ſome degree of terror. It is bare of feathers, and is in a manner armed with an helmet of horny ſubſtance, that covers it from the root of the bill to near half the head backwards. This helmet is black before and yellow behind. Its ſubſtance is very hard, being formed by the elevation of the bone of the ſkull; and it conſiſts of ſeveral plates, one over another, like the horn of an ox. Some have ſuppoſed that this was ſhed every year with the feathers; but the moſt probable opinion is, that it only exfoliates ſlowly like the beak. To the peculiar oddity of this natural armour may be added the colour of the eye in this animal, which is a bright yellow; and the globe being above an inch and a half in diameter, give it an air equally fierce and extraordinary. The hole of the ear is very large and open, being only covered with ſmall black feathers. The ſides of the head, about the eye and ear, being deſtitute of any covering, are blue, except the middle of the lower eyelid, which is white. The part of the bill which anſwers to the upper jaw in other animals is very hard at the edges above, and the extremity of it is like that of a turkey-cock. The end of the lower mandible is ſlightly notched, and the whole is of a greyiſh brown, except a green ſpot on each ſide. As the beak admits a very wide opening, this contributes not a little to the bird's menacing appearance. The neck is of a violet colour, inclining to that of ſlate; and it is red behind in ſeveral places, but chiefly in the middle. About the middle of the neck before, at the riſe of the large feathers, there are two proceſſes formed by the ſkin, which reſemble ſomewhat the gills of a cock, but that they are blue as well as red. The ſkin which covers the forepart of the breaſt, on which this bird leans and reſts, is hard, callous, and without feathers. The thighs and legs are covered with feathers, and are extremely thick, ſtrong, ſtraight, and covered with ſcales of ſeveral ſhapes; but the legs are thicker a little above the foot than in any other place. The toes are likewiſe covered with ſcales, and are but three in number; for that which ſhould be behind is wanting. The claws are of a hard ſolid ſubſtance, black without and white within.

The internal parts are equally remarkable. The caſſowary unites with the double ſtomach of animals that live upon vegetables the ſhort inteſtines of thoſe that live upon fleſh. The inteſtines of the caſſowary are 13 times ſhorter than thoſe of the oſtrich. The heart is very ſmall, being but an inch and an half long, and an inch broad at the baſe. Upon the whole, it has the head of a warrior, the eye of a lion, the defence of a porcupine, and the ſwiftneſs of a courſer.

Thus formed for a life of hoſtility, for terrifying others, and for its own defence, it might be expected that the caſſowary was one of the moſt fierce and terrible animals of the creation. But nothing is ſo oppoſite to its natural character: it never attacks others; and inſtead of the bill, when attacked, it rather makes uſe of its legs, and kicks like a horſe, or runs againſt its purſuer, beats him down, and treads him to the ground.

The manner in which this animal moves is not leſs extraordinary than its appearance. Inſtead of going directly forward, it ſeems to kick up behind with one leg; and then making a bound onward with the other, it goes with ſuch prodigious velocity, that the ſwifteſt racer would be left far behind.

The ſame degree of voraciouſneſs which we perceived in the oſtrich obtains as ſtrongly here. The caſſowary ſwallows every thing that comes within the capacity of its gullet. The Dutch aſſert, that it can devour not only glaſs, iron, and ſtones, but even live and burning coals, without teſtifying the ſmalleſt fear or feeling the leaſt injury. It is ſaid, that the paſſage of the food through its gullet is performed ſo ſpeedily, that even the very eggs which it has ſwallowed whole paſs through it unbroken in the ſame form they went down. In fact, the alimentary canal of this animal, as was obſerved above, is extremely ſhort; and it may happen, that many kinds of food are indigeſtible in its ſtomach, as wheat or currants are to man, when ſwallowed whole.

The caſſowary's eggs are of a grey-aſh colour, inclining to green. They are not ſo large nor ſo round as thoſe of the oſtrich. They are marked with a number of little tubercles of a deep green, and the ſhell is not very thick. The largeſt of theſe is found to be 15 inches round one way, and about 12 the other.

The ſouthern parts of the moſt eaſtern Indies ſeem to be the natural climate of the caſſowary. His domain, if we may ſo call it, begins where that of the oſtrich terminates. The latter has never been found beyond the Ganges; while the caſſowary is never ſeen nearer than the iſlands of Banda, Sumatra, Java, the Molucca iſlands, and the correſponding parts of the continent. Yet even here this animal ſeems not to have multiplied in any conſiderable degree, as we find one of the kings of Java making a preſent of one of theſe birds to the captain of a Dutch ſhip, conſidering it as a very great rarity.

Governor Phillip's Voyage to Botany Bay.

2. The *Caſuarius Novæ Hollandiæ*, or New Holland caſſowary, differs conſiderably from the common caſſowary. It is a much larger bird, ſtanding higher on its legs, and having the neck longer than in the common one. Total length ſeven feet two inches. The bill is not greatly different from that of the common caſſowary; but the horny appendage or helmet on the top of the head in this ſpecies is totally wanting: the whole of the head and neck is alſo covered with feathers, except the throat and fore part of the neck about half way, which are not ſo well feathered as the reſt; whereas in the common caſſowary the head and neck are bare and carunculated as in the turkey.

The plumage in general conſiſts of a mixture of brown and grey, and the feathers are ſomewhat curled or bent at the ends in the natural ſtate: the wings are ſo very ſhort as to be totally uſeleſs for flight, and indeed are ſcarcely to be diſtinguiſhed from the reſt of the plumage, were it not for their ſtanding out a little. The long ſpines which are ſeen in the wings of the common ſort are in this not obſervable, nor is there any appearance of a tail. The legs are ſtout, formed much as in the galeated caſſowary, with the addition of their being jagged or ſawed the whole of their length at the back part.

This bird is not uncommon in New Holland, as ſeveral of them have been ſeen about Botany Bay and other parts. Although it cannot fly, it runs ſo ſwiftly, that a greyhound can ſcarcely overtake it. The fleſh is ſaid to be in taſte not unlike beef.

STRUTHIOLA, in botany; a genus of plants belonging to the claſs of *tetrandria*, and order of *monogynia*. The corolla is wanting; the calyx is tubulous, with eight glandules at its mouth; the berry is without juice, and monoſpermous. The ſpecies are three, the virgata, erecta, and nana, all of foreign extraction.

STRYCHNOS, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *monogynia*; and in the natural ſyſtem ranging under the 28th order, *Luridæ*. The corolla is quinquefid; the berry is unilocular, with a woody bark. The ſpecies are three, the nux vomica, colubrina, and potatorum, natives of foreign countries.

STRYMON (anc. geog.), formerly *Conozus*; a river con-

Strype, Stuart.

ſtituting the ancient limits of Macedonia and Thrace; riſing in mount Scombrus (Ariſtotle). Authors differ as to the modern name of this river.

STRYPE (John), was deſcended from a German family, born at London, and educated at Cambridge. He was vicar of Low Layton in Eſſex, and diſtinguiſhed himſelf by his compilations of Lives and Memoirs; in which, as Dr Birch remarks, his fidelity and induſtry will always give a value to his writings, however deſtitute they may be of the graces of ſtyle. He died in 1737, after having enjoyed his vicarage near 68 years.

STUART (Dr Gilbert), was born at Edinburgh in the year 1742. His father Mr George Stuart was profeſſor of humanity in the univerſity, and a man of conſiderable eminence for his claſſical taſte and literature. For theſe accompliſhments he was probably indebted in no ſmall degree to his relation the celebrated Ruddiman, with whom both he and his ſon converſed familiarly though they afterwards united to injure his fame.

Gilbert having finiſhed his claſſical and philoſophical ſtudies in the grammar ſchool and univerſity, applied himſelf to juriſprudence, without following or probably intending to follow the profeſſion of the law. For that profeſſion he has been repreſented as unqualified by indolence; by a paſſion which at a very early period of life he diſplayed for general literature; or by boundleſs diſſipation:—and all theſe circumſtances may have contributed to make him relinquiſh purſuits in which he could hope to ſucceed only by patient perſeverance and ſtrict decorum of manners. That he did not waſte his youth in idleneſs, is, however, evident from An Hiſtorical Diſſertation concerning the Antiquity of the Britiſh Conſtitution, which he publiſhed before he had completed his twenty-ſecond year, and which had ſo much merit as to induce the univerſity of Edinburgh to confer upon the author, though ſo young a man, the degree of LL.D.

After a ſtudious interval of ſome years, he produced a valuable work, under the title of A View of Society in Europe, in its Progreſs from Rudeneſs to Refinement; or, Inquiries concerning the Hiſtory of Laws, Government, and Manners. He had read and meditated with patience on the moſt important monuments of the middle ages; and in this volume (which ſpeedily reached a ſecond edition) he aimed chiefly at the praiſe of originality and invention, and diſcovered an induſtry that is ſeldom connected with ability and diſcernment. About the time of the publication of the firſt edition of this performance, having turned his thoughts to an academical life, he aſked for the profeſſorſhip of public law in the univerſity of Edinburgh. According to his own account he had been promiſed that place by the miniſter, but had the mortification to ſee the profeſſorſhip beſtowed on another, and all his hopes blaſted by the influence of Dr Robertſon, whom he repreſented as under obligations to him.

To the writer of this article, who was a ſtranger to theſe rival candidates for hiſtorical fame, this part of the ſtory ſeems very incredible; as it is not eaſy to conceive how it ever could be in the power of Dr Stuart to render to the learned Principal any eſſential ſervice. It was believed indeed by the earl of Buchan, and by others, who obſerved that the illiberal jealouſy not unfrequent in the world of letters, was probably the ſource of this oppoſition; which entirely broke the intimacy of two perſons who, before that time, were underſtood to be on the moſt friendly footing with each other. Ingratitude, however, is as likely to have been the vice of Dr Stuart as of Dr Robertſon; for we have been told by a writer,* who, at leaſt in one inſtance, has completely proved what he affirms, that "ſuch was Gilbert Stuart's laxity of principle as a man, that he conſidered ingratitude as one of the moſt venial ſins; ſuch was his conceit as a writer, that he regarded no one's merits but his own; ſuch were his diſappointments, both as a writer and a man, that he allowed his peeviſhneſs to ſour into malice, and indulged his malevolence till it ſettled in corruption."

Stuart, Stucco.

Soon after this diſappointment Dr Stuart went to London, where he became from 1768 to 1774 one of the writers of the Monthly Review. In 1772 Dr Adam, rector of the high ſchool at Edinburgh, publiſhed a Latin Grammar, which he intended as an improvement of the famous Ruddiman's. Stuart attacked him in a pamphlet under the name of *Buſhby*, and treated him with much ſeverity. In doing this, he was probably actuated more by ſome perſonal diſlike of Dr Adam than by regard for the memory of his learned relation; for on other occaſions he ſhowed ſufficiently that he had no regard to Ruddiman's honour as a grammarian, editor, or critic.

In 1774 he returned to his native city, and began the Edinburgh Magazine and Review, in which he diſcuſſed the liberty and conſtitution of England, and diſtinguiſhed himſelf by an inquiry into the character of John Knox the reformer, whoſe principles he reprobated in the ſevereſt terms. About this time he reviſed and publiſhed Sullivan's Lectures on the Conſtitution of England. Soon after he turned his thoughts to the hiſtory of Scotland, and publiſhed Obſervations concerning its Public Law and Conſtitutional Hiſtory; in which he examined with a critical care the preliminary book to Dr Robertſon's Hiſtory. His next work was The Hiſtory of the Reformation; a book which deſerves praiſe for the eaſy dignity of the narrative, and for ſtrict impartiality. His laſt great work, The Hiſtory of Scotland from the Eſtabliſhment of the Reformation to the Death of Queen Mary, which appeared in 1782, has been very generally read and admired. His purpoſe was to vindicate the character of the injured queen, and expoſe the weakneſs of the arguments by which Dr Robertſon had endeavoured to prove her guilty: but though the ſtyle of this work is his own, it contains very little matter which was not furniſhed by Goodall and Tytler; and it is with the arms which theſe two writers put into his hands that Dr Stuart vanquiſhed his great antagoniſt.

In 1782 he once more viſited London, and engaged in the Political Herald and Engliſh Review; but the jaundice and dropſy increaſing on him, he returned by ſea to his native country, where he died in the houſe of his father on the 13th of Auguſt 1786.

In his perſon Dr Stuart was about the middle ſize and juſtly proportioned. His countenance was modeſt and expreſſive, ſometimes glowing with ſentiments of friendſhip, of which he was truly ſuſceptible, and at others darting that ſatire and indignation at folly and vice which appear in ſome of his writings. He was a boon companion; and, with a conſtitution that might have ſtood the ſhock of ages, he fell a premature martyr to intemperance. His talents were certainly great, and his writings are uſeful; but he ſeems to have been influenced more by paſſion than prejudice, and in his character there was not much to be imitated.

STUCCO, in building a compoſition of white marble pulveriſed, and mixed with plaſter of lime; and the whole being ſifted and wrought up with water, is to be uſed like common plaſter: this is called by Pliny *marmoratum opus* and *albarium opus*.

A patent has been granted to Mr B. Higgins for inventing a new kind of ſtucco, or water-cement, more firm and durable than any heretofore. Its compoſition, as extracted from the ſpecification ſigned by himſelf, is as follows: "Drift-ſand, or quarry (A) ſand, which conſiſts chiefly of hard quartoſe flat-faced grains with ſharp angles; which is the freeſt, or may be moſt eaſily freed by waſhing, from clay, ſalts, and calcareous, gypſeous, or other grains leſs hard and durable than quartz; which contains the ſmalleſt quantity of pyrites or heavy metallic matter inſeparable by waſhing; and which ſuffers the ſmalleſt diminution of its bulk in waſhing in the following manner—is to be preferred before any other. And where a coarſe and a fine ſand of this kind, and correſponding in the ſize of their grains with the coarſe and fine ſands hereafter deſcribed, cannot be eaſily procured, let ſuch ſand of the foregoing quality be choſen as may be ſorted and cleanſed in the following manner:

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* Chalmers in his life of Ruddiman.

"Let the ſand be ſifted in ſtreaming clear water, thro' a ſieve which ſhall give paſſage to all ſuch grains as do not exceed one-ſixteenth of an inch in diameter; and let the ſtream of water and the ſifting be regulated ſo that all the ſand, which is much finer than the Lynn-ſand commonly uſed in the London glaſs-houſes, together with clay and every other matter ſpecifically lighter than ſand, may be waſhed away with the ſtream, whilſt the purer and coarſer ſand, which paſſes through the ſieve, ſubſides in a convenient receptacle, and whilſt the coarſe rubbiſh and rubble remain on the ſieve to be rejected.

"Let the ſand which thus ſubſides in the receptacle be waſhed in clean ſtreaming water through a finer ſieve, ſo as to be further cleanſed and ſorted into two parcels; a coarſer, which will remain in the ſieve which is to give paſſage to ſuch grains of ſand only as are leſs than one-thirtieth of an inch in diameter, and which is to be ſaved apart under the name of *coarſe ſand*; and a finer, which will paſs thro' the ſieve and ſubſide in the water, and which is to be ſaved apart under the name of *fine ſand*.—Let the coarſe and the fine ſand be dried ſeparately, either in the ſun or on a clean iron-plate, ſet on a convenient ſurface, in the manner of a ſand-heat (B).

"Let lime be choſen (C) which is ſtone-lime, which heats the moſt in ſlaking, and ſlakes the quickeſt when duly watered; which is the freſheſt made and cloſeſt kept; which diſſolves in diſtilled vinegar with the leaſt efferveſcence, and leaves the ſmalleſt reſidue inſoluble, and in this reſidue the ſmalleſt quantity of clay, gypſum, or martial matter.

"Let the lime choſen according to theſe important rules be put in a braſs-wired ſieve to the quantity of 14 pounds. Let the ſieve be finer than either of the foregoing; the finer, the better it will be: let the lime be ſlaked (D) by plunging it in a butt filled with ſoft water, and raiſing it out quickly and ſuffering it to heat and fume, and by repeating this plunging and raiſing alternately, and agitating the lime, until it be made to paſs through the ſieve into the water; and let the part of the lime which does not eaſily paſs through the ſieve be rejected: and let freſh portions of the lime be thus uſed, until as many (E) ounces of lime have paſſed through the ſieve as there are quarts of water in the butt. Let the water thus impregnated ſtand in the butt cloſely covered (F) until it becomes clear; and through wooden (G) cocks placed at different heights in the butt, let the clear liquor be drawn off as faſt (H) and as low as the lime ſubſides, for uſe. This clear liquor I call the *cementing liquor* (I). The freer the water is from ſaline matter, the better will be the cementing liquor made with it.

(A) "This is commonly called *pit-ſand*.

(B) "The ſand ought to be ſtirred up continually until it is dried, and is then to be taken off; for otherwiſe the evaporation will be very ſlow, and the ſand which lies next the iron plate, by being overheated, will be diſcoloured.

(C) "The perference given to ſtone-lime is founded on the preſent practice in the burning of lime, and on the cloſer texture of it, which prevents it from being ſo ſoon injured by expoſure to the air as the more ſpongy chalk-lime is; not on the popular notion that ſtone-lime has ſomething in it whereby it excels the beſt chalk in the cementing properties. The gypſum contained in lime-ſtone remains unaltered, or very little altered, in the lime, after the burning; but it is not to be expected that clay or martial matter ſhould be found in their native ſtate in well-burned lime; for they concrete or vitrify with a part of the calcareous earth, and conſtitute the hard grains or lumps which remain undiſſolved in weak acids, or are ſeparable from the ſlaked lime by ſifting it immediately through a ſieve.

(D) "This method of impregnating the water with lime is not the only one which may be adopted. It is, however, preferred before others, becauſe the water clears the ſooner in conſequence of its being warmed by the ſlaking lime; and the gypſeous part of the lime does not diffuſe itſelf in the water ſo freely in this way as it does when the lime is ſlaked to fine powder in the common method, and is then blended with the water; for the gypſeous part of the lime ſlakes at firſt into grains rather than into fine powder, and will remain on the ſieve after the pure lime has paſſed through, long enough to admit of the intended ſeparation; but when the lime is otherwiſe ſlaked, the gypſeous grains have time to ſlake to a finer powder, and paſſing through the ſieve, diſſolve in the water along with the lime. I have imagined that other advantages attended this method of preparing the lime-water, but I cannot yet ſpeak of them with preciſion.

(E) "If the water contains no more acidulous gas than is uſually found in river or rain water, a fourth part of this quantity of lime, or leſs, will be ſufficient.

(F) "The calcareous cruſt which forms on the ſurface of the water ought not to be broke, for it aſſiſts in excluding the air, and preventing the abſorption of acidulous gas whereby the lime-water is ſpoiled.

(G) "Braſs-cocks are apt to colour a part of the liquor.

(H) "Lime-water cannot be kept many days unimpaired, in any veſſels that are not perfectly air-tight. If the liquor be drawn off before it clears, it will contain whiting, which is injurious; and if it be not inſtantly uſed after it is drawn limpid from the butt into open veſſels, it will grow turbid again, and depoſite the lime changed to whiting by the gas abſorbed from the air. The calcareous matter which ſubſides in the butt reſembles whiting the more nearly as the lime has been more ſparingly employed; in the contrary circumſtances, it approaches to the nature of lime; and in the intermediate ſtate, it is fit for the common compoſition of the plaſterers for inſide ſtucco.

(I) "At the time of writing this ſpecification, I preferred this term before that of lime-water, on grounds which I had not ſufficiently examined.

“ Let 56 pounds of the aforeſaid choſen lime be ſlaked, by gradually ſprinkling on it, and eſpecially on the unſlaked pieces, the cementing liquor, in a cloſe (K) clean place. Let the ſlaked part be immediately (L) ſifted through the laſt-mentioned fine braſs-wired ſieve: Let the lime which paſſes be uſed inſtantly, or kept in air-tight veſſels, and let the part of the lime which does not paſs through the ſieve be rejected (M).—This finer richer part of the lime which paſſes through the ſieve I call *purified lime*.

“ Let bone-aſh be prepared in the uſual manner, by grinding the whiteſt burnt bones, but let it be ſifted, to be much finer than the bone-aſh commonly ſold for making cupels.

“ The moſt eligible materials for making my cement being thus prepared, take 56 pounds of the coarſe ſand and 42 pounds of the fine ſand; mix them on a large plank of hard wood placed horizontally; then ſpread the ſand ſo that it may ſtand to the height of ſix inches, with a flat ſurface on the plank; wet it with the cementing liquor; and let any ſuperfluous quantity of the liquor, which the ſand in the condition deſcribed cannot retain, flow away off the plank. To the wetted ſand add 14 pounds of the purified lime in ſeveral ſucceſſive portions, mixing and beating them up together in the mean time with the inſtruments generally uſed in making fine mortar: then add 14 pounds of the bone-aſh in ſucceſſive portions, mixing and beating all together. The quicker and the more perfectly theſe materials are mixed and beaten together, and the ſooner the cement thus formed is uſed, the better (N) it will be. This I call the *water-cement coarſe-grained*, which is to be applied in building, pointing, plaſtering, ſtuccoing, or other work, as mortar and ſtucco now are; with this difference chiefly, that as this cement is ſhorter than mortar or common ſtucco, and dries ſooner, it ought to be worked expeditiouſly in all caſes; and in ſtuccoing, it ought to be laid on by ſliding the trowel upwards on it; that the materials uſed along with this cement in building, or the ground on which it is to be laid in ſtuccoing, ought to be well wetted with the cementing liquor in the inſtant of laying on the cement; and that the cementing liquor is to be uſed when it is neceſſary to moiſten the cement, or when a liquid is required to facilitate the floating of the cement.

“ When ſuch cement is required to be of a finer texture, take 98 pounds of the fine ſand, wet it with the cementing liquor, and mix it with the purified lime and the bone-aſh in the quantities and in the manner above deſcribed; with this difference only, that 15 pounds of lime, or (O) thereabouts, are to be uſed inſtead of 14 pounds, if the greater part of the ſand be as fine as Lynn ſand. This I call *water-cement fine-grained*. It is to be uſed in giving the laſt coating, or the finiſh to any work intended to imitate the finer-grained ſtones or ſtucco. But it may be applied to all the uſes of the water-cement coarſe-grained, and in the ſame manner.

“ When for any of the foregoing purpoſes of pointing, building, &c. ſuch a cement is required much cheaper and coarſer-grained, then much coarſer clean ſand than the foregoing coarſe ſand, or well waſhed fine rubble, is to be provided. Of this coarſe ſand or rubble take 56 pounds, of the foregoing coarſe ſand 28 pounds, and of the fine ſand 14 pounds; and after mixing theſe, and wetting them with the cementing liquor in the foregoing manner, add 14 pounds, or ſomewhat leſs, of the (P) purified lime, and then 14 pounds or ſomewhat leſs of the bone-aſh, mixing them together in the manner already deſcribed. When my cement is required to be white, white ſand, white lime, and the whiteſt bone-aſh are to be choſen. Grey ſand, and grey bone-aſh formed of half-burnt bones, are to be choſen to make the cement grey; and any other colour of the cement is obtained, either by chooſing coloured ſand, or by the admixture of the neceſſary quantity of coloured talc in powder, or of coloured, vitreous, or metallic powders, or other durable colouring ingredients commonly uſed in paint.

“ To the end that ſuch a water-cement as I have deſcribed may be made as uſeful as it is poſſible in all circumſtances; and that no perſon may imagine that my claim and right under theſe letters-patent may be eluded by divers variations, which may be made in the foregoing proceſs without producing any notable defect in the cement; and to the end that the principles of this art, as well as the art itſelf, of making my cement, may be gathered from this ſpecification and perpetuated to the public; I ſhall add the following obſervations:

“ This my water-cement, whether the coarſe or fine grained, is applicable in forming artificial ſtone, by making alternate layers of the cement and of flint, hard ſtone, or brick,

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(K) “ The vapour which ariſes in the ſlaking of lime contributes greatly to the ſlaking of theſe pieces which lie in its way; and an unneceſſary waſte of the liquor is prevented, by applying it to the lime heaped in a pit or in a veſſel, which may reſtrain the iſſue of the vapour, and direct it through the maſs. If more of the liquor be uſed than is neceſſary to ſlake the lime, it will create error in weighing the ſlaked powder, and will prevent a part of it from paſſing freely thro' the ſieve. The liquid is therefore to be uſed ſparingly, and the lime which has eſcaped its action is to be ſprinkled apart with freſh liquor.

(L) “ When the aggregation of the lumps of lime is thus broken, it is impaired much ſooner than it is in the former ſtate, becauſe the air more freely pervades it.

(M) “ Becauſe it conſiſts of heterogeneous matter or of ill-burnt lime; which laſt will ſlake and paſs through the ſieve, if the lime be not immediately ſifted after the ſlaking agreeable to the text.

(N) “ Theſe proportions are intended for a cement made with ſharp ſand, for incruſtation in expoſed ſituations, where it is neceſſary to guard againſt the effects of hot weather and rain. In general, half this quantity of bone-aſhes will be found ſufficient; and although the incruſtation in this latter caſe will not harden deeply ſo ſoon, it will be ultimately ſtronger, provided the weather be favourable.

“ The injuries which lime and mortar ſuſtain by expoſure to the air, before the cement is finally placed in a quieſcent ſtate, are great; and therefore our cement is the worſe for being long beaten, but the better as it is quickly beaten until the mixture is effected, and no longer.

(O) “ The quantity of bone-aſhes is not to be increaſed with that of the lime; but it is to be leſſened as the expoſure and purpoſes of the work will admit.

(P) “ Becauſe leſs lime is neceſſary, as the ſand is coarſer.

brick, in moulds of the figure of the intended ſtone, and by expoſing the maſſes ſo formed to the open (Q) air to harden.

“ When ſuch cement is required for water (R) fences, two thirds of the preſcribed quantity of bone-aſhes are to be omitted ; and in the place thereof an equal meaſure of powdered terras is to be uſed ; and if the ſand employed be not of the coarſeſt ſort, more terras muſt be added, ſo that the terras ſhall be by weight one-ſixth part of the weight of the ſand.

“ When ſuch a cement is required of the fineſt grain (S) or in a fluid form, ſo that it may be applied with a bruſh, flint powder, or the powder of any quartoſe or hard earthy ſubſtance, may be uſed in the place of ſand ; but in a quantity ſmaller, as the flint or other powder is finer ; ſo that the flint-powder, or other ſuch powder, ſhall not be more than ſix times the weight of the lime, nor leſs than four times its weight. The greater the quantity of lime within theſe limits, the more will the cement be liable to crack by quick drying, and *vice verſa.*

“ Where ſuch ſand as I prefer cannot be conveniently procured, or where the ſand cannot be conveniently waſhed and ſorted, that ſand which moſt reſembles the mixture of coarſe and fine ſand above preſcribed, may be uſed as I have directed, provided due attention is paid to the quantity of the lime, which is to be greater (T) as the quantity is finer, and *vice verſa.*

“ Where ſand cannot be eaſily procured, any durable ſtony body, or baked earth groſsly powdered (U), and ſorted nearly to the ſizes above preſcribed for ſand, may be uſed in the place of ſand, meaſure for meaſure, but not weight for weight, unleſs ſuch groſs powder be as heavy ſpecifically as ſand.

“ Sand may be cleanſed from every ſofter, lighter, and leſs durable matter, and from that part of the ſand which is too fine, by various methods preferable (X), in certain circumſtances, to that which I have deſcribed.

“ Water may be found naturally free from fixable gas, ſelenite, or clay ; ſuch water may, without any notable inconvenience, be uſed in the place of the cementing liquor ; and water approaching this ſtate will not require ſo much lime as I have ordered to make the cementing liquor ; and a cementing liquor ſufficiently uſeful may be made by various methods of mixing lime and water in the deſcribed proportions, or nearly ſo.

“ When ſtone-lime cannot be procured, chalk-lime, or ſhell-lime, which beſt reſembles ſtone-lime, in the characters above written of lime, may be uſed in the manner deſcribed, except that fourteen pounds and a half of chalk-lime will be required in the place of fourteen pounds of ſtone-lime. The proportion of lime which I have preſcribed above may be increaſed without inconvenience, when the cement or ſtucco is to be applied where it is not liable to dry quickly ; and in the contrary circumſtance, this proportion may be diminiſhed ; and the defect of lime in quantity or quality may be very advantageouſly ſupplied (Y), by cauſing a conſiderable quantity of the cementing liquor to ſoak into the work, in ſucceſſive portions, and at diſtant intervals of time, ſo that the calcareous matter of the cementing liquor, and the matter attracted from the open air, may fill and ſtrengthen the work.

“ The powder of almoſt every well-dried or burnt animal ſubſtance may be uſed inſtead of bone-aſh ; and ſeveral earthy powders, eſpecially the micaceous and the metallic ; and the elixated aſhes of divers vegetables whoſe earth will not burn to lime ; and the aſhes of mineral fuel, which are of the calcareous kind, but will not burn to lime, will anſwer the ends of bone-aſh in ſome degree.

“ The quantity of bone-aſh deſcribed may be leſſened without injuring the cement, in thoſe circumſtances eſpecially which admit the quantity of lime to be leſſened, and in thoſe wherein the cement is not liable to dry quickly. And the art of remedying the defects of lime may be advantageouſly practiſed to ſupply the deficiency of bone-aſh, eſpecially in building, and in making artificial ſtone with this cement.

(Q) “ But they muſt not be expoſed to the rain until they are almoſt as ſtrong as freſh Portland ſtone ; and even then they ought to be ſheltered from it as much as the circumſtances will admit. Theſe ſtones may be made very hard and beautiful, with a ſmall expence of bone-aſh, by ſoaking them, after they have dried thoroughly and hardened, in the lime liquor, and repeating this proceſs twice or thrice, at diſtant intervals of time. The like effect was experienced in incruſtations.

(R) “ In my experiments, mortar made with terras-powder, in the uſual method, does not appear to form ſo ſtrong a cement for water-fences as that made, according to the ſpecification, with coarſe ſand ; and I ſee no more reaſon for avoiding the uſe of ſand in terras-mortar, than there would be for rejecting ſtone from the embankment. The bone-aſhes meant in this place are the dark grey or black ſort. I am not yet fully ſatisfied about the operation of them in this inſtance.

(S) “ The qualities and uſes of ſuch fine calcareous cement are recommended chiefly for the purpoſe of ſmoothing and finiſhing the ſtronger cruſtaceous works, or for waſhing walls to a lively and uniform colour. For this laſt intention, the mixture muſt be as thin as new cream, and laid on briſkly with a bruſh, in dry weather ; and a thick and durable coat is to be made by repeated waſhing ; but is not to be attempted by uſing a thicker liquor ; for the coat made with this laſt is apt to ſcale, whilſt the former endures the weather much longer than any other thin calcareous covering that has been applied in this way. Fine yellow-ochre is the cheapeſt colouring ingredient for ſuch waſh, when it is required imitate Bath ſtone, or the warm-white ſtones.

(T) “ If ſea ſand be well waſhed in freſh water, it is as good as any other round ſand.

(U) “ The cement made with theſe and the proper quantities of purified lime and lime-water, are inferior to the beſt, as the grains of theſe powders are more periſhable and brittle than thoſe of ſand. They will not therefore be employed, unleſs for the ſake of evaſion, or for want of ſand : in this latter caſe, the finer powder ought to be waſhed away.

(X) “ This and the next paragraph is inſerted with a view to evaſions, as well as to ſuggeſt the eaſier and cheaper methods which may be adopted in certain circumſtances, by artiſts who underſtand the principles which I endeavoured to teach.

(Y) “ This practice is noticed, as the remedy which may be uſed for the defects ariſing from evaſive meaſures, and as the method of giving ſpongy incruſtations containing bone-aſhes the greateſt degree of hardneſs.”

STUD, in the manege, a collection of breeding horſes and mares.

STUDDING SAILS, certain light ſails extended, in moderate and ſteady breezes, beyond the ſkirts of the principal ſails, where they appear as wings upon the yard-arms.

STUFF, in commerce, a general name for all kinds of fabrics of gold, ſilver, ſilk, wool, hair, cotton, or thread, manufactured on the loom; of which number are velvets, brocades, mohairs, ſatins, taffetas, cloths, ſerges, &c.

STUKELY (Dr William), a celebrated antiquarian, deſcended from an ancient family in Lincolnſhire, was born at Holbech in 1687, and educated in Bennet college, Cambridge. While an under-graduate, he often indulged a ſtrong propenſity to drawing and deſigning; but made phyſic his principal ſtudy, and firſt began to practiſe at Boſton in his native country. In 1717 he removed to London, where, on the recommendation of Dr Mead, he was ſoon after elected a fellow of the Royal Society; he was one of the firſt who revived that of the antiquarians in 1718, and was their ſecretary for many years during his reſidence in town. In 1729 he took holy orders by the encouragement of archbiſhop Wake; and was ſoon after preſented by lord-chancellor King with the living of All-Saints in Stamford. In 1741 he became one of the founders of the Egyptian ſociety, which brought him acquainted with the benevolent duke of Montague, one of the members: who prevailed on him to leave Stamford, and preſented him to the living ot St George the Martyr, Queen Square. He died of a ſtroke of the palſy in 1765. In his phyſical capacity, his Diſſertation on the Spleen was well received; and his *Itinerarium Curioſum*, the firſt fruit of his juvenile excurſions, was a good ſpecimen of what was to be expected from his riper age. His great learning, and profound reſearches into the dark remains of antiquity, enabled him to publiſh many elaborate and curious works: his friends uſed to call him the *arch-druid* of his age. His diſcourſes, intitled *Palæographia Sacra*, on the vegetable creation, beſpeak him a botaniſt, philoſopher, and divine.

STUM, in the wine-trade, denotes the unfermented juice of the grape after it has been ſeveral times racked off and ſeparated from its ſediment. The caſks are for this purpoſe well matched or fumigated with brimſtone every time, to prevent the liquor from fermenting, as it would otherwiſe readily do, and become wine. See MUST.

STUPIDITY. The Greek word μωροτης correſponds moſt with our Engliſh word *ſtupidity* or *fooliſhneſs*, when uſed to expreſs that ſtate of mind in which the intellects are defective. The immediate cauſes are ſaid to be, a deficiency of vital heat, or a defect in the brain. Stupid children ſometimes become ſprightly youths; but if ſtupidity continues to the age of puberty, it is hardly ever removed. If ſtupidity follows upon a violent paſſion, an injury done to the head, or other evident cauſe, and if it continues long, it becomes incurable. But the ſtupidity which conſiſts in a loſs of memory, and ſucceeds a lethargy, ſpontaneouſly ceaſes when the lethargy is cured.

STUPOR, a numbneſs in any part of the body, whether occaſioned by ligatures obſtructing the blood's motion, by the palſy, or the like.

STUPPA, or STUPE, in medicine, is a piece of cloth dipped in ſome proper liquor, and applied to an affected part.

STURDY, a diſtemper to which cattle are ſubject, called alſo the *turning evil*. See FARRIERY.

STURGEON. See ACCIPENSER.

STURMIUS (John), a learned philologer and rhetorician, was born at Sleida in Eiſel near Cologne in 1507. He ſtudied at firſt in his native country with the ſons of count de Manderſcheld, whoſe receiver his father was. He afterwards purſued his ſtudy at Liege in the college of St Jerom, and then went to Louvain in 1524. Five years he ſpent there, three in learning and two in teaching. He ſet up a printing-preſs with Rudger Reſcius profeſſor of the Greek tongue, and printed ſeveral Greek authors. He went to Paris in 1529, where he was highly eſteemed, and read public lectures on the Greek and Latin writers, and on logic. He married there, and kept a great number of boarders: but as he liked what were called the *new opinions*, he was more than once in danger; and this undoubtedly was the reaſon why he removed to Straſburgh in 1537, in order to take poſſeſſion of the place offered him by the magiſtrates. The year following he opened a ſchool, which became famous, and by his means obtained of Maximilian II. the title of an univerſity in 1566. He was very well ſkilled in polite literature, wrote Latin with great purity, and was a good teacher. His talents were not confined to the ſchool; for he was frequently intruſted with deputations in Germany and foreign countries, and diſcharged theſe employments with great honour and diligence. He ſhowed extreme charity to the refugees on account of religion: He not only laboured to aſſiſt them by his advice and recommendations; but he even impoveriſhed himſelf for them. He died in his 82d year, after he had been for ſome time blind. He publiſhed many books; the principal of which are, 1. *Partitiones Dialecticæ*. 2. *De Educatione Principum*. 3. *De Nobilitate Anglicana*. 4. *Linguæ Latinae reſolvendæ Ratio*. 5. Excellent notes on Ariſtotle's and Hermogenes's Rhetoric, &c.

He ought not to be confounded with *John Sturmius*, a native of Mechlin, and phyſician and profeſſor of mathematics at Louvain, who alſo wrote ſeveral works.

STURNUS, the STARLING; a genus of birds belonging to the order of *paſſeres*. The beak is ſubulated, depreſſed, and ſomewhat blunt; the ſuperior mandible is entire, and ſomewhat open at the edges; the noſtrils are marginated above; and the tongue is ſharp and emarginated. There are 15 ſpecies according to Dr Latham; the vulgaris, capenſis, ludovicianus, militaris, cellaris, carunculatus, gallinaceus, ſericeus, viridis, olivaceus, moritanicus, loyca, dauuricus, junceti, and mexicanus.

Latham's Synopſis, vol. iii.

The *vulgaris*, or common ſtarling, is the only ſpecies of the ſturnus that is indigenous. The weight of the male of this ſpecies is about three ounces; that of the female rather leſs. The length is eight inches three quarters: the bill is brown or yellow, but in old birds generally yellow. The whole plumage is black, very reſplendant, with changeable blue, purple, and copper: each feather marked with a pale yellow ſpot. The leſſer coverts are edged with yellow, and ſlightly gloſſed with green. The quill-feathers and tail duſky: the former edged with yellow on the exterior ſide; the laſt with dirty white. The legs of a reddiſh brown.

The ſtare breeds in hollow trees, eaves of houſes, towers, ruins, cliffs, and often in high rocks over the ſea, ſuch as that of the iſle of Wight. It lays four or five eggs, of a pale-greeniſh aſh-colour; and makes its neſt of ſtraw, ſmall fibres of roots, and the like. In winter, ſtares aſſemble in vaſt flocks: they collect in myriads in the fens of Lincolnſhire, and do great damage to the fen-men, by rooſting on the reeds, and breaking them down by their weight; for reeds are the thatch of the country, and are laid up in harveſt with great care. Theſe birds feed on worms and inſects; and it is ſaid that they will get into pigeon-houſes, for the ſake of ſucking the eggs. Their fleſh is ſo bitter as to be ſcarce eatable. They are fond of following oxen and other large cattle as they feed in the meadows, attracted, it is ſaid, by the inſects which flutter round them, or by thoſe, perhaps, which ſwarm in their dung, or in meadows in general. From this habit is derived the German name *Rinder Staren.* They are alſo accuſed of feeding on the carcaſes that are expoſed on gibbets; but it is probably in ſearch only of inſects. They live ſeven or eight years, or even longer, in the domeſtic ſtate. The wild ones cannot be decoyed by the call, becauſe they regard not the ſcream of the owl. A method has been diſcovered of taking entire families, by fixing to the walls and the trees where they lodge pots of earthen ware of a convenient form, which the birds often prefer to place their neſts in. Many are alſo caught by the gin and draw-net. In ſome parts of Italy it is common to employ tame weaſels to drag them out of their neſts, or rather their holes; for the artifice of man conſiſts in employing one enſlaved race to extend his dominion over the reſt.

ffon's t. Hiry of rds. l. iii.

The ſtare, it is ſaid, can be taught to ſpeak either French, German, Latin, Greek, &c. and to pronounce phraſes of ſome length. Its pliant throat accommodates itſelf to every inflection and every accent. It can readily articulate the letter R, and acquires a ſort of warbling which is much ſuperior to its native ſong. This bird is ſpread through an extenſive range in the ancient continent. It is found in Sweden, Germany, France, Italy, the Iſle of Malta, the Cape of Good Hope, and is everywhere nearly the ſame; whereas thoſe American birds which have been called ſtares, preſent a great diverſity of appearance.

STYE, or STYTHE, in the eye. See CRITHE.

STYLE, a word of various ſignifications, originally deduced from *ſtylos*, a kind of bodkin wherewith the ancients wrote on plates of lead, or on wax, &c. and which is ſtill uſed to write on ivory-leaves and paper prepared for that purpoſe, &c.

STYLE, in dialling, denotes the gnomon or cock of a dial raiſed on the plane thereof to project a ſhadow.

STYLE, in botany. See BOTANY, Sect. iv. p. 434.

STYLE, in language, is the peculiar manner in which a man expreſſes his conceptions. It is a picture of the ideas which riſe in his mind, and of the order in which they are there produced.

The qualities of a good ſtyle may be ranked under two heads; perſpicuity and ornament. It will readily be admitted, that perſpicuity ought to be eſſentially connected with every kind of writing; and to attain it, attention muſt be paid, firſt to ſingle words and phraſes, and then to the conſtruction of ſentences. When conſidered with reſpect to words and phraſes, it requires theſe three qualities; purity, propriety, and preciſion. When conſidered with regard to ſentences, it requires a clear arrangement of the words and unity in the ſenſe; to which, if ſtrength and harmony be added, the ſtyle will become ornamented.

One of the moſt important directions to be obſerved by him who wiſhes to form a good ſtyle, is to acquire clear and preciſe ideas on the ſubject concerning which he is to write or ſpeak. To this muſt be added frequency of compoſition, and an acquaintance with the ſtyle of the beſt authors. A ſervile imitation, however, of any author is carefully to be avoided; for he who copies, can hardly avoid copying faults as well as beauties. A ſtyle cannot be proper unleſs it be adapted to the ſubject, and likewiſe to the capacity of our hearers, if we are to ſpeak in public. A ſimple, clear, and unadorned ſtyle, ſuch as that of Swift, is fitteſt for intricate diſquiſition; a ſtyle elegant as Addiſon's, or impetuous like Johnſon's, is moſt proper for fixing the attention on truths; which, though known, are too much neglected. We muſt not be inattentive to the ornaments of ſtyle, if we wiſh that our labours ſhould be read and admired; but he is a contemptible writer, who looks not beyond the dreſs of language, who lays not the chief ſtreſs upon his matter, and who does not regard ornament as a ſecondary and inferior recommendation. For further obſervations on the different kinds of ſtyle, ſee ORATORY, nº 99, &c.

STYLE, in juriſprudence, the particular form or manner of proceeding in each court of juriſdiction, agreeable to the rules and orders eſtabliſhed therein: thus we ſay, the ſtyle of the court of Rome, of chancery, of parliament, of the privy-council, &c.

STYLE, in muſic, denotes a peculiar manner of ſinging, playing, or compoſing; being properly the manner that each perſon has of playing, ſinging, or teaching; which is very different both in reſpect of different geniuſes, of countries, nations, and of the different matters, places, times, ſubjects, paſſions, expreſſions, &c. Thus we ſay, the ſtyle of Paleſtrina, of Lully, of Corelli, of Handel, &c.; the ſtyle of the Italians, French, Spaniards, &c.

Old STYLE, the Julian method of computing time, as the *New* STYLE is the Gregorian method of computation. See KALENDAR.

Plate CCCCLXXXVI.

STYLEPHORUS CHORDATUS, a genus of fiſhes belonging to the order of *apodes*. This very curious genus was diſcovered by Dr Shaw, who read a deſcription of it before the Linnæan Society in the year 1788. The eyes are fixed on cylindrical pillars which lie cloſe together. The roſtrum, or narrow part which is terminated by the mouth, is connected to the back part of the head by a flexible leathery duplicature, which permits it either to be extended in ſuch a manner that the mouth points directly upwards, or to fall back ſo as to be received into a ſort of caſe, formed by the upper part of the head. There are three pairs of branchiæ ſituate under the throat. The pectoral fins are ſmall; the dorſal fin runs from the head to within about an inch and a half of the tail; the caudal fin is ſhort, and is furniſhed with five remarkable ſpines. The body is extremely long, and compreſſed very much, and gradually diminiſhes as it approaches the tail, which terminates in a proceſs or ſtring of an enormous length, and finiſhes in a very fine point. This ſtring, or caudal proceſs, ſeems to be ſtrengthened throughout its whole length, or at leaſt as far as the eye can trace it, by a ſort of double fibre or internal part. The ſtylephorus chordatus is a native of the Weſt Indian Sea. It was taken between the iſlands of Cuba and Martinico, near a ſmall cluſter of little iſlands about nine leagues from ſhore, and was ſeen ſwimming near the ſurface. The whole length of this uncommon animal from the head to the extremity of the caudal proceſs is about thirty-two inches, of which the proceſs itſelf meaſures twenty-two.

Tranſactions of the Linnæan Society, vol. i.

STYLET, a ſmall dangerous kind of poniard which may be concealed in the hand, chiefly uſed in treacherous aſſaſſinations. The blade is uſually triangular, and ſo ſmall that the wound it makes is almoſt imperceptible.

STYLITES, PILLAR SAINTS, in eccleſiaſtical hiſtory, an appellation given to a kind of ſolitaries, who ſtood motionleſs upon the tops of pillars, raiſed for this exerciſe of their patience, and remained there for ſeveral years, amidſt the admiration and applauſe of the ſtupid populace. Of theſe we find ſeveral mentioned in ancient writers, and even as low as the twelfth century, when they were totally ſuppreſſed.

The founder of the order was St Simeon Stylites, a famous anchoret in the fifth century, who firſt took up his abode on a column ſix cubits high; then on a ſecond of twelve cubits, a third of twenty-two, a fourth of thirty-ſix, and on another of forty cubits, where he thus paſſed thirty-ſeven years of his life. The tops of theſe columns were only three feet in diameter, and were defended by a rail that reached almoſt to the girdle, ſomewhat reſembling a pulpit. There was no lying down in it. The faquirs, or devout people of the Eaſt, imitate this extraordinary kind of life to this day.

STYLOCERALOIDES,
STYLO GLOSSUS,
Stylo-Hyoidæus,
Stylo-Pharyngæus,
STYLOIDES,

The names of different muſcles in the human body. See *Table of the Muſcles under* ANATOMY.

STYLOSANTHES, in botany: A genus of the *decandria* order, belonging to the *diadelphia* claſs of plants; and in the natural method ranking under the 32d order, *Papilionaceæ*. The calyx is tubulated, very long, having the corolla attached to it. The legumen or pod biarticulated and hooked. Of this there are two ſpecies, both natives of Jamaica, viz. 1. *Procumbens*, the *hedyſarum procumbens* of Linnæus; a figure of which may be ſeen in Sloane's Natural Hiſtory of Jamaica. 2. *Viſcoſa*, the *trifolium* 2. of Browne; a figure of which is alſo given by Sloane.

STYPTIC, in pharmacy, a medicine which by its aſtringency ſtops hæmorrhagies, &c. See PHARMACY, n° 547.

STYRAX, the STORAX-TREE, in botany: A genus of plants belonging to the claſs of *decandria*, and to the order of *monogynia*; and in the natural ſyſtem ranging under the 18th order, *bicornes*. Linnæus only mentions one ſpecies of this genus, the *ſtyrax-officinale*; but Aiton, in his *Hortus Kewenſis*, has added two more; namely, the *grande folium* and *lævigatum*; and we believe a fourth may now be added, the *ſtyrax benzoin*.

The *officinale* uſually riſes above twenty feet in height; it ſends off many ſtrong branches, which are covered with a roughiſh bark of a grey colour: the leaves are broad, elliptical, entire, ſomewhat pointed, on the upper ſurface ſmooth, and of a light green colour, on the under ſurface covered with a whitiſh down; they are placed alternately, and ſtand upon ſhort footſtalks: the flowers are large, white, and diſpoſed in cluſters upon ſhort peduncles, which terminate the branches: the corolla is monopetalous, funnel-ſhaped, and divided at the limb into five lance-ſhaped ſegments: the filaments are ten, placed in a regular circle, and ſeem to adhere towards the baſe: the antheræ are erect and oblong: the germen is oval, and ſupports a ſlender ſtyle, with a ſimple ſtigma: the fruit is a pulpy pericarpium, which contains one or two nuts of an oval compreſſed figure.

Woodville's Medical Botany, vol. ii.

The reſinous drug called *ſtorax* iſſues in a fluid ſtate from inciſions made in the trunk or branches of the tree. Two ſorts of this reſin have been commonly diſtinguiſhed in the ſhops. 1. *Storax in the tear*: is ſcarcely, if ever, found in ſeparate tears, but in maſſes, ſometimes compoſed of whitiſh and pale reddiſh brown tears, and ſometimes of an uniform reddiſh yellow or bowniſh appearance; unctuous and ſoft like wax, and free from viſible impurities. This is ſuppoſed to be the ſort which the ancients received from Pamphylia in reeds or canes, and which was thence named *calamita*.

Lewis's Materia Medica, vol. ii.

2. *Common ſtorax*: in large maſſes, conſiderably lighter and leſs compact that the former, and having a large admixture of woody matter like ſaw-duſt. This appears to be the kind intended by the London college, as they direct their ſtyrax calamita to be purified, for medicinal uſe, by ſoftening it with boiling water, and preſſing it out from the feces betwixt warm iron plates; a proceſs which the firſt ſort does not ſtand in need of. And indeed there is rarely any other than this impure ſtorax to be met with in the ſhops.

Storax, with ſome of the ancients, was a familiar remedy as a reſolvent, and particularly uſed in catarrhal complaints, coughs, aſthmas, menſtrual obſtructions, &c. and from its affinity to the balſams it was alſo preſcribed in ulcerations of the lungs, and other ſtates of pulmonary conſumption. And our pharmacopœias formerly directed the *pilulæ e ſtyrace*; but this odoriferous drug has now no place in any of the officinal compounds; and though a medicine which might ſeem to promiſe ſome efficacy in nervous debilities, yet by modern practitioners it is almoſt totally diſregarded.

The *ſtyrax benzoin* is deſcribed by Dr Dryander in the Philoſophical Tranſactions for 1787, p. 308, &c. It has been characterized by oblong acuminated leaves, which are downy underneath, and nearly of the length of the racemi. The botanical character of this tree was miſtaken by modern botaniſts till Dr Dryander aſcertained it to be a ſtyrax. Benzoin was long ſuppoſed to be the produce of a ſpecies of *laurus*. Linnæus detected this error: but he committed another; for he tells us, that it is furniſhed by a ſhrub which, in the country where it grows, is called *croton benzoe*; and afterwards, in his *Supplementum Plantarum*, deſcribes the ſame plant a ſecond time, under the name of *terminalia benzoin*.

Plate CCCCLXXXVI.

This tree, which is a native of Sumatra, is deemed in ſix years of ſufficient age for affording the benzoin, or when its trunk acquires about ſeven or eight inches in diameter; the bark is then cut through longitudinally, or ſomewhat obliquely, at the origin of the principal lower branches, from which the drug exudes in a liquid ſtate, and by expoſure to the ſun and air ſoon concretes, when it is ſcraped off from the bark with a knife or chiſel. The quantity of benzoin which one tree affords never exceeds three pounds, nor are the trees found to ſuſtain the effects of theſe annual inciſions longer than ten or twelve years. The benzoin which iſſues firſt from the wounded bark is the pureſt, being ſoft, extremely fragrant, and very white; that which is leſs eſteemed is of a browniſh colour, very hard, and mixed with various impurities, which it acquires during its long continuance upon the trees. Eſchelſkron diſtinguiſhes benzoin into three kinds, viz. *camayan poeti*, or white benjamin, which, upon being melted in a bladder by the heat of the ſun, appears marked with red ſtreaks or veins. *Camayan bamatta* is leſs white than the former, and often ſpotted with white circles, called eyes, from the number of which its goodneſs is eſtimated: it likewiſe melts by the heat of the ſun. *Camayan itam*, or black benjamin, which requires to be melted in hot water for its preſervation in bladders. In Arabia, Perſia, and other parts of the Eaſt, the coarſer kinds of benjamin are conſumed for fumigating and perfuming the temples, and for deſtroying inſects.

Woodville's Medical Botany, vol. ii.

The benzoin which we find here in the ſhops is in large brittle maſſes, compoſed partly of white, partly of yellowiſh or light brown, and often alſo of darker coloured pieces: that which is cleareſt, and contains the moſt white matter, called by authors *benzoe amygdaloides*, is accounted the beſt. This reſin has very little taſte, impreſſing on the palate only a ſlight ſweetneſs: its ſmell, eſpecially when rubbed or heated, is extremely fragrant and agreeable. It totally diſſolves in rectified ſpirit, (the impurities excepted, which are generally in a very ſmall quantity), into a deep yellowiſh red liquor, and in this ſtate diſcovers a degree of warmth and pungency, as well as ſweetneſs. It imparts, by digeſtion, to water alſo a conſiderable ſhare of its fragrance, and a ſlight pungency: the filtered liquor, gently exhaled, leaves not a reſinous or mucilaginous extract, but a cryſtalline matter, ſeemingly of a ſaline nature, amounting to one-tenth or one-eighth of the weight of the benzoin. Expoſed to the fire in proper veſſels, it yields a quantity of a white ſaline concrete, called *flores benzoes*, of an acidulous taſte and grateful odour, ſoluble in rectified ſpirit, and in water by the aſſiſtance of heat.

The principal uſe of this fragrant reſin is in perfumes, and as a coſmetic; for which laſt purpoſe, a ſolution of it in ſpirit of wine is mixed with ſo much water as is ſufficient to render it milky, as twenty times its quantity or more. It promiſes, however, to be applicable to other uſes, and to approach in virtue, as in fragrance, to ſtorax and balſam of Tolu. It is ſaid to be of great ſervice in diſorders of the breaſt, for reſolving obſtructions of the pulmonary veſſels, and promoting expectoration: in which intentions the flowers are ſometimes given, from three or four grains to fifteen. The white powder, precipitated by water from ſolutions of the benzoin in ſpirit, has been employed by ſome as ſimilar and ſuperior to the flowers, but appears to be little other than the pure benzoin in ſubſtance: it is not the ſaline, but the reſinous matter of the benzoin, that is moſt diſpoſed to be precipitated from ſpirit by water. The flowers, ſnuffed up the noſe, are ſaid to be a powerful errhine.

Liquid ſtorax is a reſinous juice obtained from a tree called by Linnæus *liquidambar ſtyraciflua*, a native of Virginia and Mexico, and lately naturalized in Britain. The juice called liquidambar is ſaid to exude from inciſions made in the trunk of this tree, and the liquid ſtorax to be obtained by boiling the bark or branches in water. Two ſorts of liquid ſtorax are diſtinguiſhed by authors: one, the purer part of the reſinous matter that ariſes to the ſurface in boiling, ſeparated by a ſtrainer, of the conſiſtence of honey, tenacious like turpentine, of a reddiſh or aſh brown colour, moderately tranſparent, of an acrid unctuous taſte, and a fragrant ſmell, faintly reſembling that of the ſolid ſtorax, but ſomewhat diſagreeable: the other, the more impure part, which remains on the ſtrainer, is not tranſparent, in ſmell and taſte is much weaker, and contains a conſiderable proportion of the ſubſtance of the bark. What is moſt commonly met with under this name in the ſhops is of a weak ſmell and a grey colour, and is ſuppoſed to be an artificial compoſition.

Liquid ſtorax has been employed chiefly in external applications. Among us, it is at preſent almoſt wholly in diſuſe.

STYX (fab. hiſt.), a celebrated river of hell, round which it flows nine times. The gods held the waters of the Styx in ſuch veneration, that to ſwear by them was reckoned an oath altogether inviolable. If any of the gods had perjured themſelves, Jupiter obliged them to drink the waters of the Styx, which lulled them for one whole year into a ſenſeleſs ſtupidity, for the nine following years they were deprived of the ambroſia and the nectar of the gods, and after the expiration of the years of their puniſhment, they were reſtored to the aſſembly of the deities, and to all their original privileges. It is ſaid that this veneration was ſhewn to the Styx, becauſe it received its name from the nymph Styx, who with her three daughters aſſiſted Jupiter in his war againſt the Titans.

Tranſ. of the R. Society of Edinburgh Vol. ii.

Styx was a river which it was neceſſary for departed ſhades to paſs before they could enter the infernal regions; and it was the office of Charon to ferry them over in a boat which was kept for that purpoſe. The ghoſts of thoſe who had not been honoured with the rites of ſepulture were obliged to wander an hundred years before Charon could admit them into his boat to convey them before the judges of Hades. What could have given riſe to this fable of Charon and his boat, it is not very material to inquire. Mythological writers have ſaid, that the Greeks learned it from the Egyptians, which is indeed probable enough; that the Egyptians framed both this, and ſome other fables relating to the dead, from certain cuſtoms peculiar to their country; that in particular there was, not far from Memphis, a famous burying-place, to which the dead bodies were conveyed in a boat acroſs the lake Acheruſia; and that Charon was a boatman who had long officiated in that ſervice. The learned Dr. Blackwell ſays, in his life of Homer, that, in the old Egyptian language, *Charoni* ſignified "ferryman."

SUABIA, a circle of Germany, bounded on the north by the circle of Franconia and that of the Lower Rhine; on the weſt by the circle of the Lower Rhine and Alſace; on the ſouth by Switzerland; and on the eaſt by the circle of Bavaria. Of all the circles of the empire, Suabia is the moſt divided; it contains four eccleſiaſtical and thirteen lay principalities, nineteen independent prelacies and abbeys, twenty-ſix earldoms and lordſhips, and thirty-one free cities. The prime directors of the circle, as they are termed, are the biſhop of Conſtance and the duke of Wirtemberg. The duke has the ſole direction of all that relates to war.

The mixture of the various forms of government and religious ſects; the oppreſſion exerciſed by the great on the poor; the game conſtantly played by the emperor, who poſſeſſes many pieces of detached country in Suabia, which depend not on the circle, and can, in conſequence of his privileges as archduke of Auſtria, extend his poſſeſſions in it by various ways; are circumſtances (ſays baron Rieſbeck) which give the cultivation of the country, and the character of the inhabitants, a moſt extraordinary caſt. In ſeveral of the poſt towns where you ſtop, you ſee the higheſt degree of cultivation in the midſt of the moſt ſavage wildneſs; a great degree of knowledge and poliſh of manners, mixed with the groſſeſt ignorance and ſuperſtition; traces of liberty; under the deepeſt oppreſſion; national pride, together with the contempt and neglect of the native country; in ſhort, all the ſocial qualities in ſtriking contraſt and oppoſition to each other. Thoſe parts of Suabia which belong to the great potentates, ſuch as Wirtemberg, Auſtria, and Baden, are certainly the moſt improved. The whole of Suabia may comprehend about nine hundred German ſquare miles, and two millions of people. More than half of theſe are ſubjects of the three abovementioned princes, though they are not proprietors of near one half of the lands.

Baron Rieſbeck's Travels through Germany, vol. i.

SUARES (Francis), a Jeſuit, was born in Granada on the 5th of January 1548. He was a profeſſor of theology at Alcala, Salamanca, Rome, and Coimbra in Portugal. He died at Liſbon in 1617 with the greateſt reſignation; "I never thought (ſaid he) that it was ſo eaſy to die." His memory was aſtoniſhing, he could repeat the whole of his voluminous works by heart. His writings fill 23 folio volumes, and are moſtly on theological and moral ſubjects. His Treatiſe of Laws has been reprinted in Britain His Defence of the Catholic Faith againſt the Errors of England was written at the requeſt of pope Paul V. This book was publicly burnt at London by order of James I. When Suares heard it, he is ſaid to have exclaimed, "O that I too could ſeal with my blood, the truths which I have defended with my pen!"

SUBAH, the general name of the viceroyſhips, or greater governments, into which the Mogul empire was divided, conſiſting of ſeveral provinces. The juriſdiction of a ſubahdar, the ſame as ſubahſhip, ſubaedaree, or nizamut.

SUBAHDAR, the viceroy, lord-lieutenant, or governor, holding a ſubah; the ſame as nabob or nazim. Alſo the black commander of a company of Seapoys.

SUBALTERN, a ſubordinate officer, or one who diſcharges his poſt under the command and ſubject to the direction of another; ſuch are lieutenants, ſub-lieutenants, cornets, and enſigns, who ſerve under the captain.

SUBCLAVIAN, in anatomy, is applied to any thing under the arm-pit or ſhoulder, whether artery, nerve, vein, or muſcle.

SUB-DEACON, an inferior miniſter, who anciently attended at the altar, prepared the ſacred veſſels, delivered them to the deacons in time of divine ſervice, attended the doors of the church during communion ſervice, went on the biſhop's embaſſies with his letters or meſſages to foreign churches, and was inveſted with the firſt of the holy orders. They were ſo ſubordinate to the ſuperior rulers of the church, that, by a canon of the council of Laodicea, they were forbidden to ſit in the preſence of a deacon without his leave. According to the canons, a perſon muſt be twenty-two years of age to be promoted to the order of ſubdeacon. See Deacon.

SUBDOMINANT, in muſic a name given by M. Rameau to the fourth note of the tone, which of conſequence is the ſame interval from the tonic when deſcending as the dominant in riſing. This denomination ariſes from the affinity which this author finds by inverſion between the minor mode of the ſubordinant and the major mode of the tonic.

SUBDUPLE ratio, is when any number or quantity is contained in another twice. Thus 3 is ſaid to be ſubduple of 6, as 6 is duple of 3. See Ratio.

SUBDUPLICATE ratio of any two quantities, is the ratio of their ſquare roots.

SUBER, the cork-tree, in botany. See Quercus.

SUBJECT, a perſon under the rule and dominion of a ſovereign prince or ſtate.

Subject is alſo uſed for the matter of an art or ſcience, or that which it conſiders, or whereon it is employed: thus the human body is the ſubject of medicine.

SUBINFEUDATION, was where the inferior lords, in imitation of their ſuperiors, began to carve out and grant to others minuter eſtates than their own, to be held of themſelves; and were ſo proceeding downwards *in infinitum*, till the ſuperior lords obſerved that by this method of ſubinfeudation they loſt all their feodal profits, or wardſhips, marriages, and eſcheats, which fell into the hands of theſe meſne or middle lords, who were the immediate ſuperiors of the terre-tenant, or him who occupied the land. This occaſioned the ſtat. of Weſtm. 3. or *quia emptores*, 18 Edw. I. to be made; which directs, that, upon all ſales or feoffments of lands, the feoffee ſhall hold the ſame, not of his immediate feoffer, but of the chief lord of the fee of whom ſuch feoffer himſelf held it. And from hence it is held, that all manors exiſting at this day muſt have exiſted by immemorial preſcription; or at leaſt ever ſince the 18 Edw. I. when the ſtatute of *quia emptores* was made.

Blackſtone's Commentary, vol. ii.

SUBITO, in the Italian muſic, is uſed to ſignify that a thing is to be performed quickly and haſtily: thus we meet with *volti ſubito*, turn over the leaf quickly.

SUBJUNCTIVE, in grammar. See Grammar.

SUBLIMATE, a chemical preparation, conſiſting of quickſilver united with the marine acid. See Chemistry-*Index*.

SUBLIMATION, in chemiſtry, the condenſing and collecting, in a ſolid form, by means of veſſels aptly conſtructed, the fumes of bodies raiſed from them by the application of a proper heat. See Chemistry, n° 581.

SUBLIME, or Sublimity. See the article Grandeur and Sublimity.

SUBLINGUAL artery. See Anatomy.

Sublingual Glands, in anatomy, two glands under the tongue, placed one on each ſide thereof.

SUBMULTIPLE, in geometry, &c. A ſubmultiple number, or quantity, is that which is contained a certain number of times in another, and which, therefore, repeated a certain number of times, becomes exactly equal thereto. Thus 3 is a ſubmultiple of 21. In which ſenſe a ſubmultiple coincides with an aliquot part.

Submultiple Ratio, is that between the quantity contained and the quantity containing. Thus the ratio of 3 to 21 is ſubmultiple. In both caſes ſubmultiple is the reverſe of multiple: 21, *e. gr.* being a multiple of 3, and the ratio of 21 to 3 a multiple ratio.

SUBORDINARIES. See Heraldry, Chap. III. Sect. II. page 454.

SUBORDINATION, a relative term, expreſſing an inferiority betwixt one perſon and another.

SUBORNATION, in law, a ſecret, underhand, preparing, inſtructing, or bringing in a falſe witneſs; and from hence *ſubornation of perjury* is the preparing or corrupt alluring to perjury. The puniſhment for this crime was formerly death, then baniſhment or cutting out the tongue, afterwards forfeiture of goods; and it is now a fine and impriſonment, and never more to be received as evidence. The ſtatute 2 Geo. II. c. 25. ſuperadded a power for the court to order the offender to be ſent to the houſe of correction for a term not exceeding ſeven years, or to be tranſported for the ſame period.

SUBPŒNA, in law, a writ whereby common perſons are called into chancery, in ſuch caſes where the common law hath provided no ordinary remedy; and the name of it proceeds from the words therein, which charge the party called to appear at the day and place aſſigned, *ſub pœna centum librarum*, &c. The ſubpœna is the leading proceſs in the courts of equity; and by ſtatute, when a bill is filed againſt any perſon, proceſs of ſubpœna ſhall be taken out to oblige the defendant to appear and anſwer the bill, &c.

Subpoena ad teſtificandum, a writ or proceſs to bring in witneſſes to give their teſtimony. If a witneſs on being ſerved with this proceſs does not appear, the court will iſſue an attachment againſt him; or a party, plaintiff or defendant, injured by his non-attendance, may maintain an action againſt the witneſs. See *Blackſt. Com.* Vol. III. p. 369.

Subpoena in Equity, "a proceſs in equity, calling on a defendant to appear and anſwer to the complainant's bill. See ſtatute 5th Geo. II. c. 25. which enacts, that where the party cannot be found to be ſerved with a ſubpœna, and abſconds (as believed) to avoid being ſerved, a day ſhall be appointed him to appear to the bill of the plaintiff; which is to be inſerted in the London Gazette, read in the pariſh-church where the defendant laſt lived, and fixed up at the Royal Exchange: and if the defendant doth not appear upon that day, the bill ſhall be taken *pro confeſſo*."

SUBREPTITIOUS, a term applied to a letter, licence, patent, or other act, fraudulently obtained of a ſuperior, by concealing ſome truth which, had it been known, would have prevented the conceſſion or grant.

SUBROGATION, or Surrogation, in the Civil Law, the act of ſubſtituting a perſon in the place, and intitling him to the rights, of another. In its general ſenſe, ſubrogation implies a ſucceſſion of any kind, whether of a perſon to a perſon, or of a perſon to a thing.

There are two kinds of ſubrogation: the one *conventional*, the other *legal*. *Conventional* ſubrogation is a contract whereby a creditor transfers his debt, with all appurtenances thereof, to the profit of a third perſon. *Legal* ſubrogation is that which the law makes in favour of a perſon who diſcharges an antecedent creditor; in which caſe there is a legal tranſlation of all rights of the ancient creditor to the perſon of the new one.

SUBSCRIPTION, in general, ſignifies the ſignature put at the bottom of a letter, writing, or inſtrument.

In commerce, it is uſed for the ſhare or intereſt which particular perſons take in a public ſtock or a trading company,

pany, by writing their names, and the ſhares they require, in the books or regiſter thereof.

Subscription to articles of faith is required of the clergy of every eſtabliſhed church, and of ſome churches not eſtabliſhed. Whether ſuch ſubſcription ſerves any good purpoſe, in a religious or theological view, is a very doubtful queſtion. It may be neceſſary in an eſtabliſhment, as a teſt of loyalty to the prince, and of attachment to the conſtitution, civil and eccleſiaſtical, but it cannot produce uniformity of opinion. As all language is more or leſs ambiguous, it becomes difficult, if not impoſſible, to determine in what ſenſe the words of long eſtabliſhed creeds are to be interpreted; and we believe that the clergy of the churches of England and Scotland ſeldom conſider themſelves as fettered by the thirty-nine Articles, or the Confeſſion of Faith, when compoſing inſtructions either for their reſpective pariſhes or for the public at large. See Independents.

Subscription, in the commerce of books, ſignifies an engagement to take a certain number of copies of a book intended to be printed, and a reciprocal obligation of the bookſeller or publiſher to deliver the ſaid copies, on certain terms.—Theſe ſubſcriptions, which had their riſe in England about the middle of the laſt century, were lately very frequent in France and Holland, and are now very common among ourſelves.

SUBSEQUENT, ſomething that comes after another, particularly with regard to the order of time.

SUBSIDY, in law, "ſignifies an aid or tax granted to the king by parliament, for the neceſſary occaſions of the kingdom; and is to be levied on every ſubject of ability, according to the rate or value of his lands or goods: but this word, in ſome of our ſtatutes, is confounded with that of cuſtoms." See Tax.

SUBSTANCE, the ſubject to which we ſuppoſe qualities belong. Thus gold is the ſubſtance to which the quaties of ductility, yellowneſs, denſity, &c. belong. See Metaphysics, n° 145.

SUBSTANTIAL, in the ſchools, ſomething belonging to the nature of ſubſtance.

SUBSTANTIVE, in grammar. See Grammar.

SUBSTITUTE, a perſon who officiates for another in his abſence.

SUBSTITUTION, in the civil law, a diſpoſition of a teſtament, whereby the teſtator ſubſtitutes one heir for another, who has only the uſufruit, and not the property, of the thing left him.

SUBSTRACTION, or Subtraction, in arithmetic, the ſecond rule, or rather operation, in arithmetic, whereby we deduct a leſs number from a greater, to learn their preciſe difference. See Arithmetic and Algebra.

SUBTANGENT of a Curve, the line that determines the interſection of a tangent with the axis; or that determines the point wherein the tangent cuts the axis prolonged.

SUBTENSE, formed from *ſub* "under," and *tendo* "I ſtretch." in geometry, a right line which is oppoſite to an angle, and drawn between the two extremities of the arch which meaſures that angle.

SUBTERRANEOUS, whatever is under ground: thus naturaliſts ſpeak of ſubterraneous fires, ſubterraneous damps, &c.

Subterraneous Cavern. See Quarries.

SUBTILE, in phyſics, an appellation given to whatever is extremely ſmall, fine, and delicate; ſuch as the animal-ſpirits, the effluvia of ordorous bodies, &c. are ſuppoſed to be.

SUBULARIA, Rough-leaved Alysson, or *Awlwort*, in botany: A genus of plants belonging to the claſs of *tetradynamia*, and order of *ſiliculoſa*; and in the natural order ranging under the 39th order, *ſiliquoſæ*. The ſilicula its entire and ovate; the valves are ovate, concave, and contrary to the partitions. The ſtyle is ſhorter than the ſilicula. There is only one ſpecies, the *aquatica*, which is a native of Britain. It is about an inch high. The leaves are awl-ſhaped, and grow in cluſters round the root. The ſtalk is naked, and produces four or five ſmall white flowers growing alternately on ſhort footſtalks. It flowers under water, whereas moſt aquatic plants emerge above water at the time of flowering. The Author of Nature has, however, carefully prevented the tender flower from receiving any injury from the water, by making the petals cloſe, and form themſelves into a kind of arch. This plant grows on the borders of the Highland lakes, in Loch Tay, in Scotland, alſo in Wales and Ireland.

SUBULATED, ſomething ſhaped like an awl.

SUCCEDANEUM, in pharmacy, denotes a drug ſubſtituted in the place of another.

SUCCESSION, in metaphyſics, the idea which we get by reflecting on the ideas that follow one another in our mind; and from the ſucceſſion of ideas we get the idea of *time*. See Metaphysics, n° 93. and 209.

Succession, in law. See Descent.

Succession to the Crown. See *Hereditary Right.*—"From the days of Egbert, the firſt ſole monarch of England, even to the preſent, the four cardinal maxims mentioned in that article have ever been held conſtitutional canons of ſucceſſion. It is true, as Sir William Blackſtone obſerves, this ſucceſſion, through fraud or force, or ſometimes through neceſſity, when in hoſtile times the crown deſcended on a minor or the like, has been very frequently ſuſpended; but has generally at laſt returned back into the old hereditary channel, though ſometimes a very conſiderable period has intervened. And even in thoſe inſtances where this ſucceſſion has been violated, the crown has ever been looked upon as hereditary in the wearer of it. Of which the uſurpers themſelves were ſo ſenſible, that they for the moſt part endeavoured to vamp up ſome feeble ſhow of a title by deſcent, in order to amuſe the people, while they gained the poſſeſſion of the kingdom. And, when poſſeſſion was once gained, they conſidered it as the purchaſe or acquiſition of a new eſtate of inheritance, and tranſmitted, or endeavoured to tranſmit it, to their own poſterity by a kind of hereditary right of uſurpation. (See *Black. Com.* v. i. 197—217.) From the hiſtorical view there given, it appears, that the title to the crown is at preſent hereditary, though not quite ſo abſolutely hereditary as formerly: and the common ſtock, or anceſtor, from whom the deſcent muſt be derived, is alſo different. Formerly, the common ſtock was King Egbert; then William the Conqueror; afterwards, in James I.'s time, the two common ſtocks united; and ſo continued till the vacancy of the throne in 1688: now it is the Princeſs Sophia, in whom the inheritance was veſted by the new king and parliament. Formerly, the deſcent was abſolute, and the crown went to the next heir without any reſtriction: but now, upon the new ſettlement, the inheritance is conditional; being limited to ſuch heirs only, of the body of the Princeſs Sophia, as are Proteſtant members of the church of England, and are married to none but Proteſtants.

"And in this due medium conſiſts the true conſtitutional notion of the right of ſucceſſion to the imperial crown of theſe kingdoms. The extremes between which it ſteers are each of them equally deſtructive of thoſe ends for which ſocieties were formed and are kept on foot. Where the magiſtrate, upon every ſucceſſion, is elected by the people, and may by the expreſs proviſion of the laws be depoſed (if not puniſhed) by his ſubjects, this may ſound like the perfection of liberty, and look well enough when delineated on paper; but in practice will be ever productive of tumult, contention, and anarchy. And, on the other hand, divine indefeaſible hereditary right, when coupled with the doctrine of unlimited paſſive obedience, is ſurely of all conſtitutions the moſt thoroughly ſlaviſh and dreadful. But when ſuch an hereditary right as our laws have created and veſted in the royal ſtock, is cloſely interwoven with thoſe liberties which are equally the inheritance of the ſubject; this union will form a conſtitution, in theory the moſt beautiful of any, in practice the moſt approved, and, we truſt, in duration the moſt permanent.

“In France the ſucceſſion to the monarchy was limited to heirs male (See Salic); but in Navarre the crown was inherited by the heir of line, whether male or female. The caſe ſtands thus: Philip the Fourth, king of France, ſurnamed *the Fair*, in the year 1285 eſpouſed Jane queen of Navarre in her own right; and as king conſort of this latter kingdom added the title of Navarre to his former one of France. Louis X. ſon and heir of Philip and Jane (ſurnamed *Hutin*, or the *Boiſterous*), ſucceeded to both crowns. By Margaret his firſt wife, who had been crowned queen of Navarre, he left one daughter Joan or Jane. His ſecond wife Clementia was pregnant at the time of his deceaſe, and was delivered of a poſthumous ſon, whom moſt of the French annaliſts recognize as John I. of France, though he lived no longer than three weeks. On his death the kingdom of France paſſed to Philip V. (ſurnamed the *Long*), and that of Navarre (to which the Salic law could by no conſtruction extend) to Joanna the only child and heir of Louis and Margaret. From Joanna, in lineal ſucceſſion, the kingdom of Navarre paſſed to Jane d'Albret, mother of Henry IV. of France, and wife of Anthony of Vendoſme, who as king conſort wore the crown of Navarre. On the acceſſion of Henry to the kingdom of France, the two monarchies were united, and the four ſucceeding princes aſſumed the joint titles. But if ever the monarchy be reſtored in France, Mary, princeſs royal and daughter of Louis XVI. will have the ſame right to the throne of Navarre that her uncle has to the throne of France; for ſhe is the undoubted heir of line of the great and illuſtrious Henry IV.”

SUCCINIC Acid, an acid extracted from amber by ſublimation in a gentle heat, and riſes in a concrete form into the neck of the ſubliming veſſel. The operation muſt not be puſhed too far, or by too ſtrong a fire, otherwiſe the oil of the amber riſes along with the acid. The ſalt is dried upon blotting paper, and purified by repeated ſolution and cryſtallization.

Lavoiſier's Elements of Chemiſtry.

The acid is ſoluble in 24 times its weight of cold water, and in a much ſmaller quantity of hot water. It poſſeſſes the qualities of an acid in a very ſmall degree, and only affects the blue vegetable colours very ſlightly. The affinities of this acid with the ſalifiable baſes were determined by Mr de Morveau, who is the firſt chemiſt that has endeavoured to aſcertain them.

SUCCINUM, Amber, in mineralogy, a ſpecies of bitumen claſſed under the inflammable ſubſtances. As a full account of this mineral was given under the word Amber, nothing remains but to mention a few things which recent experiments enable us to add. According to Dr Kirwan, 100 grains of amber afford about 72 of petroleum, 4.5 of ſuccinic acid, and a reſidue of fixed matter and water. Mr Scheele ſays, that, when diſtilled, it yields an aqueous acid reſembling vinegar in its qualities. This would induce us to believe it to be of vegetable origin. But its origin is a point not yet aſcertained. Its ſpecific gravity is from 1,065 to 1,100, and melts at 550° of Fahrenheit. Wallerius affirms, that mirrors, priſms, &c. may be made of amber.

SUCCORY, in botany. See Cichorium.

SUCCOTH (anc. geog.), a town which lay between the brook Jabbok and the river Jordon, where Jacob fixed his tents. There was another Succoth where the Iſraelites firſt encamped after their departure from Rameſes towards the Red Sea. Succoth ſignifies *tents*.

SUCCUBUS, a term uſed by ſome writers for a dæmon who aſſumes the ſhape of a woman, and as ſuch lies with a man; in which ſenſe it ſtands oppoſed to *incubus*, which was a dæmon in form of a man, that lies with a woman. But the truth is, the ſuccubus is only a ſpecies of the night-mare. See Medicine, n° 329.

SUCCULA, in mechanics, an axis or cylinder, with ſtaves in it to move it round; but without any tympanum or peritrochium.

SUCCULENT Plants, among botaniſts, ſuch whoſe leaves are thick and full of juice.

SUCKER, in ichthyology. See Cyclopterus.

SUCKERS, in gardening, the ſame with Offsets.

SUCKING-fish. See Echeneis.

SUCKLING (Sir John), an Engliſh poet and dramatic writer, was the ſon of Sir John Suckling, comptroller of the houſehold to king Chales I. and born at Witham in Eſſex in 1613. He diſcovered an uncommon propenſity to the acquiring of languages, inſomuch that he is reported to have ſpoken Latin at five years of age, and to have written it at nine. When he was grown up, he travelled; but ſeems to have affected nothing more than the character of a courtier and fine gentlemen; which he ſo far attained, that he was allowed to have the peculiar happineſs of making every thing he did become him. In his travels he made a campaign under the great Guſtavus Adolphus; and his loyalty, if not his valour, appeared in the beginning of the civil wars, for, after his return to England, he raiſed a troop of horſe for the king's ſervice entirely at his own charge; and mounted them ſo completely and richly, that they are ſaid to have coſt him 12,000 l. This troop, with Sir John at its head, behaved ſo ill in the engagement with the Scots, upon the Engliſh borders, in 1639, as to occaſion the famous lampoon compoſed by Sir John Mennis; “Sir John he got him an ambling nag,” &c. This ballad, which was ſet to a briſk tune, was much ſung by the parliamentarians, and continues to be ſung to this day. This diſaſtrous expedition, and the ridicule that attended it, was ſuppoſed to have haſtened his death; being ſeized by a fever, of which he died, at 28 years of age. He was a ſprightly wit, and an eaſy verſifier, but no great poet. His works, conſiſting of a few poems, letters, and plays, have nevertheleſs gone through ſeveral editions.

SUCTION, the act of ſucking or drawing up a fluid, as air, water, milk, or the like, by means of the mouth and lungs; or, in a ſimilar manner, by artificial means. See Pneumatics and Hydrostatics.

SUDATORY, a name given by the ancient Romans to their hot or ſweating rooms; ſometimes alſo called *Laconica*.

SUDEROE. See *Ferro-Iſlands*.

SUDORIFIC, an appellation given to any medicine that cauſes or promotes ſweat.

SUESSIONES, a branch of the Remi, a people of Gallia Belgica (Pliny); called ſometimes *Sueſſones*, in the lower age *Sueſſi*; ſituated between the Remi to the eaſt, the Nervii to the north, the Veromandui to the weſt, and the Meldæ to the ſouth, in the tract now called *le Soiſſonois*.—*Sueſſiones*, *Sueſſones*, and *Sueſſonæ*, the name of their city in the lower age; thought to have been formerly called *Noviodunum* (Cæſar), is now called *Soiſſons*.

SUET, Sevum, or *Sebum*, in anatomy, the ſolid fat found in ſeveral animals, as ſheep, oxen, &c. but not in the human ſpecies. See the article Fat.—It is of the ſevum that tallow is made.

SUETONIUS TRANQUILLUS (Caius), a famous Latin hiſtorian, was born at Rome, and became ſecretary to the emperor Adrian, about the 118th year of the Chriſtian era; but that poſt was taken from him three years after, when ſeveral perſons fell under that prince's diſpleaſure for not ſhowing the empreſs Sabina all the reſpect ſhe deſerved. During his diſgrace he compoſed many works, which are loſt. Thoſe now extant are his Hiſtory of the XII firſt Emperors, and a part of his Treatiſe of the Illuſtrious Grammarians and Rhetoricians. Pliny the Younger was his intimate friend, and perſuaded him to publiſh his books. His Hiſtory of the XII Roman Emperors has been much commended by moſt of our polite ſcholars. He repreſents, in a continued ſeries of curious and intereſting particulars, without any digreſſions or reflections, the actions of the emperors, without omitting their vices, which he expoſes with all their deformity, and with the ſame freedom mentions the good qualities of the very ſame perſons; but the horrid diſſoluteneſs and obſcene actions he relates of Tiberius, Caligula, Nero, &c. have made ſome ſay, that he wrote the lives of the emperors with the ſame licentiouſneſs with which they lived. The edition of this hiſtory procured by Grævius at Utrecht in 1672, with the excellent Commentaries of Torrentius and Caſaubon, and the notes of ſome other learned critics, is much eſteemed. Burman alſo publiſhed an edition in two vols. 4to with notes.

SUEVI, the Catti or Chatti of Cæſar (Strabo), placed on the Rhine: the reaſon of Cæſar's calling them thus does not appear, though conſiderably diſtant from the proper Suevi or Alemanni.

Suevi (Tacitus), a common name of the people ſituated between the Elbe and the Viſtula, diſtinguiſhed otherwiſe by particular names; as in Ptolemy, *Suevi Angeli*, *Suevi Sennones*.

SUEVUS (anc. geog.), a river of Germany, thought to be the ſame with the Viadrus or Oder, emptying itſelf at three mouths into the Baltic, the middlemoſt of which is called *Swine* or *Swene*; which laſt comes nearer the name *Suevus*.

SUEZ, a ſmall ſea-port town, ſituated near the northern extremity of the Red Sea, and about 30 hours journey eaſt from Cairo. The country around it is a ſandy plain, without the ſmalleſt ſpot of verdure. The only water which can be drunk is brought from El-Naba, or the ſpring, at the diſtance of three hours journey; and it is ſo brackiſh, that without a mixture of rum it is inſupportable to Europeans. The town itſelf is a collection of miſerable ruins, the khans being the only ſolid buildings; yet from March till June, the ſeaſon when the Jidda and Yambo fleet arrives, the town becomes crowded; but after its departure nobody remains except the governor, who is a Mamlouk, 12 or 14 perſons who form his houſehold, and the garriſon. The fortreſs is a defenceleſs heap of ruins, which the Arabs conſider as a citadel, becauſe it contains ſix braſs four pounders, and two Greek gunners, who turn their heads aſide when they fire. The harbour is a wretched quay, where the ſmalleſt boats are unable to reach the ſhore, except at the higheſt tides. There, however, the merchandiſe is embarked, to convey it over the banks of ſand to the veſſels which anchor in the road. This road, ſituated a league from the town, is ſeparated from it by a ſhore which is left dry at low water; it has no works for its defence, ſo that the veſſels which M. Volney tells us he has ſeen there, to the number of 28 at a time, might be attacked without oppoſition; for the ſhips themſelves are incapable of reſiſtance, none having any other artillery than four ruſty ſwivels.

Volney's Travels, vol. i.

Suez has always been, notwithſtanding its local diſadvantages, a place of great trade, on account of its geographical ſituation. It was by the gulph of Suez that the commodities of India were formerly conveyed to Europe, till the diſcovery of the paſſage by the Cape of Good Hope converted that trade into a new channel. As the iſthmus of Suez, which ſeparates the Red Sea from the Mediterranean, is not more than 57 miles, it has been frequently propoſed to join theſe two ſeas together by a canal. As there are no mountains nor remarkable inequalities of ſurface, this plan would at firſt view appear eaſy to be executed. But though the difference of levels would not prevent a junction, the great difficulty ariſes from the nature of the correſponding coaſts of the Mediterranean and the Red Sea, which are of a low and ſandy ſoil, where the waters form lakes, ſhoals, and moraſſes, ſo that veſſels cannot approach within a conſiderable diſtance. It will therefore be found ſcarcely poſſible to dig a permanent canal amid theſe ſhifting ſands: not to mention, that the ſhore is deſtitute of harbours, which muſt be entirely the work of art. The country beſides has not a drop of freſh water, and to ſupply the inhabitants, it muſt be brought as far as from the Nile.

The beſt and only method therefore of effecting this junction, is that which has been already ſucceſsfully practiſed at different times; which is, by making the river itſelf the medium of communication, for which the ground is perfectly well calculated; for Mount Mokattam ſuddenly terminating in the latitude of Cairo, forms only a low and ſemicircular mound, round which is a continued plain from the banks of the Nile as far as the point of the Red Sea. The ancients, who early underſtood the advantage to be derived from this ſituation, adopted the idea of joining the two ſeas by a canal connected with the river. Strabo * obſerves, that this was firſt executed under Seſoſtris, who reigned about the time of the Trojan war; and this work was ſo conſiderable as to occaſion it to be remarked, "that it was 100 cubits (or 170 feet) wide, and deep enough for large veſſels." After the Greeks conquered the country, it was reſtored by the Ptolemies, and again renewed by Trajan. In ſhort, even the Arabs themſelves followed theſe examples. "In the time of Omar ebn-el-Kattab (ſays the hiſtorian El Makin), the cities of Mecca and Medina ſuffering from famine, the Calif ordered Amrou governor of Egypt to cut a canal from the Nile to Kolzoum, that the contributions of corn and barley appointed for Arabia might be conveyed that way."

This canal is the ſame which runs at preſent to Cairo, and loſes itſelf in the country to the north-eaſt of Berket-el-Hadj, or the Lake of the Pilgrims.

The place on the weſt coaſt of the gulph of Suez, where the children of Iſrael are ſuppoſed to have entered it, is called *Badea*, about ſix miles to the north of Cape Korondel, on the other ſide of the gulph, as we are informed in a letter from the ingenious Edward Wortley Montague, F. R. S. to Dr Watſon, containing an account of his journey from Cairo to the Written Mountains in the deſert of Sinai. Oppoſite to Badea is a ſtrong current which ſets to the oppoſite ſhore, about ſouth-eaſt, with a whirlpool called *Birque Pharoane*, the *well* or *pool of Pharoah*, being the place where his hoſt is ſaid to have been deſtroyed. We are told by the ſame gentleman, that the Egyptian ſhore from Suez to Badea is ſo rocky and ſteep, that there was no entering upon the gulph but at one of theſe two places.

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* Lib. xvii.

The Britiſh nation, we believe, never attempted to carry on commerce with any of the ports of the Red Sea beyond Jidda, till, on the ſuggeſtion of Mr Bruce, in 1776, ſome Britiſh merchants at Bengal equipped two or three veſſels for Suez, laden with piece-goods of Bengal and coaſt manufactures. The command of the veſſels was committed to Captain Greig, a meritorious ſeaman; and the management of the goods was entruſted to Mr Straw, a gentleman diſtinguiſhed for his mercantile knowledge. The ſale turned out to advantage; but ſuch great expences were incurred in making preſents to the bey of Cairo and Suez, as to conſume the whole profits gained by the ſale of the cargo. The great purpoſe of the expedition was, however, accompliſhed, as a firman was obtained from the government of Cairo to trade by the way of Suez. In conſequence of this, three ſhips went to Suez the following year, and as many in 1778. The opening of this trade alarmed the jealouſy of the Eaſt India Company; they applied to government, and orders were given to relinquiſh this promiſing commerce. Theſe orders reached Egypt ſooner than Bengal, and the conſequence was fatal to the unfortunate adventurers who viſited Suez that year (1779). By a plan concerted between the beys, a large body of Bedouin Arabs attacked the caravan paſſing from Suez to Cairo with goods valued at 12 lacks of rupees. The goods were plundered, the Europeans were ſtripped and left naked in the deſert, expoſed to the burning rays of the ſun, without a drop of water to quench their thirſt, or food to ſupport life. Moſt of them died, and ſome of their bodies were afterwards found mangled and disfigured by wolves. We have been favoured with a particular account of the ſufferings of theſe unfortunate men by a correſpondent, which, we are ſorry, we have not room to inſert. Thoſe who wiſh to obtain a more full account may conſult the Annual Regi- for 1781 or 1782.

SUFFETULA (anc. geog.), a town of Africa, in the dominions of Carthage; probably ſo called from Suffetes, the title of the magiſtrates of that city. It is now called *Spaitla*, in the kingdom of Tunis, and has many elegant remains of antiquity. There are three temples in a great meaſure entire; one of them of the Compoſite order, the other two Corinthian. "A beautiful and perfect capital of the Compoſite order (ſays Mr Bruce), the only perfect one that now exiſts, is deſigned in all its parts in a very large ſize; and with the detail of the reſt of the ruin, is a precious monument of what that order was, now in the collection of the king." The town itſelf (he ſays) is ſituated in the moſt beautiful ſpot in Barbary, ſurrounded by great numbers of juniper-trees, and watered by a pleaſant ſtream, which ſinks under the earth at that place, without appearing any more.

SUFFOCATION, in medicine, the privation of reſpiration or breathing. See the articles DROWNING, HANGING, &c.

SUFFOLK, a county of England. Its name is contracted from *Southfolk*, ſo called from its ſituation in regard to Norfolk. It is bounded on the weſt by Cambridgeſhire; on the ſouth by Eſſex, from which it is parted by the river Stour; on the eaſt by the German Ocean; and on the north by Norfolk, ſeparated from it by the Leſſer Ouſe and the Waveney. From weſt to eaſt it is 52 miles in length, about 20 at a medium in breadth, and 196 in circumference. It contains 22 hundreds, 29 market-towns, 575 pariſhes, upwards of 34,000 houſes, and more than 200,000 inhabitants. The whole is divided into two parts, viz. the Liberty of St Edmund, and the Geldable; the former of which contains the weſt parts of the county, and the other the eaſt; and there is a grand jury for each at the aſſizes. The air is reckoned as wholeſome and pleaſant as any in the kingdom, nor is it otherwiſe upon the ſea coaſt, which is dry and ſandy, and free from ſalt marſhes. The ſoil, except to the weſt and upon the ſea-coaſt, is very rich, being a compound of clay and marle. Towards the ſea there are large heaths and tracts of ſand; but theſe produce hemp, rye, and peaſe, and feed great flocks of ſheep. About Newmarket the ſoil is much the ſame; but in high Suffolk or the woodlands, beſides wood, there are very rich paſtures, where abundance of cattle are fed. In other parts of the country, as about Bury, there is plenty of corn. As this county is noted for the richneſs of its paſtures, ſo is it for butter and cheeſe, eſpecially the former, which is ſaid to be remarkably good; ſo that being packed up in firkins, it is ſold for all uſes both by ſea and land, and conveyed to many parts of England, eſpecially to London. The inland parts of the county are well ſupplied with wood for fuel, and thoſe upon the ſea-coaſt with coals from Newcaſtle. The manufactures of the county are chiefly woollen and linen cloth. It lies in the dioceſe of Norwich, has two archdeacons, viz. of Sedbury and Suffolk; gives title of earl to a branch of the Howards; ſends two members to parliament for the county, and two for each of the following places, Ipſwich, Dunwich, Orford, Aldborough, Sudbury, Eye, and St Edmund's-Bury. The county is extremely well watered by the following rivers, which either traverſe its borders, or run acroſs into the German Ocean, viz. the Leſſer Ouſe, the Waveney, the Blithe, the Deben, the Orwell or Gipping, and the Stour.

Gough's edition of Camden's Britannia.

SUFFRAGAN, an appellation given to ſimple biſhops with regard to archbiſhops, on whom they depend, and to whom appeals lie from the biſhops' courts.

Suffragan is likewiſe the appellation given to a biſhop, who is occaſionally appointed to reſide in a town or village, and aſſiſt the dioceſan.

SUFFRAGE, denotes a vote given in an aſſembly, where ſomething is deliberated on, or where a perſon is elected to an office or benefice.

SUFFRUTEX, among botaniſts, denotes an underſhrub, or the loweſt kind of woody plants, as lavender.

SUGAR, a ſolid ſweet ſubſtance obtained from the juice of the ſugar-cane; or, according to chemiſts, an eſſential ſalt, capable of cryſtallization, of a ſweet and agreeable flavour, and contained in a greater or leſs quantity in almoſt every ſpecies of vegetables, but moſt abundant in the ſugar-cane.

1 Value of ſugar.

As the ſugar-cane is the principal production of the Weſt Indies, and the great ſource of their riches; as it is ſo important in a commercial view, from the employment which it gives to ſeamen, and the wealth which it opens for merchants; and beſides is now become a neceſſary of life—it may juſtly be eſteemed one of the moſt valuable plants in the world. The quantity conſumed in Europe is eſtimated at nine millions Sterling, and the demand would probably be greater if it could be ſold at a reduced price. Since ſugar then is reckoned ſo precious a commodity, it muſt be an object of deſire to all perſons of curioſity and reſearch, to obtain ſome general knowledge of the hiſtory and nature of the plant by which it is produced, as well as to underſtand the proceſs by which the juice is extracted and refined. We will therefore firſt inquire in what countries it originally flouriſhed, and when it was brought into general uſe, and became an article of commerce.

From the few remains of the Grecian and Roman authors which have ſurvived the ravages of time, we can find no proofs that the juice of the ſugar-cane was known at a very early period. There can be no doubt, however, that in thoſe countries where it was indigenous its value was not long

2
Was probably known to the ancient Jews.

concealed. It is not improbable that it was known to the ancient Jews; for there is ſome reaſon to ſuppoſe, that the Hebrew word קנה, which occurs frequently in the Old Teſtament, and is by our tranſlators rendered ſometimes *calamus* and ſometimes *ſweet-cane*, does in fact mean the ſugar-cane. The firſt paſſage in which we have obſerved it mentioned is Exod. xxx. 23. where Moſes is commanded to make an ointment with myrrh, cinnamon, kené, and caſſia. Now the kené does not appear to have been a native of Egypt nor of Judea; for in Jeremiah vi. 20. it is mentioned as coming from a far country. "To what purpoſe cometh there to me incenſe from Sheba and the ſweet-cane from a far country?" This is not true of the calamus aromaticus, which grows ſpontaneouſly in the Levant, as well as in many parts of Europe. If the cinnamon mentioned in the paſſage of Exodus quoted above was true cinnamon, it muſt have come from the Eaſt Indies, the only country in the world from which cinnamon is obtained. There is no difficulty therefore in ſuppoſing, that the ſugar-cane was exported from the ſame country. If any credit be due to etymology, it confirms the opinion that kené denotes the ſugar-cane; for the Latin word *canna* and the Engliſh word *cane* are evidently derived from it. It is alſo a curious fact, that *ſachar* or *ſheker* ‡, in Hebrew, ſignifies *inebriation*, from which the Greek word σακχαρ "ſugar" is undoubtedly to be traced.

3
Account of it by Greek and Roman authors.

The ſugar-cane was firſt made known to the weſtern parts of the world by the conqueſts of Alexander the Great. Strabo * relates that Nearchus his admiral found it in the Eaſt Indies in the year before Chriſt 325. It is evidently alluded to in a fragment of Theophraſtus, preſerved in Photius. Varro, who lived A. C. 68, deſcribes it in a fragment quoted by Iſidorus § as a fluid preſſed from reeds of a large ſize, which was ſweeter than honey ‖. Dioſcorides, about the year 35 before Chriſt, ſays "that there is a kind of honey called *ſaccharon*, which is found in India and Arabia Felix. It has the appearance of ſalt, and is brittle when chewed. If diſſolved in water, it is beneficial to the bowels and ſtomach, is uſeful in diſeaſes of the bladder and kidneys, and, when ſprinkled on the eye, removes thoſe ſubſtances that obſcure the ſight." This is the firſt account we have of its medical qualities. Galen often preſcribed it as a medicine. Lucan relates, that an oriental nation in alliance with Pompey uſed the juice of the cane as a common drink.

> *Quique bibunt tenera dulces ab arundine ſuccos.*
> Lib. iii. 237.

Pliny ſays it was produced in Arabia and India, but that the beſt came from the latter country. It is alſo mentioned by Arrian, in the Periplus of the Red Sea, by the name of Σακχαρ (*ſachar*) as an article of commerce from India to the Red Sea. Ælian ¶, Tertullian ‡, and Alexander Aphrodiſæus †, mention it as a ſpecies of honey procured from canes (A).

4
Is a native of the Eaſt Indies.

That the ſugar-cane is an indigenous plant in ſome parts of the Eaſt Indies, we have the ſtrongeſt reaſon to believe; for Thunberg found it in Japan, and has accordingly mentioned it as a native of that country in his *Flora Japonica*, publiſhed in 1784. Oſbeck alſo found it in China in 1751. It may indeed have been tranſplanted from ſome other country; but as it does not appear from hiſtory that the inhabitants of Japan or China ever carried on any commerce with remote nations, it could only be conveyed from ſome neighbouring country. Marco Polo, a noble Venetian, who travelled into the Eaſt about the year 1250, found ſugar in abundance in Bengal. Vaſco de Gama, who doubled the Cape of Good Hope in 1497, relates, that a conſiderable trade in ſugar was then carried on in the kingdom of Calicut. On the authority of Dioſcorides and Pliny, too, we ſhould be diſpoſed to admit, that it is a native of Arabia, did we not find, on conſulting Niebuhr's Travels, that that botaniſt has omitted it when enumerating the moſt valuable plants of that country. If it be a ſpontaneous production of Arabia, it muſt ſtill flouriſh in its native ſoil. Mr Bruce found it in Upper Egypt. If we may believe the relation of Giovan Lioni, a conſiderable trade was carried on in ſugar in Nubia in 1500: it abounded alſo at Thebes, on the Nile, and in the northern parts of Africa, about the ſame period.

5
Introduced into Europe probably during the cruſades.

There is reaſon to believe that the ſugar-cane was introduced into Europe during the cruſades; expeditions which however romantic in their plan, and unſucceſsful in their execution, were certainly productive of many advantages to the nations of Europe. Albertus Aquenſis, a monkiſh writer, obſerves, that the Chriſtian ſoldiers in the Holy Land frequently derived refreſhment and ſupport during a ſcarcity of proviſions by ſucking the canes. This plant flouriſhed alſo in the Morea, and in the iſlands of Rhodes and Malta; from which it was tranſported into Sicily. The date of this tranſaction it is not eaſy to aſcertain; but we are ſure that ſugar was cultivated in that iſland previous to the year 1166; for Lafitau the Jeſuit, who wrote a hiſtory of the Portugueſe diſcoveries, mentions a donation made that year to the monaſtery of St Bennet, by William the ſecond king of Sicily, of a mill for grinding ſugar-canes, with all its rights, members, and appurtenances.

From Sicily, where the ſugar-cane ſtill flouriſhes on the ſides of mount Hybla, it was conveyed to Spain, Madeira, the Canary and Cape de Verd iſlands, ſoon after they were diſcovered in the 15th century.

D'Orvile's Travels.

6
Suppoſed by ſome not a native of America or the Weſt Indies.

An opinion has prevailed, that the ſugar-cane is not a native of the weſtern continent, or its adjacent iſlands the Weſt Indies, but was conveyed thither by the Spaniards or Portugueſe ſoon after the diſcovery of America by Columbus. From the teſtimony of Peter Martyr, in the third book of his firſt decade, compoſed during Columbus's ſecond voyage, which commenced in 1493 and ended in 1495, it appears, that the ſugar-cane was known at that time in Hiſpaniola. It may be ſaid, that it was brought thither by Columbus; but for this aſſertion we have found no direct evidence; and though we had direct evidence, this would not prove that the ſugar-cane was not an indigenous plant of the Weſt Indies. There are authors of learning who, after inveſtigating this ſubject with attention, do not heſitate to maintain, that it is a native both of the iſlands and of the continent of America.

7
This opinion oppoſed by Labat.

P. Labat has ſupported this opinion with much appearance of truth ‡; and, in particular, he appeals to the teſtimony of Thomas Gage, an Engliſhman, who viſited New Spain in 1625. Gage enumerates ſugar-canes among the proviſions with which the Charaibes of Guadaloupe ſupplied his ſhip. "Now (ſays Labat) it is a fact that the Spaniards had never cultivated an inch of ground in the Smaller Antilles. Their ſhips commonly touched at thoſe iſlands indeed for wood and water; and they left ſwine in the view of ſupplying with freſh proviſions ſuch of their countrymen as might call there in future; but it would be abſurd in the higheſt

‡ שכר.

* Lib. xv.

§ Lib. xvii. cap 7.

‖ Matthioli Dios cap. lxxv.

¶ Nat. Hiſt.

‡ De Judicio Dei.

† Lib. ii. Prob. 79.

‡ Tom. iii. c. xv.

(A) For a more minute account of the hiſtory of ſugar in the early and middle ages, a paper of the Mancheſter Tranſactions, in Volume IV. by Dr Falconer, may be conſulted.

higheſt degree to ſuppoſe, that they would plant ſugar-canes, and at the ſame time put hogs aſhore to deſtroy them.

"Neither had the Spaniards any motive for beſtowing this plant on iſlands which they conſidered as of no kind of importance, except for the purpoſe that has been mentioned; and to ſuppoſe that the Charaibes might have cultivated, after their departure, a production of which they knew nothing, betrays a total ignorance of the Indian diſpoſition and character.

8 From teſtimony.

"But (continues Labat) we have ſurer teſtimony, and ſuch as proves, beyond all contradiction, that the ſugar-cane is the natural production of America. For, beſides the evidence of Francis Ximines, who, in a Treatiſe on American Plants, printed at Mexico, aſſerts, that the ſugar-cane grows without cultivation, and to an extraordinary ſize, on the banks of the river Plate, we are aſſured by Jean de Lery, a Proteſtant miniſter, who was chaplain in 1556 to the Dutch garriſon in the fort of Coligny, on the river Janeiro, that he himſelf found ſugar-canes in great abundance in many places on the banks of that river, and in ſituations never viſited by the Portugueſe. Father Hennepen and other voyagers bear teſtimony in like manner to the growth of the cane near the mouth of the Miſſiſſippi; and Jean de Laet to its ſpontaneous production in the iſland of St Vincent. It is not for the plant itſelf, therefore, but for the ſecret of making ſugar from it, that the Weſt Indies are indebted to the Spaniards and Portugueſe; and theſe to the nations of the eaſt."

Such is the reaſoning of Labat, which the learned Laſitau has pronounced incontrovertible; and it is greatly ſtrengthened by recent diſcoveries, the ſugar-cane having been found in many of the iſlands of the Pacific Ocean by the late illuſtrious navigator Captain Cook.

9 Deſcription of the ſugar-cane.

The ſugar-cane, or ſaccharum officinarum of botaniſts, is a jointed reed, commonly meaſuring (the flag part not included) from three feet and a half to ſeven feet in height, but ſometimes riſing to 12 feet. When ripe it is of a fine ſtraw colour inclining to yellow, producing leaves or blades, the edges of which are finely and ſharply ſerrated, and terminating in an arrow decorated with a panicle. The joints in one ſtalk are from 40 to 60 in number, and the ſtalks riſing from one root are ſometimes very numerous. The young ſhoot aſcends from the earth like the point of an arrow; the ſhaft of which ſoon breaks, and the two firſt leaves, which had been incloſed within a quadruple ſheath of ſeminal leaves, riſe to a conſiderable height (B). See Plate CCCCLXXXVI. M is the arrow and N the lower part with the root.

10 Soil moſt favourable to its growth.

As the cane is a rank ſucculent plant, it muſt require a ſtrong deep ſoil to bring it to perfection, perhaps indeed no ſoil can be too rich for this purpoſe. The ſoil which experience has found to be moſt favourable to the cultivation of it in the Weſt Indies is the dark grey loam of St Chriſtopher's, which is ſo light and porous as to be penetrable by the ſlighteſt application of the hoe. The under ſtratum is gravel from 8 to 12 inches deep. Canes planted in particular ſpots in this iſland have been known to yield 8000 pounds of Muſcovado ſugar from a ſingle acre. The average produce of the iſland for a ſeries of years has been 16,000 hogſheads of 16 cwt. which is one-half only of the whole cane-land, or 8500 acres. When annually cut, it gives nearly two hogſheads of 16 cwt. per acre for the whole of the land in ripe canes.

Next to the aſhy loam of St Chriſtopher's is the ſoil which in Jamaica is called *brick-mold;* not as reſembling a brick in colour, but as containing ſuch a due mixture of clay and ſand as is ſuppoſed to render it well adapted for the uſe of the kiln. It is a deep, warm, and mellow, hazel earth, eaſily worked; and though its ſurface ſoon grows dry after rain, the under ſtratum retains a conſiderable degree of moiſture in the drieſt weather; with this advantage too, that even in the wetteſt ſeaſon it ſeldom requires trenching. Plant-canes, by which is meant canes of the firſt growth, have been known in very fine ſeaſons to yield two tons and a half of ſugar per acre. After this may be reckoned the black mold of ſeveral varieties. The beſt is the deep black earth of Barbadoes, Antigua, and ſome other of the windward iſlands; but there is a ſpecies of this mold in Jamaica that is but little, if any thing inferior to it, which abounds with limeſtone and flint on a ſubſtratum of ſoapy marle. Black mold on clay is more common; but as the mold is generally ſhallow, and the clay ſtiff and retentive of water, this laſt ſort of land requires great labour, both in ploughing and trenching, to render it profitable. When manured and properly pulverized, it becomes very productive. It is unneceſſary to attempt a minute deſcription of all the other ſoils which are found in theſe iſlands. There is, however, a peculiar ſort of land on the north ſide of Jamaica, chiefly in the pariſh of Trelawney, that cannot be paſſed over unnoticed, not only on account of its ſcarcity but its value; few ſoils producing finer ſugars, or ſuch *as anſwer ſo well in the pan;* an expreſſion ſignifying a greater return of refined ſugar than common. The land alluded to is generally of a red colour; the ſhades of which, however, vary conſiderably from a deep chocolate to a rich ſcarlet; in ſome places it approaches to a bright yellow, but it is everywhere remarkable, when firſt turned up, for a gloſſy or ſhining ſurface, and if wetted ſtains the fingers like paint.

Edwards's Hiſtory of the Weſt Indies, vol. ii.

11 Proper ſeaſon for planting it.

And in every climate there is a ſeaſon more favourable for vegetation than others, it is of great importance that plants for ſeed be committed to the ground at the commencement of this ſeaſon. As the cane requires a great deal of moiſture to bring it to maturity, the propereſt ſeaſon for planting it is in the months of September and October, when the autumnal rains commence, that it may be ſufficiently luxuriant to ſhade the ground before the dry weather ſets in. Thus the root is kept moiſt, and the crop is ripe for the mill in the beginning of the enſuing year. Canes planted in the month of November, or later in the ſeaſon, loſe the advantage of the autumnal rains; and it often happens that dry weather in the beginning of the enſuing year retards their vegetation until the vernal or May rains ſet in, when they ſprout both at the roots and the joints; ſo that by

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(B) "A field of canes, when ſtanding, in the month of November, when it is in arrow or full bloſſom (ſays Mr Beckford in his deſcriptive Account of the Iſland of Jamaica), is one of the moſt beautiful productions that the pen or pencil can poſſibly deſcribe. It in common riſes from three to eight feet or more in height; a difference of growth that very ſtrongly marks the difference of ſoil or the varieties of culture. It is when ripe of a bright and golden yellow; and where obvious to the ſun, is in many parts very beautifully ſtreaked with red: the top is of a darkiſh green; but the more dry it becomes, from either an exceſs of ripeneſs or a continuance of drought, of a ruſſet yellow, with long and narrow leaves depending; from the centre of which ſhoots up an arrow like a ſilver wand from two to ſix feet in height; and from the ſummits of which grows out a plume of white feathers, which are delicately fringed with a lilac dye; and indeed is, in its appearance, not much unlike the tuft that adorns this particular and elegant tree."

by the time they are cut the field is loaded with unripe ſuckers inſtead of ſugar-canes. A January plant, however, commonly turns out well; but canes planted very late in the ſpring, though they have the benefit of the May rains, ſeldom anſwer expectation; for they generally come in unſeaſonably, and throw the enſuing crops out of regular rotation. They are therefore frequently cut before they are ripe; or if the autumnal ſeaſons ſet in early, are cut in wet weather, which has probably occaſioned them to ſpring afreſh; in either caſe the effect is the ſame: The juice is unconcocted, and all the ſap being in motion, the root is deprived of its natural nouriſhment, to the great injury of the ratoon. The chief objection to a fall plant is this, that the canes become rank and top heavy, at a period when violent rains and high winds are expected, and are therefore frequently lodged before they are fit to be cut.

The ſugar-cane is propagated by the top-ſhoots, which are cut from the tops of the old canes. The uſual method of planting in the Weſt Indies is this: The quantity of land intended to be planted, being cleared of weeds and other incumbrances, is firſt divided into ſeveral plats of certain dimenſions, commonly from 15 to 20 acres each; the ſpaces between each plat or diviſion are left wide enough for roads, for the coveniency of carting, and are called *intervals*. Each plat is then ſubdivided, by means of a line and wooden pegs, into ſmall ſquares of about three feet and a half. Sometimes indeed the ſquares are a foot larger; but this circumſtance makes but little difference. The negroes are then placed in a row in the firſt line, one to a ſquare, and directed to dig out with their hoes the ſeveral ſquares, commonly to the depth of five or ſix inches. The mold which is dug up being formed into a bank at the lower ſide, the excavation or cane-hole ſeldom exceeds 15 inches in width at the bottom, and two feet and a half at the top. The negroes then fall back to the next line, and proceed as before. Thus the ſeveral ſquares between each line are formed into a trench of much the ſame dimenſions with that which is made by the plough. An able negro will dig from 100 to 120 of theſe holes for his day's work of ten hours; but if the land has been previouſly ploughed and lain fallow, the ſame negro will dig nearly double the number in the ſame time (c).

The cane-holes or trench being now completed, whether by the plough or by the hoe, and the cuttings ſelected for planting, which are commonly the tops of the canes that have been ground for ſugar (each cutting containing five or ſix gems), two of them are ſufficient for a cane hole of the dimenſions deſcribed. Theſe, being placed longitudinally in the bottom of the hole, are covered with mold about two inches deep; the reſt of the bank being intended for future uſe. In 12 or 14 days the young ſprouts begin to appear; and as ſoon as they riſe a few inches above the ground, they are, or ought to be, carefully cleared of weeds, and furniſhed with an addition of mold from the banks. This is uſually performed by the hand. At the end of four or five months the banks are wholly levelled, and the ſpaces between the rows carefully hoe-ploughed. Frequent cleanings, while the canes are young, are indeed ſo eſſentially neceſſary, that no other merit in an overſeer can compenſate for the want of attention in this particular. A careful manager will remove at the ſame time all the lateral ſhoots or ſuckers that ſpring up after the canes begin to joint, as they ſeldom come to maturity, and draw nouriſhment from the original plants.

14
The plough might be uſed with advantage.

“In the cultivation of other lands, in Jamaica eſpecially (ſays Mr Edwards, the elegant hiſtorian of the Weſt Indies, whoſe ſuperior excellence has induced us frequently to refer to him in the courſe of this article), the plough has been introduced of late years, and in ſome few caſes to great advantage; but it is not every ſoil or ſituation that will admit the uſe of the plough; ſome lands being much too ſtony, and others too ſteep; and I am ſorry I have occaſion to remark, that a practice commonly prevails in Jamaica, on properties where this auxiliary is uſed, which would exhauſt the fineſt lands in the world. It is that of ploughing, then croſs-ploughing, round-ridging, and harrowing the ſame lands from year to year, or at leaſt every other year, without affording manure: accordingly it is found that this method is utterly deſtructive of the ratoon or ſecond growth, and altogether ruinous. It is indeed aſtoniſhing that any planter of common reading or obſervation ſhould be paſſive under ſo pernicious a ſyſtem. Some gentlemen, however, of late manage better: their practice is to break up ſtiff and clayey land, by one or two ploughings, early in the ſpring, and give it a ſummer's fallow. In the autumn following, being then mellow and more eaſily worked, it is holed and planted by manual labour after the old method, which has been already deſcribed. But in truth, the only advantageous ſyſtem of ploughing in the Weſt Indies is to confine it to the ſimple operation of holing, which may certainly be performed with much greater facility and diſpatch by the plough than by the hoe; and the relief which, in the caſe of ſtiff and dry ſoils, is thus given to the negroes, exceeds all eſtimation, in the mind of a humane and provident owner. On this ſubject I ſpeak from practical knowledge. At a plantation of my own, the greateſt part of the land which is annually planted is neatly and ſufficiently laid into cane-holes, by the labour of one able man, three boys, and eight oxen, with the common ſingle-wheeled plough. The plough-ſhare indeed is ſomewhat wider than uſual; but this is the only difference, and the method of ploughing is the ſimpleſt poſſible. By returning the plough back along the furrow, the turf is alternately thrown to the right and to the left, forming a trench ſeven inches deep, about two feet and a half wide at the top, and one foot wide at the bottom. A ſpace of 18 or 20 inches is left between each trench, on which the mold being thrown by the ſhare, the banks are properly formed, and the holing is complete. Thus the land is not exhauſted by being too much expoſed to the ſun; and in this manner a field of 20 acres is holed with one plough, and with great eaſe, in 13 days. The plants are afterwards placed in the trench as in the common method, where manual labour alone is employed.

Edwards's Hiſtory of the Weſt Indies, vol. ii.

15
Canes named according to the age of their roots.

In moſt parts of the Weſt Indies it is uſual to hole and plant a certain proportion of the cane-land, commonly one-third in annual rotation. Canes of the firſt year's growth are called *plant canes*, as has been already obſerved. The ſprouts that ſpring from the roots of the canes that have been

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(c) As the negroes work at this buſineſs very unequally, according to their different degrees of bodily ſtrength, it is ſometimes the practice to put two negroes to a ſingle ſquare; but if the land has not had the previous aſſiſtance of the plough, it commonly requires the labour of 50 able negroes for 13 days to hole 20 acres. In Jamaica, ſome gentlemen, to eaſe their own ſlaves, have this laborious part of the planting-buſineſs performed by job-work. The uſual price for holing and planting is L. 6 currency *per* acre (equal to L. 4, 7s. Sterling). The coſt of falling and clearing heavy woodland is commonly as much more.

been previouſly cut for ſugar are called *ratoons*; the firſt yearly returns from their roots are called *firſt ratoons*; the ſecond year's growth *ſecond ratoons*.

16 Manures employed.

Mr Edwards informs us, that the manure generally uſed is a compoſt formed, 1ſt, Of the vegetable aſhes, drawn from the fires of the boiling and ſtill houſes. 2dly, Feculencies diſcharged from the ſtill-houſe, mixed up with rubbiſh of buildings, white-lime, &c. 3dly, Refuſe, or field-traſh (*i e.*), the decayed leaves and ſtems of the canes; ſo called in contradiſtinction to cane-traſh, reſerved for fuel. 4thly, Dung, obtained from the horſe and mule ſtables, and from moveable pens, or ſmall incloſures made by poſts and rails, occaſionally ſhifted upon the lands intended to be planted, and into which the cattle are turned at night. 5thly, Good mold, collected from gullies and other waſte places, and thrown into the cattle pens.

17 The ſugar-cane deſtroyed by monkeys.

The ſugar-cane is liable to be deſtroyed by monkeys, rats, and inſects. The upland plantations ſuffer greatly from monkeys; theſe creatures, which now abound in the mountainous parts of St Chriſtopher's, were firſt brought thither by the French, when they poſſeſſed half that iſland; they come down from the rocks in ſilent parties by night, and having poſted centinels to give the alarm if any thing approaches, they deſtroy incredible quantities of the cane, by their gambols as well as their greedineſs. It is in vain to ſet traps for theſe creatures, however baited; and the only way to protect the plantation, and deſtroy them, is to ſet a numerous watch, well armed with fowling-pieces, and furniſhed with dogs. The negroes will perform this ſervice cheerfully, for they are very fond of monkeys as food. The celebrated Father Labat ſays, they are very delicious, but the white inhabitants of St Kitt's never eat them.

Grainger's Hiſtory of the Sugar-cane.

18 Rats.

The low-land plantations ſuffer as much by rats as thoſe on the mountains do from monkeys; but the rats, no more than the monkeys, are natives of the place; they came with the ſhipping from Europe, and breed in the ground under looſe rocks and buſhes: the field negroes eat them greedily, and they are ſaid to be publicly ſold in the markets at Jamaica. To free the plantations from theſe vermin, the breed of wild cats ſhould be encouraged, and ſnakes ſuffered to multiply unmoleſted; they may alſo be poiſoned with arſenic, and the raſped root of the caſſava made into pellets, and plentifully ſcattered over the grounds. This practice, however, is dangerous; for as the rats when thus poiſoned become exceeding thirſty, they run in droves to the neighbouring ſtreams, which they poiſon as they drink, and the cattle grazing on the banks of theſe polluted waters have frequently periſhed by drinking after them: It is ſafer therefore to make the pellets of flour, kneaded with the juice of the night-ſhade, the ſcent of which will drive them away though they will not eat it. There is an Eaſt Indian animal called *mungoes*, which bears a natural antipathy to rats; if this animal was introduced into the ſugar iſlands, it would probably extirpate the whole race of theſe noxious vermin. The *formica omnivora* of Linnæus, the carnivorous ant, which is called in Jamaica the *raffle's ant*, would ſoon clear a ſugar plantation of rats.

19 And inſects.

The ſugar-cane is alſo ſubject to a diſeaſe which no foreſight can obviate, and for which human wiſdom has hitherto in vain attempted to find a remedy. This diſeaſe is called the *blaſt*, and is occaſioned by the *aphis* of Linnæus. When this happens, the fine, broad, green blades become ſickly, dry, and withered; ſoon after they appear ſtained in ſpots; and if theſe ſpots are carefully examined, they will be found to contain innumerable eggs of an inſect like a bug, which are ſoon quickened, and cover the plants with the vermin: the juice of the canes thus affected becomes ſour, and no future ſhoot iſſues from the joints. Ants alſo concur with the bugs to ſpoil the plantation, and againſt theſe evils it is hard to find a remedy.

20 Time at which the crop ripen

The crops of ſugar-canes do not ripen preciſely at the ſame period in all the colonies. In the Daniſh, Spaniſh, and Dutch ſettlements, they begin in January, and continue till October. This method doth not imply any fixed ſeaſon for the maturity of the ſugar-cane. The plant, however, like others, muſt have its progreſs; and it hath been juſtly obſerved to be in flower in the months of November and December. It muſt neceſſarily follow, from the cuſtom theſe nations have adopted of continuing to gather their crops for 10 months without intermiſſion, that they cut ſome canes which are not ripe enough, and others that are too ripe, and then the fruit hath not the requiſite qualities. The time of gathering them ſhould be at a fixed ſeaſon, and probably the months of March and April are the fitteſt for it; becauſe all the ſweet fruits are ripe at that time, while the ſour ones do not arrive to a ſtate of maturity till the months of July and Auguſt.

Raynal's Hiſtory of the Eaſt and Weſt Indies, vol. iv.

The Engliſh cut their canes in March and April; but they are not induced to do this on account of their ripeneſs. The drought that prevails in their iſlands renders the rains which fall in September neceſſary to their planting; and as the canes are 18 months in growing, this period always brings them to the preciſe point of maturity (D).

21 A ſeaſon of feſtivity. Edwards, vol. ii. p. 226.

"The time of crop in the ſugar iſlands (ſays Mr Edwards) is the ſeaſon of gladneſs and feſtivity to man and beaſt. So palatable, ſalutary, and nouriſhing, is the juice of the cane, that every individual of the animal creation, drinking freely of it, derives health and vigour from its uſe. The meagre and ſickly among the negroes exhibit a ſurpriſing alteration in a few weeks after the mill is ſet in action. The labouring horſes, oxen, and mules, though almoſt conſtantly at work during this ſeaſon, yet, being indulged with plenty of the green tops of this noble plant, and ſome of the ſcummings from the boiling-houſe, improve more than at any other period of the year. Even the pigs and poultry fatten on the refuſe. In ſhort, on a well-regulated plantation, under a humane and benevolent director, there is ſuch an appearance during crop-time of plenty and buſy cheerfulneſs, as to ſoften, in a great meaſure, the hardſhips of ſlavery, and induce a ſpectator to hope, when the miſeries of life are repreſented as inſupportable, that they are ſometimes exaggerated through the medium of fancy."

The plants being cut, the branches at the top are given to the cattle for food; the top ſhoot, which is full of eyes, is

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(D) The account given in the text concerning the time when the ſugar-canes are collected, we have taken from the Abbé Raynal's Hiſtory of the Trade and Settlements of the Eaſt and Weſt Indies; but Mr Cazaud obſerves, that in February, March, and April, all the canes, whatever be their age, are as ripe as the nature of the ſoil ever allows them to be. He ſays farther, that the dryneſs of the weather, and not the age of the canes, which increaſes from January to April, is the cauſe that in January 400 gallons of juice commonly yield 48 gallons of ſugar and molaſſes, one with another; in February from 56 to 64; in March from 64 to 72; in April ſometimes 80; after which period the ſugar ferments, and even burns, when the refiner is not very expert at his buſineſs.

Philoſoph. Tranſact. vol. lxix.

22 e canes en cut ſent to mill.

is preſerved for planting. The canes are cut into pieces about a yard long, tied up in bundles, and carried in carts to the mill, where they are bruiſed, and the juice is extracted from them. The mill conſiſts principally of three upright iron-plated rollers or cylinders, from 30 to 40 inches in length, and from 20 to 25 inches in diameter; and the middle one, to which the moving power is applied, turns the other two by means of cogs. Between theſe rollers, the canes (being previouſly cut ſhort, and tied into bundles) are twice compreſſed; for having paſſed through the firſt and ſecond rollers, they are turned round the middle one by a circular piece of frame work or ſcreen, called in Jamaica the *Dumb-returner*, and forced back through the ſecond and third; an operation which ſqueezes them completely dry, and ſometimes even reduces them to powder. The cane juice is received in a leaden bed, and thence conveyed into a veſſel called the *receiver*. The refuſe, or macerated rind of the cane (which is called *cane-traſh*, in contradiſtinction to *field-traſh*), ſerves for fuel to boil the liquor.

23 he juice tracted om them.

The juice as it flows from the mill, taken at a medium, contains eight parts of pure water, one part of ſugar, and one part conſiſting of coarſe oil and mucilaginous gum, with a portion of eſſential oil.

24 eſſels uſed r purify- g it are,

As the juice has a ſtrong diſpoſition to fermentation, it muſt be boiled as ſoon as poſſible. There are ſome water-mills that will grind with great eaſe canes ſufficient for 30 hogſheads of ſugar in a week. It is neceſſary to have boiling veſſels, or clarifiers, that will correſpond in dimenſions to the quantity of juice flowing from the receiver. Theſe clarifiers are commonly three in number, and are ſometimes capable of containing 1000 gallons each; but it is more uſual to ſee them of 300 or 400 gallons each. Beſides the clarifiers which are uſed for the firſt boiling, there are generally four coppers or boilers. The clarifiers are placed in the middle or at one end of the boiling-houſe. If at one end, the boiler called the *teache* is placed at the other, and ſeveral boilers (generally three) are ranged between them. The teache is ordinarily from 70 to 100 gallons, and the boilers between the clarifiers and teache diminiſh in ſize from the firſt to the laſt. Where the clarifiers are in the middle, there is uſually a ſet of three boilers of each ſide, which conſtitute in effect a double boiling-houſe. On very large eſtates this arrangement is found uſeful and neceſſary. The objection to ſo great a number is the expence of fuel; to obviate which, in ſome degree, the three boilers on each ſide of the clarifiers are commonly hung to one fire.

25 The clarifier.

The juice runs from the receiver along a wooden gutter lined with lead into the boiling-houſe, where it is received into one of the clarifiers. When the clarifier is filled, a fire is lighted, and a quantity of Briſtol quicklime in powder, which is called *temper*, is poured into the veſſel. The uſe of the lime is to unite with the ſuperabundant acid, which, for the ſucceſs of the proceſs, it is neceſſary to get rid of. The quantity ſufficient to ſeparate the acid muſt vary according to the ſtrength of the quicklime and the quality of the liquor. Some planters allow a pint of lime to every 100 gallons of liquor; but Mr Edwards thinks that little more than half the quantity is a better medium proportion, and even then, that it ought to be diſſolved in boiling water, that as little of it as poſſible may be precipitated. The heat is ſuffered gradually to increaſe till it approaches within a few degrees of the heat of boiling water, that the impurities may be thoroughly ſeparated. But if the liquor were ſuffered to boil with violence, the impurities would again incorporate with it. It is known to be ſufficiently heated when the ſcum begins to riſe in bliſters, which break into white froth, and appear generally in about 40 minutes. The fire is then ſuddenly extinguiſhed by means of a damper, which excludes the external air, and the liquor is allowed to remain about an hour undiſturbed, during which period the impurities are collected in ſcum on the ſurface. The juice is then drained off either by a ſyphon or a cock; the ſcum being of a tenacious gummy nature, does not flow out with the liquor, but remains behind in the clarifier. The liquid juice is conveyed from the clarifier by a gutter into the evaporating boiler, commonly termed the *grand copper*; and if it has been obtained from good canes it generally appears tranſparent.

26 And four coppers.

In the evaporating boiler, which ſhould be large enough to receive the contents of the clarifier, the liquor is allowed to boil; and as the ſcum riſes it is taken off. The ſcumming and evaporation are continued till the liquor becomes finer and thicker, and ſo far diminiſhed in bulk that it may be eaſily contained in the ſecond copper. When put into the ſecond copper, it is nearly of the colour of Madeira wine; the boiling and ſcumming are continued, and if the impurities be conſiderable, a quantity of lime-water is added. This proceſs is carried on till the liquor be ſufficiently diminiſhed in quantity to be contained in the third copper. After being purified a third time, it is put into the fourth copper, which is called the *teache*, where it is boiled and evaporated till it is judged ſufficiently pure to be removed from the fire. In judging of the purity of the liquor, many of the negroes (ſays Mr Edwards) gueſs ſolely by the eye (which by long habit they do with great accuracy), judging by the appearance of the grain on the back of the ladle: but the practice moſt in uſe is to judge by what is called the *touch*; i. e. taking up with the thumb a ſmall portion of the hot liquor from the ladle; and, as the heat diminiſhes, drawing with the fore-finger the liquid into a thread. This thread will ſuddenly break, and ſhrink from the thumb to the ſuſpended finger, in different lengths, according as the liquor is more or leſs boiled. The proper boiling height for ſtrong muſcovado ſugar is generally determined by a thread of a quarter of an inch long. It is evident, that certainty in this experiment can be attained only by long habit, and that no verbal precepts will furniſh any degree of ſkill in a matter depending wholly on conſtant practice.

27 After being clarified it is cooled, granulated, and freed from its melaſſes.

The juice being thus purified by paſſing through the clarifier and four coppers, it is poured into coolers, which are uſually ſix in number. The removal from the teache to the cooler is called *ſtriking*. The cooler is a ſhallow wooden veſſel 7 feet long, from 5 to 6 wide, about 11 inches deep, and capable of containing a hogſhead of ſugar. As the liquor cools, the ſugar grains, that is, collects into an irregular maſs of imperfect cryſtals, ſeparating itſelf from the melaſſes. It is then removed from the cooler, and conveyed to the curing-houſe, where the melaſſes drain from it. For receiving them there is a large ciſtern, the ſloping ſides of which are lined with boards. Directly above the ciſtern a frame of joiſt-work without boarding is placed, on which empty hogſheads without heads are ranged. The bottoms of theſe hogſheads are pierced with 8 or 10 holes, in each of which the ſtalk of a plantain leaf is fixed ſo as to project 6 or 8 inches below the joiſts, and riſe a little above the top of the hogſhead. The hogſheads being filled with the contents of the cooler, conſiſting of ſugar and melaſſes, the melaſſes being liquid, drain through the ſpungy ſtalk, and drop into the ciſtern. After the melaſſes are drained off, the ſugar becomes pretty dry and fair, and is then called *muſcovado*, or *raw ſugar*.

We have deſcribed the proceſs for extracting ſugar, which is generally adopted in the Britiſh Weſt India iſlands, according to the lateſt improvements; and have been anxious to preſent it to our readers in the ſimpleſt and moſt perſpicuous form, that it might be intelligible to every perſon; and have therefore avoided to mention the obſervations and propoſed amendments of thoſe who have written on this ſubject. Had we done ſo, we ſhould have ſwelled the preſent article to too great a ſize, without accompliſhing the purpoſe which we have in view; for our intention is not to inſtruct the planters, but to give a diſtinct account of the moſt approved methods which the planters have generally adopted. But though we judge it uſeleſs to trouble our readers with all the little varieties in the proceſs which different perſons employ, we flatter ourſelves it will not be diſagreeable to learn by what methods the French make their ſugar purer and whiter than others. A quantity of ſugar from the cooler is put into conical pans or earthen pots, called by the French *formes*, having a ſmall perforation at the apex, which is kept cloſed. Each cone, reverſed on its apex, is ſupported in another earthen veſſel. The ſyrup is ſtirred together, and then left to cryſtallize. At the end of 15 or 16 hours, the hole in the point of each cone is opened, that the impure ſyrup may run out. The baſe of theſe ſugar loaves is then taken out, and white pulverized ſugar ſubſtituted in its ſtead; which being well preſſed down, the whole is covered with clay moiſtened with water. This water filters through the maſs, carrying the ſyrup with it which was mixed with the ſugar, but which by this management flows into a pot ſubſtituted in the place of the firſt. This ſecond fluid is called *fine ſyrup*. Care is taken to moiſten and keep the clay to a proper degree of ſoftneſs as it becomes dry. The ſugar loaves are afterwards taken out, and dried in a ſtove for eight or ten days; after which they are pulverized, packed, and exported to Europe, where they are ſtill farther purified. The reaſon aſſigned why this proceſs is not univerſally adopted in the Britiſh ſugar iſlands is this, that the water which dilutes and carries away the molaſſes diſſolves and carries with it ſo much of the ſugar, that the difference in quality does not pay for the difference in quantity. The French planters probably think otherwiſe, upwards of 400 of the plantations of St Domingo having the neceſſary apparatus for claying and actully carrying on the ſyſtem.

28
Method of purifying uſed by the French.

Chaptal's Chemiſtry, vol. iii.

29
The art of refining ſugar introduced by a Venetian.

The art of refining ſugar was firſt made known to the Europeans by a Venetian, who is ſaid to have received 100,000 crowns for the invention. This diſcovery was made before the new world was explored; but whether it was an invention of the perſon who firſt communicated it, or whether it was conveyed from China, where it had been known for a conſiderable time before, cannot now perhaps be accurately aſcertained. We find no mention made of the refining of ſugar in Britain till the year 1659, though it probably was practiſed ſeveral years before. For in the Portugueſe iſland of St Thomas in 1624 there were 74 ſugar ingenios, each having upwards of 200 ſlaves. The quantity of raw ſugar imported into England in 1778 amounted to 1,403,995 cwts.; the quantity imported into Scotland in the ſame year was 117,285 cwts.; the whole quantity imported into Great Britain in 1787 was 1,926,741 cwts.

Anderſon's Origin of Commerce.

30
In refineing it is mixed with lime-water and bullock's blood, and, expoſed to heat.

The ſugar which undergoes the operation of refining in Europe is either raw ſugar, ſometimes called *muſcovado* or *caſſonado*, which is raw ſugar, in a purer ſtate. The raw ſugar generally contains a certain quantity of melaſſes as well as earthy and feculent ſubſtances. The caſſonado, by the operation of earthing, is freed from its melaſſes. As the intention of refining theſe ſugars is to give them a higher degree of whiteneſs and ſolidity, it is neceſſary for them to undergo other proceſſes. The firſt of theſe is called *clarification*. It conſiſts in diſſolving the ſugar in a certain proportion of lime-water, adding a proper quantity of bullock's blood, and expoſing it to heat in order to remove the impurities which ſtill remain. The heat is increaſed very gradually till it approach that of boiling water. By the aſſiſtance of the heat, the animal matter which was thrown in coagulates, at the ſame time that it attracts all the ſolid feculent and earthy matter, and raiſes it to the ſurface in the appearance of a thick foam of a browniſh colour. As the feculencies are never entirely removed by a firſt proceſs, a ſecond is neceſſary. The ſolution is therefore cooled to a certain degree by adding ſome water; then a freſh quantity of blood, but leſs conſiderable that at firſt, is poured in. The fire is renewed, and care is taken to increaſe the heat gently as before. The animal ſubſtance ſeizes on the impurities which remain, collects them on the ſurface, and they are then ſkimmed off. The ſame operation is repeated a third and even a fourth time, but no addition is made to the liquor except water. If the different proceſſes have been properly conducted, the ſolution will be freed from every impurity, and appear tranſparent. It is then conveyed by a gutter into an oblong baſket about 16 inches deep, lined with a woollen cloth; and after filtering through this cloth, it is received in a ciſtern or copper which is placed below.

31
Then freed from its remaining impurities by evaporation.

The ſolution being thus clarified it undergoes a ſecond general operation called *evaporation*. Fire is applied to the copper into which the ſolution was received, and the liquid is boiled till it has acquired the proper degree of conſiſtency. A judgment is formed of this by taking up a ſmall portion of the liquid and drawing it into a thread. When, after this trial, it is found ſufficiently viſcous, the fire is extinguiſhed, and the liquid is poured into coolers. It is then ſtirred violently by an inſtrument called an *oar*, from the reſemblance it bears to the oar of a boat. This is done in order to diminiſh the viſcoſity, and promote what is called the *granulation*, that is, the forming of it into grains or imperfect cryſtals. When the liquid is properly mixed and cooled, it is then poured into moulds of the form of a ſugar loaf. Theſe moulds are ranged in rows. The ſmall ends, which are loweſt, are placed in pots; and they have each of them apertures ſtopped up with linen for filtering the ſyrup, which runs from the moulds into the pots. The liquor is then taken out ſlowly in ladlefuls from the coolers, and poured into the moulds. When the moulds are filled, and the contents ſtill in a fluid ſtate, it is neceſſary to ſtir them, that no part may adhere to the moulds, and that the ſmall cryſtals which are juſt formed may be equally diffuſed thro' the whole maſs. When the ſugar is completely cryſtallized, the linen is taken away from the apertures in the moulds, and the ſyrup, or that part which did not cryſtallize, deſcends into the pots in which the moulds are placed. After this purgation the moulds are removed and fixed in other pots, and a ſtratum of fine white clay diluted with water is laid on the upper part of the loaf. The water deſcending through the ſugar, by its own weight, mixes with the ſyrup which ſtill remains in the body of the loaf, and waſhes it away. When the clay dries, it is taken off, and another covering of moiſt clay put in its place; and if it be not then ſufficiently waſhed, a third covering of clay is applied. After the loaves have ſtood ſome days in the moulds, and have acquired a conſiderable degree of firmneſs and ſolidity, they are taken out, and carried to a ſtove, where they are gradually heated to the 50° of Reaumur (64° of Fahernheit), in order to diſſipate any moiſture which may be ſtill confined in them. After remaining in the ſtove eight days, they are taken out; and after cutting off all diſcolouring ſpecks, and the head if ſtill wet, they are wrapped in blue paper, and are ready for ſale. The ſeveral ſyrups collected during the different parts of the proceſs, treated in the ſame manner which we have juſt deſcribed, afford ſugars of inferior quality; and the laſt portion, which no longer affords any ſugar, is ſold by the name of *melaſſes*.

32
Afterwards poured into moulds, where the ſyrup is drained from it.

33
Laſtly expoſed to a certain degree of heat.

34
what
he beauty
f ſugar
onſiſts;
ow far-
her re-
ned.

The beauty of refined ſugar, when formed into loaves, conſiſts in whiteneſs, joined to a ſmallneſs of grain; in being dry, hard, and ſomewhat tranſparent. The proceſs which we have deſcribed above refers to ſugar once refined; but ſome more labour is neceſſary to produce double refined ſugar. The principal difference in the operation is this, the latter is clarified by white of eggs inſtead of blood, and freſh water in place of lime-water.

35
How ſu-
gar-candy
made.

Sugar-candy is the true eſſence of the cane formed into large cryſtals by a ſlow proceſs. When the ſyrup is well clarified, it is boiled a little, but not ſo much as is done for the proof mentioned in the proceſs for making common ſugar. It is then placed in old moulds, having their lower ends ſtopped with linen, and croſſed at little diſtances with ſmall twigs to retain the ſugar as it cryſtallizes. The moulds are then laid in a cool place. In proportion as the ſyrup cools cryſtals are formed. In about nine or ten days the moulds are carried to the ſtove, and placed in a pot; but the linen is not removed entirely, ſo that the ſyrup falls down ſlowly in drops. When the ſyrup has dropped away, and the cryſtals of the ſugar-candy are become dry, the moulds are taken from the ſtove and broken in pieces, to diſengage the ſugar, which adheres ſtrongly to the ſides of the moulds. If the ſyrup has been coloured with cochineal, the cryſtals take a ſlight taint of red; if indigo has been mixed, they aſſume a bluiſh colour. If it be deſired to have the candy perfumed, the eſſence of flowers or amber may be dropped into the moulds along with the ſyrup.

Having now given ſome account of the method uſually employed for refining ſugar, it will not be improper to ſay a few things concerning its nature and its uſes.

36
Chemical
ualities of
ſugar.

Sugar is ſoluble in water, and in a ſmall degree in alcohol. When united with a ſmall portion of water, it becomes fuſible; from which quality the art of preſerving is indebted for many of its preparations. It is phoſphoric and combuſtible; when expoſed to fire emitting a blue flame if the combuſtion be ſlow, and a white flame if the combuſtion be rapid. By diſtillation it produces a quantity of phlegm, acid, oil, gas, and charcoal. Bergman, in treating ſugar with the nitrous acid, obtained a new acid now known by the name of the *oxalic acid*: but he has omitted to mention the principles of which ſugar is compoſed. Lavoiſier, however, has ſupplied this omiſſion; and after many experiments has aſſigned three principles in ſugar, hydrogene, oxygene, and carbone. If the juice expreſſed from the ſugar-cane be left to itſelf, it paſſes into the acetous fermentation; and during the decompoſition of the ſugar, which is continued for three or four months, a great quantity of glutinous matter is ſeparated. This matter when diſtilled gives a portion of ammoniac. If the juice be expoſed to the ſpirituous fermentation, a wine is obtained analogous to cyder. If this wine, after being kept in bottles a year, be diſtilled, we obtain a portion of *eau de vie*.

37
Its uſes in
medicine,
&c.

The uſes to which ſugar are applied are indeed numerous and important: It can be made ſo ſolid as in the art of preſerving to receive the moſt agreeable colours and the greateſt variety of forms. It can be made ſo fluid as to mix with any ſoluble ſubſtance.—It preſerves the juice and ſubſtance of fruits in all countries and in all ſeaſons. It affords a delicious ſeaſoning to many kinds of food. It is uſeful in pharmacy, for it unites with medicines, and removes their diſagreeable flavour: it is the baſis of all ſyrups. M. Macquer has ſhown in a very ſatisfactory manner how uſeful ſugar would be if employed in fermenting wines. Sugar has alſo been found a remedy for the ſcurvy, and a valuable article of food in caſes of neceſſity. M. Imbert de Lennes, firſt ſurgeon to the late Duke of Orleans, publiſhed the following ſtory in the *Gazette de Santé*, which confirms this aſſertion. A veſſel laden with ſugar bound from the Weſt Indies was becalmed in its paſſage for ſeveral days, during which the ſtock of proviſions was exhauſted. Some of the crew were dying of the ſcurvy, and the reſt were threatened with a ſtill more terrible death. In this emergency recourſe was had to the ſugar. The conſequence was, the ſymptoms of the ſcurvy went off, the crew found it a wholeſome and ſubſtantial aliment, and returned in good health to France.

38
Affords the
greateſt
quantity of
nouriſh-
ment of
any kind
of food.

“Sugar (ſays Dr Ruſh) affords the greateſt quantity of nouriſhment in a given quantity of matter of any ſubſtance in nature; of courſe it may be preſerved in leſs room in our houſes, and may be conſumed in leſs time, than more bulky and leſs nouriſhing aliment. It has this peculiar advantage over moſt kinds of aliment, that it is not liable to have its nutritious qualities affected by time or the weather; hence it is preferred by the Indians in their excurſions from home. They mix a certain quantity of maple ſugar, with an equal quantity of Indian corn, dried and powdered, in its milky ſtate. This mixture is packed in little baſkets, which are frequently wetted in travelling, without injuring the ſugar. A few ſpoonfuls of it mixed with half a pint of ſpring water afford them a pleaſant and ſtrengthening meal. From the degrees of ſtrength and nouriſhment which are conveyed into animal bodies by a ſmall bulk of ſugar, it might probably be given to horſes with great advantage, when they are uſed in places or other circumſtances which make it difficult or expenſive to ſupport them with more bulky or weighty aliment. A pound of ſugar with graſs or hay has ſupported the ſtrength and ſpirits of an horſe during a whole day's labour in one of the Weſt-India Iſlands. A larger quantity given alone has fattened horſes and cattle, during the war before laſt in Hiſpaniola, for a period of ſeveral months, in which the exportation of ſugar, and the importation of grain, were prevented by the want of ſhips.

Tranſ-
actions of
the Ame-
rican Philo-
ſophical
Society,
vol. iii.

39
An excel-
lent anti-
dote againſt
worms.

“The plentiful uſe of ſugar in diet is one of the beſt preventives that has ever been diſcovered of the diſeaſes which are produced by worms. Nature ſeems to have implanted a love for this aliment in all children, as if it were on purpoſe to defend them from thoſe diſeaſes. Dr Ruſh knew a gentleman in Philadelphia, who early adopted this opinion, and who, by indulging a large family of children in the uſe of ſugar, has preſerved them all from the diſeaſes uſually occaſioned by worms.

40
And proba-
bly againſt
the plague
and other
malignant
fevers.

“Sir John Pringle has remarked, that the plague has never been known in any country where ſugar compoſes a material part of the diet of the inhabitants. Dr Ruſh thinks it probable that the frequency of malignant fevers of all kinds has been leſſened by this diet, and that its more general uſe would defend that claſs of people who are moſt ſubject to malignant fevers from being ſo often affected by them.

41
Has given
relief from
the pain of
the ſtone.

“In the numerous and frequent diſorders of the breaſt, which occur in all countries where the body is expoſed to a variable temperature of weather, ſugar affords the baſis of many agreeable remedies. It is uſeful in weakneſſes, and acrid defluxions upon other parts of the body. Many facts might be adduced in favour of this aſſertion. Dr Ruſh mentions only one, which, from the venerable name of the perſon whoſe caſe furniſhed it, cannot fail of commanding attention and credit. Upon my inquiring of Dr Franklin, at the requeſt of a friend (ſays our reſpectable author), about a year before he died, whether he had found any relief from the pain of the ſtone from the blackberry jam, of which he took large quantities, he told me that he had, but that he believed the medicinal part of the jam reſided wholly in the ſugar; and as a reaſon for thinking ſo, he added, that he often found the ſame relief by taking about half a pint of a ſyrup, prepared by boiling a little brown ſugar in water, juſt before he went to bed, that he did from a doſe of opium. It has been ſuppoſed by ſome of the early phyſicians of our country, that the ſugar obtained from the maple-tree is more medicinal than that obtained from the Weſt India ſugar-cane; but this opinion I believe is without foundation. It is preferable in its qualities to the Weſt-India ſugar only from its ſuperior cleanlineſs.

42
Not hurtful to the teeth.

"Caſes may occur in which ſugar may be required in medicine, or in diet, by perſons who refuſe to be benefited, even indirectly by the labour of ſlaves. In ſuch caſes the innocent maple ſugar will always be preferred. It has been ſaid, that ſugar injures the teeth; but this opinion now has ſo few advocates, that it does not deſerve a ſerious refutation."

43
Sugar manufactured in the Eaſt Indies by freemen,

In the account which we have given above of the method of cultivating and manufacturing ſugar, we have had in our eye the plantations in the Weſt Indies, where ſlaves alone are employed; but we feel a peculiar pleaſure in having it in our power to add a ſhort deſcription of the method uſed in the Eaſt Indies, becauſe there ſugar is manufactured by free men, on a plan which is much more economical than what is followed in the Weſt Indies. The account which we mean to give is an extract from the report of the committee of Privy-council for trade on the ſubject of the African ſlave-trade, drawn up by Mr Botham We ſhall give it in the author's own words.

44
Of a ſuperior quality and at a lower price.

45
How ſugar eſtates are managed at Batavia.

"Having been for two years in the Engliſh and French Weſt-Indian iſlands, and ſince conducted ſugar eſtates in the Eaſt-Indies; before the abolition of the ſlave-trade was agitated in parliament, it may be deſirable to know that ſugar of a ſuperior quality and inferior price to that in our iſlands is produced in the Eaſt-Indies; that the culture of the cane, the manufacture of the ſugar and arrack, is, with theſe material advantages, carried on by free people. China, Bengal, the coaſt of Malabar, all produce quantities of ſugar and ſpirits; but as the moſt conſiderable growth of the cane is carried on near Batavia, I ſhall explain the improved manner in which ſugar eſtates are there conducted. The proprietor of the eſtate is generally a wealthy Dutchman, who has erected on it ſubſtantial mills, boiling and curing houſes. He rents this eſtate to a Chineſe, who reſides on it as a ſuperintendant; and this renter (ſuppoſing the eſtate to conſiſt of 300 or more acres) relets it to freemen in parcels of 50 or 60 on theſe conditions: "That they ſhall plant it in canes, and receive ſo much *per* pecul of 133½ pounds for every pecul of ſugar that the canes ſhall produce."

When crop time comes on, the ſuperintendant collects a ſufficient number of perſons from the adjacent towns or villages, and takes off his crop as follows. To any ſet of tradeſmen who bring their carts and buffaloes he agrees to give ſuch a price *per* pecul to cut all his crop of canes, carry them to the mill and grind them. A ſecond to boil them *per* pecul. A third to clay them and baſket them for market *per* pecul. So that by this method of conducting a ſugar eſtate the renter knows to a certainty what the produce of it will coſt him *per* pecul. He has not any permanent or unneceſſary expence; for when the crop is taken off, the taſkmen return to their ſeveral purſuits in the towns and villages they came from; and there only remains the cane planters who are preparing the next year's crop. This like all other complex arts, by being divided into ſeveral branches, renders the labour cheaper and the work more perfectly done.

Only clayed ſugars are made at Batavia; theſe are in quality equal to the beſt ſort from the Weſt Indies, and are ſold ſo low from the ſugar eſtates as eighteen ſhillings ſterling *per* pecul of 133½ lbs. This is not the ſelling price to the trader at Batavia, as the government there is arbitrary, and ſugar ſubject to duties impoſed at will. The Shabander exacts a dollar *per* pecul on all ſugar exported. The price of common labour is from 9d to 10d *per* day. By the method of carrying on the ſugar eſtates, the taſkmen gain conſiderably more than this not only from working extraordinary hours, but from being conſidered artiſts in their ſeveral branches. They do not make ſpirits on the ſugar eſtates. The melaſſes is ſent for ſale to Batavia, where one diſtillery may purchaſe the produce of an hundred eſtates. Here is a vaſt ſaving and reduction of the price of ſpirits; not as in the Weſt Indies, a diſtillery, for each eſtate; many centre in one, and arrack is ſold at Batavia from 21 to 25 rix-dollars *per* leaguer of 160 gallons; ſay 8 d *per* gallon.

46
Deſcription of the ſugar maple.

Tranſactions of the American Philoſophical Society, vol. iii.

The SUGAR MAPLE, (the *acer ſaccharinum* of Linnæus), as well as the ſugar-cane, produces a great quantity of ſugar. This tree grows in great numbers in the weſtern counties of all the middle ſtates of the American union. Thoſe which grow in new York and Pennſylvania yield the ſugar in a greater quantity than thoſe which grow on the waters of Ohio.—Theſe trees are generally found mixed with the beech, hemlock, white and water aſh, the cucumber-tree, linden, aſpen, butter nut, and wild cherry trees. They ſometimes appear in groves covering five or ſix acres in a body, but they are more commonly interſperſed with ſome or all of the foreſt trees which have been mentioned. From 30 to 50 trees are generally found upon an acre of ground. They grow only in the richeſt ſoils, and frequently in ſtony ground. Springs of the pureſt water abound in their neighbourhood. They are, when fully grown, as tall as the white and black oaks, and from two to three feet in diameter. They put forth a beautiful white bloſſom in the ſpring before they ſhow a ſingle leaf. The colour of the bloſſom diſtinguiſhes them from the acer rubrum, or the common maple, which affords a bloſſom of a red colour. The wood of the ſugar maple-tree is extremely inflammable, and is preferred upon that account by hunters and ſurveyors for firewood. Its ſmall branches are ſo much impregnated with ſugar as to afford ſupport to the cattle, horſes, and ſheep of the firſt ſettlers, during the winter, before they are able to cultivate forage for that purpoſe. Its aſhes afford a great quantity of potaſh, exceeded by few, or perhaps by none, of the trees that grow in the woods of the United States. The tree is ſuppoſed to arrive at its full growth in the woods in twenty years.

47
The oftener this tree is tapped the more ſyrup is obtained from it.

It is not injured by tapping; on the contrary, the oftener it is tapped, the more ſyrup is obtained from it. In this reſpect it follows a law of animal ſecretion. A ſingle tree had not only ſurvived, but flouriſhed after forty-two tappings in the ſame number of years. The effects of a yearly diſcharge of ſap from the tree, in improving and increaſing the ſap, are demonſtrated from the ſuperior excellence of thoſe trees which have been perforated in an hundred places, by a ſmall wood-pecker which feeds upon the ſap. The trees, after having been wounded in this way, diſtil the remains of their juice on the ground, and afterwards acquire a black colour. The ſap of theſe trees is much ſweeter to the taſte than that which is obtained from trees which have not been previouſly wounded, and it affords more ſugar.

From twenty-three gallons and one quart of ſap, procured in twenty-four hours from only two of theſe dark coloured trees, Arthur Noble, Eſq; of the ſtate of New York, obtained four pounds and thirteen ounces of good grained ſugar.

4
What quantity of ſap will produce a certain quantity of ſugar.

A tree of an ordinary ſize yields in a good ſeaſon from twenty to thirty gallons of ſap, from which are made from five to ſix pounds of ſugar. To this there are ſometimes remarkable exceptions. Samuel Lowe, Eſq; a juſtice of peace in Montgomery country, in the ſtate of New York, informed Arthur Noble, Eſq; that he had made twenty pounds and one ounce of ſugar between the 14th and 23d of April, in the year 1789, from a ſingle tree that had been tapped for ſeveral ſucceſſive years before.

49
This quantity might be increaſed by culture.

From the influence which culture has upon foreſt and other trees, it has been ſuppoſed, that by tranſplanting the ſugar maple-tree into a garden, or by deſtroying ſuch other trees as ſhelter it from the rays of the ſun, the quantity of the ſap might be increaſed, and its quality much improved. A farmer in Northampton country, in the ſtate of Pennſylvania, planted a number of theſe trees above twenty years ago in his meadow, from three gallons of ſap of which he obtains every year a pound of ſugar. It was obſerved formerly, that it required five or ſix gallons of the ſap of the trees which grow in the woods to produce the ſame quantity of ſugar.

50
The ſap diſtils from the wood in the ſpring months.

The ſap diſtils from the wood of the tree. Trees which have been cut down in the winter for the ſupport of the domeſtic animals of the new ſettlers, yield a conſiderable quantity of ſap as ſoon as their trunks and limbs feel the rays of the ſun in the ſpring of the year. It is in conſequence of the ſap of theſe trees being equally diffuſed through every part of them, that they live three years after they are girdled, that is, after a circular inciſion is made through the bark into the ſubſtance of the tree for the purpoſe of deſtroying it. It is remarkable that graſs thrives better under this tree in a meadow, than in ſituations expoſed to the conſtant action of the ſun. The ſeaſon for tapping the trees is in February, March, and April, according to the weather which occurs in theſe months.

51
Is increaſed by warm days and froſty nights.

Warm days and froſty nights are moſt favourable to a plentiful diſcharge of ſap. The quantity obtained in a day from a tree is from five gallons to a pint, according to the greater or leſs heat of the air. Mr Lowe informed Arthur Noble, Eſq; that he obtained near three and twenty gallons of ſap in one day (April 14. 1789.) from the ſingle tree which was before mentioned. Such inſtances of a profuſion of ſap in ſingle trees are however not very common.

52
How the ſap is drained from the tree.

There is always a ſuſpenſion of the diſcharge of ſap in the night if a froſt ſucceed a warm day. The perforation in the tree is made with an axe or an auger. The latter is perferred from experience of its advantages. The auger is introduced about three quarters of an inch, and in an aſcending direction (that the ſap may not be frozen in a ſlow current in the mornings or evenings), and is afterwards deepened gradually to the extent of two inches. A ſpout is introduced about half an inch into the hole made by this auger, and projects from three to twelve inches from the tree. The ſpout is generally made of the ſumach or elder, which uſually grows in the neighbourhood of the ſugar trees. The tree is firſt tapped on the ſouth ſide; when the diſcharge of its ſap begins to leſſen, an opening is made on the north ſide, from which an increaſed diſcharge takes place. The ſap flows from four to ſix weeks, according to the temperature of the weather. Troughs large enough to contain three or four gallons made of white pine, or white aſh, or of dried water aſh, aſpen, linden, poplar, or common maple are placed under the ſpout to receive the ſap, which is carried every day to a large receiver, made of either of the trees before mentioned. From this receiver it is conveyed, after being ſtrained, to the boiler.

53
Is reduced to ſugar by three modes.

We underſtand that there are three modes of reducing the ſap to ſugar; by evaporation, by freezing, and by boiling; of which the latter is moſt general, as being the moſt expeditious. We are farther aſſured, that the profit of the maple-tree is not confined to its ſugar. It affords moſt agreeable melaſſes, and an excellent vinegar. The ſap which is ſuitable for theſe purpoſes is obtained after the ſap which affords the ſugar has ceaſed to flow, ſo that the manufactories of theſe different products of the maple-tree, by ſucceeding, do not interfere with each other. The melaſſes may be made to compoſe the baſis of a pleaſant ſummer beer. The ſap of the maple is moreover capable of affording a ſpirit; but we hope this precious juice will never be proſtituted to this ignoble purpoſe. Should the uſe of ſugar in diet become more general in this country (ſays Dr Ruſh), it may tend to leſſen the inclination or ſuppoſed neceſſity for ſpirits, for I have obſerved a reliſh for ſugar in diet to be ſeldom accompanied by a love for ſtrong drink.

54
Sugar procured from many other vegetables.

There are ſeveral other vegetables raiſed in our own country which afford ſugar; as beet-roots, ſkirrets, parſneps, potatoes, celeri, red-cabbage ſtalks, the young ſhoots of Indian wheat. The ſugar is moſt readily obtained from theſe, by making a tincture of the ſubject in rectified ſpirit of wine; which, when ſaturated by heat, will depoſit the ſugar upon ſtanding in the cold.

Sugar of Milk. See Sugar of Milk.

Acid of Sugar. See Chemistry-*Index.*

SUGILLATION, in medicine, an extravaſation of blood in the coats of the eye, which at firſt appears of a reddiſh colour, and afterwards livid or black. It the diſorder is great, bleeding and purging are proper, as are alſo diſcutients.

SUICIDE, the crime of ſelf-murder, or the perſon who commits it.

We have often wiſhed to ſee a hiſtory of crimes drawn up by a man of ability and reſearch. In this hiſtory we would purpoſe that the author ſhould deſcribe the crimes peculiar to different nations in the different ſtages of ſociety, and the changes which they undergo in the progreſs of civilization. After having arranged the hiſtorical facts, he might, by comparing them with the religion and the knowledge of the people, deduce ſome important general concluſions, which would lead to a diſcovery of the cauſe of crimes, and of the remedy moſt proper to be applied. Some crimes are peculiar to certain ſtages of ſociety, ſome to certain nations, &c.

1
Suicide among the Jews.

Suicide is one of thoſe crimes which we are led to believe not common among ſavage nations. The firſt inſtances of it recorded in the Jewiſh hiſtory are thoſe of Saul and Ahitophel; for we do not think the death of Samſon a proper example We have no reaſon to ſuppoſe that it became common among the Jews till their wars with the Romans, when multitudes ſlaughtered themſelves that they might not fall alive into the hands of their enemies. But at this period the Jews were a moſt deſperate and abandoned race of men, had corrupted the religion of their fathers, and rejected that pure ſyſtem which their promiſed Meſſiah came to Jeruſalem to announce.

2
Among the Greeks.

When it became remarkable among the Greeks, we have not been able to diſcover: but it was forbidden by Pythagoras, as we learn from Athenæus, by Socrates and Ariſtotle, and by the Theban and Athenian laws. In the earlieſt ages of the Roman republic it was ſeldom committed; but when luxury and the Epicurean and Stoical philoſophy had corrupted the ſimplicity and virtue of the Roman character, then they began to ſeek ſhelter in ſuicide from their misfortunes or the effects of their own vices.

3
The Bramins and Gentoos.

The religious principles of the bramins of India led them to admire ſuicide on particular occaſions as honourable. Accuſtomed to abſtinence, mortification, and the contempt of death, they conſidered it as a mark of weakneſs of mind to ſubmit to the infirmities of old age. We are informed that the Modern Gentoos, who ſtill in moſt things conform to the cuſtoms of their anceſtors, when old and infirm, are frequently brought to the banks of rivers, particularly to

thoſe

Sullivan's Phil. Rhap. vol. ii.

Holwell's Intereſting Events, &c. vol. i.

thoſe of the Ganges, that they may die in its ſacred ſtreams, which they believe can waſh away the guilt of their ſins. But the maxims of the bramins, which have encouraged this practice, we are aſſured by Mr Holwell, are a corruption of the doctrines of the Shaſtah, which poſitively forbid ſuicide under the ſevereſt puniſhment. The practice which religion or affection has eſtabliſhed among the Gentoos for women at the death of their huſbands to burn themſelves alive on the funeral pile, we do not think ought to be conſidered as ſuicide, as we are not anxious to extend the meaning of the word; for were we to extend it thus far, it would be as proper to apply it to thoſe who chooſe rather to die in battle than make their eſcape at the expence of their honour. Thus we ſhould condemn as ſuicides the brave Spartans who died at Thermopylæ in defence of their country: we ſhould alſo be obliged to apply the ſame diſgraceful epithet to all thoſe well-meaning but weak-minded Chriſtians in Britain who in the laſt century choſe rather to die as martyrs than comply with commands which were not morally wrong. According to the Gentoo laws, "it is proper for a woman after her huſband's death to burn herſelf in the fire with his corpſe. Every woman who thus burns ſhall remain in paradiſe with her huſband three crore and fifty lacks of years. If ſhe cannot, ſhe muſt in that caſe preſerve an inviolable chaſtity. If ſhe remain chaſte, ſhe goes to paradiſe; and if ſhe do not preſerve her chaſtity, ſhe goes to hell."

4 Among the Americans. Robertſon's America.

A cuſtom ſimilar to this prevailed among many nations on the continent of America. When a chief died, a certain number of his wives, of his favourites, and of his ſlaves, were put to death, and interred together with him, that he might appear with the ſame dignity in his future ſtation, and be waited upon by the ſame attendants. This perſuaſion is ſo deeply rooted, that many of their retainers offer themſelves as victims; and the ſame cuſtom prevails in many of the negro nations of Africa.

5 The Japaneſe, and

Raynal's Hiſtory of the Eaſt and Weſt Indies, vol. i.

If we can believe the hiſtorians of Japan, voluntary death is common in that empire. The devotees of the idol Amida drown themſelves in his preſence, attended by their relations and friends, and ſeveral of the prieſts, who all conſider the devoted perſon as a ſaint who is gone to everlaſting happineſs. Such being the ſuppoſed honours appropriated to a voluntary death, it is not ſurpriſing that the Japaneſe anxiouſly cheriſh a contempt of life. Accordingly it is a part of the education of their children "to repeat poems in which the virtues of their anceſtors are celebrated, an utter contempt of life is inculcated, and ſuicide is ſet up as the moſt heroic of actions."

6 Scythians,

A notion ſeems alſo to have prevailed among the ancient Scythian tribes, that it was puſillanimous and ignoble for a man whoſe ſtrength was waſted with diſeaſe or infirmity, ſo as to be uſeleſs to the community, to continue to live. It was reckoned an heroic action voluntarily to ſeek that death which he had not the good fortune to meet in the field of battle. Perverſion of moral feeling does not ſpring up, we hope, ſpontaneouſly in any nation, but is produced by ſome peculiarities of ſituation. A wandering people like the Scythians, who roamed about from place to place, might often find it impoſſible to attend the ſick, or to ſupply from their precarious ſtore the wants of the aged infirm. The aged and infirm themſelves, no longer able to ſupport the character of warriors, would find themſelves unhappy. In this way the practice of putting to death ſuch perſons as were uſeleſs to the community might originate, and afterwards be inculcated as honourable; but he who put an end to his infirmities by his own hand, obtained a character ſtill more illuſtrious.

7 And Scandinavians.

The tribes of Scandinavia, which worſhipped Odin the "father of ſlaughter," were taught, that dying in the field of battle was the moſt glorious event that could befal them. This was a maxim ſuited to a warlike nation. In order to eſtabliſh it more firmly in the mind, all were excluded from Odin's feaſt of heroes who died a natural death. In Aſgardia ſtood the hall or Odin; where, ſeated on a throne, he received the ſouls of his departed heroes. This place was called *Valhalla*, ſignifying "the hall of thoſe who died by violence." Natural death being thus deemed inglorious, and puniſhed with excluſion from Valhalla the paradiſe of Odin he who could not enjoy death in the field of battle was led to ſeek it by his own hands when ſickneſs or old age began to aſſail him. In ſuch a nation ſuicide muſt have been very common.

8 It prevailed much in the decline of the Roman empire.

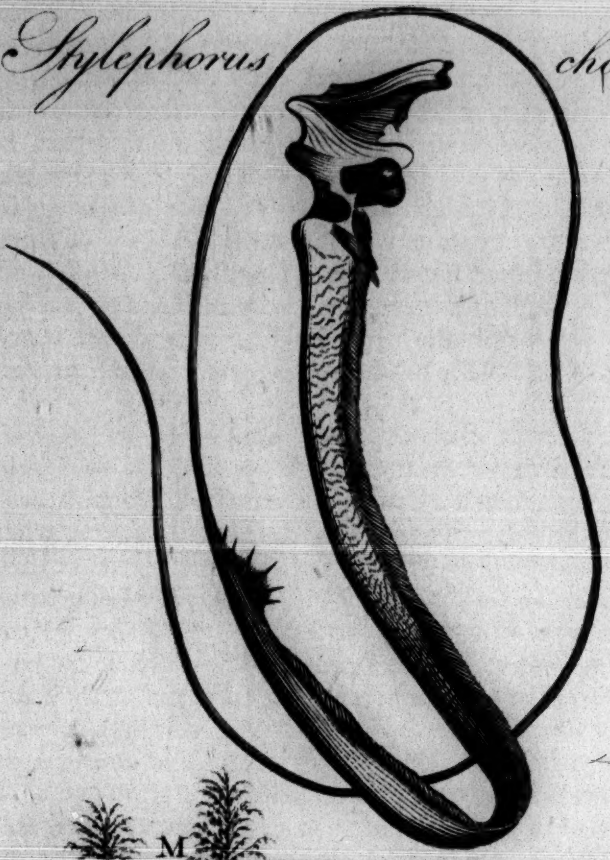
As ſuicide prevailed much in the decline of the Roman empire, when luxury, licentiouſneſs, profligacy, and falſe philoſophy, pervaded the world, ſo it continued to prevail even after Chriſtianity was eſtabliſhed. The Romans, when they became converts to Chriſtianity, did not renounce their ancient prejudices and falſe opinions, but blended them with the new religion which they embraced. The Gothic nations alſo, who ſubverted the Roman empire, while they received the Chriſtian religion, adhered to many of their former opinions and manners. Among other criminal practices which were retained by the Romans and their conquerors, that of ſuicide was one; but the principles from which it proceeded were explained, ſo as to appear more agreeable to the new ſyſtem which they had eſpouſed. It was committed, either to ſecure from the danger of apoſtacy, to procure the honour of martyrdom, or to preſerve the crown of virginity.

9 Too common in modern times, but not more ſo in England than in other countries.

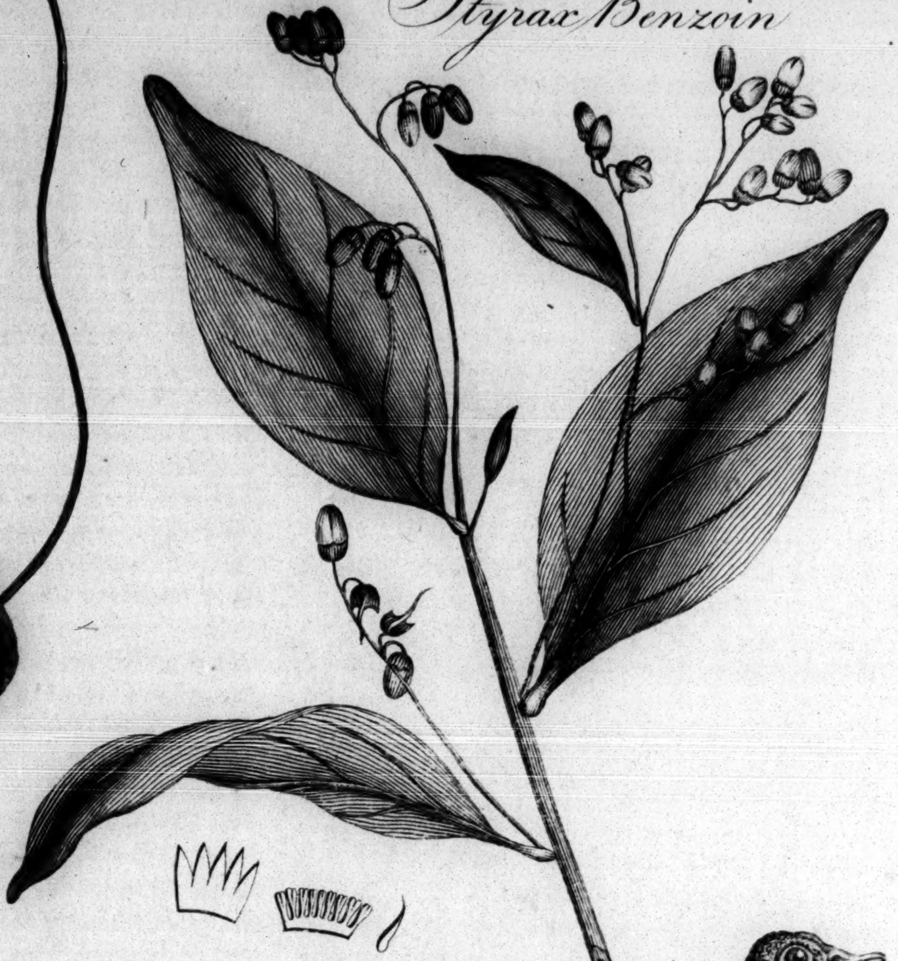
When we deſcend to modern times, we lament to find ſo many inſtances of ſuicide among the moſt poliſhed nations, who have the beſt opportunities of knowing the atrocity of that unnatural crime. The Engliſh have long been reproached by foreigners for the frequent commiſſion of it; and the "gloomy month of November" has been ſtigmatized as the ſeaſon when it is moſt common. But this diſgraceful imputation, we think, may be juſtly attributed, not to the greater frequency of the crime in England than in other places, but to the cuſtom of publiſhing in the newſpapers every inſtance of ſuicide which is known. Mr Moore, who lately publiſhed a full inquiry into this ſubject, was at great pains to obtain accurate information concerning the perpetration of this crime in different countries. Mercier, who wrote in 1782, ſays, that the annual number of ſuicides in Paris was then about 150. He does not tell us how he came by the information; but we have the authority of the Abbé Fontana for aſſerting, that more perſons put an end to their lives in Paris than in London. The Abbé had this information from the lieutenant of the police. Mr Moore was informed by one of the principal magiſtrates of Geneva, that in that city, which contains about 25,000 inhabitants, the average number of ſuicides is about *eight*. The average number of ſuicides, from what cauſe ſoever, for the laſt 28 years, has been 32 each year for London, Southwark, and Weſtminſter. In Edinburgh, which contains 80,000 inhabitants, we are convinced the average number of ſuicides does not exceed *four*. Mr Moore found, from the accounts with which he was favoured by the ſeveral coroners of the county of Kent, that for the laſt 18 years the number has been upwards of 32 each year. Kent is ſuppoſed to contain 200,000 inhabitants, and London 800,000. It is eaſy therefore to ſee, that in the metropolis many inſtances of ſuicide muſt occur which are never the ſubject of legal inquiry, and conſequently never made known to the world. Whereas in the country towns and villages of Kent it is ſcarcely poſſible to conceal ſuch an action as ſelf murder

Mercier's Tableau de Paris.

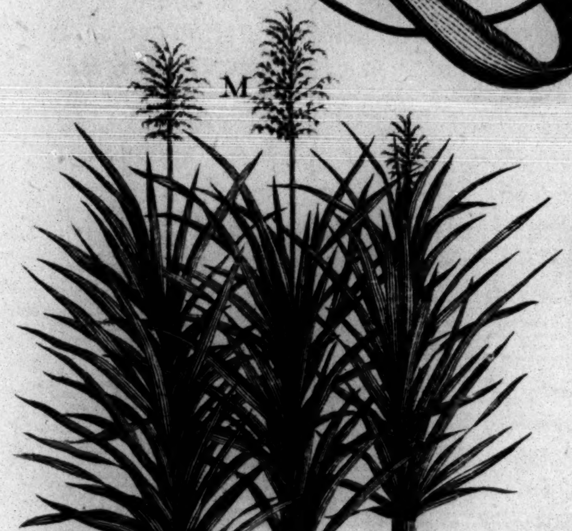
10 The number of ſuicides in Paris, London, Geneva, &c. according to the beſt accounts.



Stylephorus chordatus



Styrax Benzoin



Sugar Cane

Struthio (Ostrich)

Grav'd by James Akin

BRITISH MUSEUM

from the knowledge of the whole neighbourhood. The calculation therefore reſpecting Kent we may receive as true, while we muſt increaſe the avarage number in London very conſiderably. Mr Moore computes the average number of ſuicides in England every year at a thouſand; but the principles on which he founds this opinion are ſo imperfect and vague, that we do not think it can be depended on as coming near the truth.

11
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on.

It might lead to ſome intereſting concluſions to compare together, not only the number of ſuicides in different countries, but alſo the rank and principles, the ſex and age, of thoſe unhappy perſons by whom it has been committed. Mercier ſays, that at Paris it was the lower ranks who were moſt commonly guilty of it; that it was moſtly committed in garrets or hired lodgings; and that it proceeded from poverty and oppreſſion. A great many, he ſays, wrote letters to the magiſtrates before their death. Mr Moore's correſpondent from Geneva informed him, that from the year 1777 to 1787 more than 100 ſuicides were committed in Geneva; that two-thirds of theſe unfortunate perſons were men; that few of the clerical order have been known to commit it; and that it is not ſo much the end of an immoral, irregligious, diſſipated life, as the effect of melancholy and poverty. By the information obtained from the coroners of Kent, it appears, that of the 32, three-fourths have deſtroyed themſelves by hanging; that the proportion of males to females has been about two-thirds of the former; that no one ſeaſon of the year is more diſtinguiſhed for this crime than another; and that ſuicide is upon the increaſe. Our accounts reſpecting the city of London are very imperfect; but we think ourſelves intitled to conclude, that ſuicide is more common among the great and wealthy than among the lower ranks, and that it is uſually the effect of gaming and diſſipation.

Moore's
ull in-
uiry into
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f Suicide.

12
hyſical
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ſcribed in
ritain.

Thoſe who have inquired into the cauſes of ſuicide in Britain have enumerated many phyſical as well as moral cauſes. They have aſcribed it to the variableneſs of climate, to the great uſe of animal food, to ſtrong ſpirituous liquors, to tea, and to the ſulphureous exhalations of the pit-coal uſed as fuel, which are ſaid to produce a depreſſion of ſpirits and nervous affections. Of the climate, there is no cauſe to complain, nor is there any reaſon to impute any of the vices to its influence. There are many climates much more unfavourable where ſuicide is ſcarcely known. That an exceſſive quantity of groſs animal food, or of ſtrong liquors, or of tea, will powerfully affect the human conſtitution, we will not deny: but before we conſider theſe as cauſes, it muſt firſt be determined, whether thoſe who are guilty of ſelf-murder be much addicted to them; and if they are, whether there be not other cauſes much more violent in their nature which have operated on their mind; for we ought not raſhly to attribute vicious effects to any of thoſe things which ſeem to have been created on purpoſe for the comfort or convenience of man. We are rather ſurpriſed to find that coal is mentioned even as a diſtant cauſe of ſuicide; for it is one of the bleſſings of that iſland: and a good coal fire has always been found rather conducive to good ſpirits than injurious to them.

13
And moral
cauſes.

Among the moral cauſes which are ſuppoſed to co-operate in producing ſuicide in Britain, the freedom of its conſtitution and laws is reckoned one. That rational liberty ſhould have any tendency to encourage crimes of any kind, a Chriſtian philoſopher can never allow; for ſuch an opinion is totally diſcountenanced by enlightened views of nature. Mercier has aſcribed the frequency of ſuicide in Paris to the oppreſſion of the late government. Now it appears ſomewhat extraordinary, that ſuicide in one country ſhould be occaſioned by liberty, and in another by the want of it. One of theſe opinions muſt be falſe, and it is ſurely not difficult to diſtinguiſh which.

14
Not owing
always to
inſanity;

Humanity would in moſt caſes diſpoſe us to conclude, that ſuicide is the effect of inſanity, were there not ſo many inſtances of cool deliberate ſelf-murder. That ſuicide is an unnatural crime, which none but a madman would commit, compaſſion indeed may ſuppoſe: but the murder of a wife, a father, a child, are alſo unnatural; yet compaſſion does not teach us in all caſes to aſcribe ſuch a crime to madneſs. Paſſion may often ariſe to ſuch a height of outrage as to be ſcarcely diſtinguiſhable from madneſs in its ſymptoms and its effects; yet we always make a diſtinction between that madneſs with ariſes from diſeaſe and that which is owing to a violent perturbation of mind. If a perſon be capable of managing his worldly affairs, of making a will, and of diſpoſing of his property, immediately before his death, or after he formed the reſolution of dying by his own hands, ſuch a man is not to be conſidered as inſane.

15
But often
alſo to vi-
cious paſ-
ſion.

But though a regard for truth prevents us from aſcribing ſuicide in all caſes to inſanity, we muſt aſcribe it either to inſanity or to vicious paſſion. Theſe two diviſions, we imagine, will comprehend every ſpecies of it, whether ariſing from melancholy, *tædium vitæ* or *ennui*, diſappointment in ſchemes of ambition or love, pride, gaming, or a deſire to avoid the ſhame of a public execution; paſſions which are often increaſed by falſe views of God, of man, and of a future ſtate, ariſing from deiſm and infidelity. If theſe be the cauſes of ſuicide in modern times, what a diſgraceful contraſt do they form to thoſe principles which actuated many of the ancient philoſophers, the Gentoos, the Japaneſe, and the worſhippers of Odin? When they committed ſuicide, they committed it from principle, from a belief of its lawfulneſs, and the hope of being rewarded for what they judged an honourable ſacrifice. But in modern times, we are ſorry to ſay, when it is not the effect of madneſs, it is the effect of vice: and when it is the effect of vice, it proves that the vicious paſſions are then indulged to the higheſt degree; for there is no crime which a man can commit that is ſo ſtrong a ſymptom of the violence of particular paſſions. It is from not attending to this circumſtance, that it has been found ſo difficult to refute the arguments in favour of ſuicide. If the criminality of ſuicide be confined merely to the violent action, many apologies may be made for it; but if it be conſidered ſolely as the effect of vice, as the ſtrongeſt ſymptom of ungoverned paſſion, he who undertakes its defence muſt undertake the defence of what all men will loudly condemn (A).

It is unneceſſary then to enter particularly into the argu-

(A) Several of the heathens entertained a very juſt ſenſe of the atrocity of ſuicide. Quintus Curtius introduces Darius with the following ſpeech, when he had loſt his empire: "I wait (ſays the unfortunate monarch) the iſſue of my fate: you wonder, perhaps, that I do not terminate my own life; but I chooſe rather to die by the crime of another than by my own.

We cannot refuſe ourſelves the pleaſure of preſenting to our readers the following beautiful paſſage upon this ſubject from Fitzoſborne's letters:* "I am perſuaded (ſays this elegant writer) this diſguſt of life is frequently indulged out of a principle of mere vanity. It is eſteemed as a mark of uncommon refinement, and as placing a man above the ordinary level

* Letter lv.

16 Unneceſſary to enter into the arguments of caſuiſts upon this ſubject.

ments of thoſe caſuiſts who have undertaken the deſpicable office of advocates for the crime of ſuicide. Their talents might ſurely have been employed more uſefully to the world, and more honourably to themſelves, than in pleading for a crime which, if it were committed by every man to whom their principles would make it lawful, would totally deſtroy ſome of the nobleſt virtues, fortitude, patience, and reſignation; nay, would deſtroy ſociety itſelf, and teach us to deſpiſe the opinion that this world is a ſtate of preparation for another "I came into life without my own conſent, and may I not quit it at pleaſure?" (ſay the advocates for ſuicide). If, becauſe we came into life without our own conſent, we might quit it at pleaſure, why may we not ſpend our life alſo as we pleaſe? Why may we not rob and murder, and commit every kind of crime, if *mere inclination* is to be the rule of action? Thus upon the principles of ſuicide the highwayman and murderer may reaſon, and every man may find a ſufficient apology for any crime which he is tempted to commit. Or this abſurdity may be otherwiſe anſwered; As we came into life without our own conſent, we muſt have come with the conſent of ſome other being; and logic ſays, that with the conſent of that Being only can we lawfully quit it.

17 Its great criminality and imprudence.

It is ſufficient ſhortly to ſay, that ſuicide is contrary to the ſtrongeſt principle of the human conſtitution, ſelf-preſervation; that it is rebellion againſt God; that it is cruelty to the feelings and reputation, and often takes away the ſubſiſtence of a wife, a child, or a father; that it proves a want of fortitude to brave misfortunes; that it delivers only from imagined to plunge into real evils. We may add, that almoſt every inſtance of ſuicide of which we have heard was raſh, imprudent, and premature, interrupted a uſeful life, or prevented a more honourable death. Had Cato's pride permitted him to yield himſelf to the generoſity of Cæſar, his character and his influence might have contributed to retard the ſlavery of his country which his death tended to haſten. Had Brutus and Caſſius not executed the fatal reſolution which they had formed, of dying by their own hands in caſe of misfortune, the battle of Philippi might have had a very different iſſue. Had Hannibal ſurrendered himſelf to the Romans, inſtead of ſwallowing poiſon, he would have gained more glory in braving their tortures than he won in the battle of Cannæ; for to die innocently and heroically is the greateſt exertion of human fortitude.

18 How puniſhed by the Greeks, Ceans, &c.

As ſuicide was deemed a crime by the moſt illuſtrious and virtuous of the Greek and Roman philoſophers, it was conſidered as a crime by the laws, and treated with ignominy. By the law of Thebes ſuicides were to have no honours paid to their memory †. The Athenian law ordained the hand which committed the deed to be cut off, and burned apart from the reſt of the body. The body was not buried with the uſual ſolemnities, but was ignominiouſly thrown into ſome pit. In Cea and Maſſilia (the ancient *Marſeilles*), it was conſidered as a crime againſt the ſtate; and it was therefore neceſſary for thoſe who wiſhed to deſtroy themſelves to obtain permiſſion from the magiſtrates. § Plutarch acquaints us, that an unaccountable paſſion for ſuicide ſeized the Mileſian virgins; from indulging which they could not be prevented by the tears and entreaties of parents and friends: but what perſuaſion and entreaty could not effect was accompliſhed by very different means. A decree was iſſued, "that the body of every young woman who hanged herſelf ſhould be dragged naked through the ſtreets by the ſame rope with which ſhe had committed the deed." This wiſe edict put a complete ſtop to the extraordinary frenzy, and ſuicide was no longer committed by the virgins of Miletus.

† Petite Comment. in Leges Atticas, p. 523.

§ Plutarch on the Virtues of Women.

19 By the Romans.

In the early part of the Roman hiſtory there ſeems to have been ſeldom occaſion for framing any laws againſt ſuicide. The only inſtance recorded occurs in the reign of Tarquinius Priſcus. The ſoldiers who were appointed to make drains and common ſewers, thinking themſelves diſgraced by ſuch ſervile offices, put themſelves to death in great numbers. The king ordered the bodies of all the ſelf-murderers to be expoſed on croſſes, and this put an effectual ſtop to the practice. It is doubtful whether there was any ſtanding law againſt ſuicide during the exiſtence of the republic; but during the reign of the emperors it was thought proper to lay it under certain regulations, though not abſolutely to condemn it as a crime. In Juſtinian's Digeſts there is a law, by which it was enacted, "that if perſons accuſed, or who had been found guilty, of any crime ſhould make away with themſelves, their effects ſhould be confiſcated."

Lib. xlviii. Tit. xxi. par. 3.

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level of his ſpecies, to ſeem ſuperior to the vulgar feelings of happineſs. True good ſenſe, however, moſt certainly conſiſts not in deſpiſing, but in managing our ſtock of life to the beſt advantage, as a cheerful acquieſcence in the meaſures of Providence is one of the ſtrongeſt ſymptoms of a well conſtituted mind. Self-wearineſs is a circumſtance that ever attends folly; and to condemn our being is the greateſt, and indeed the peculiar infirmity, of human nature. It is a noble ſentiment which Tully puts into the mouth of Cato, in his Treatiſe upon old Age; *Non lubet mihi* (ſays that venerable Roman) *deplorare vitam, quod multi, et ii docti, ſæpe fecerunt; neque me vixiſſe pœnitet: quoniam ita vixi, ut non fruſtra me natum exiſtimem.*

"It is in the power, indeed, of but a very ſmall portion of mankind to act the ſame glorious part that afforded ſuch high ſatisfaction to this diſtinguiſhed patriot; but the number is yet far more inconſiderable of thoſe who cannot, in any ſtation, ſecure themſelves a ſufficient fund of complacency to render life juſtly valuable. Who is it that is placed out of the reach of the higheſt of all gratifications, thoſe of the generous affections, and that cannot provide for his own happineſs, by contributing ſomething to the welfare of others? As this diſeaſe of the mind generally breaks out with moſt violence in thoſe who are ſuppoſed to be endowed with a greater delicacy of taſte and reaſon than is the uſual allotment of their fellow-creatures, one may aſk them, whether there is any ſatiety in the purſuits of uſeful knowledge? or, if one can ever be weary of benefiting mankind? Will not the fine arts ſupply a laſting feaſt to the mind? or, can there be wanting a pleaſurable enjoyment, ſo long as there remains even one advantageous truth to be diſcovered or confirmed? To complain that life has no joys, while there is a ſingle creature whom we can relieve by our bounty, aſſiſt by our counſels, or enliven by our preſence is, to lament the loſs of that which we poſſeſs, and is juſt as rational as to die for thirſt with the cup in our hands. But the misfortune is, when a man is ſettled into a habit of receiving all his pleaſures from the mere ſelfiſh indulgencies, he wears out of his mind the reliſh of every nobler enjoyment, at the ſame time that his powers of the ſenſual kind are growing more languid by each repetition. It is no wonder, therefore, he ſhould fill up the meaſure of his gratifications long before he has completed the circle of his duration; and either wretchedly ſit down the remainder of his days in diſcontent, or raſhly throw them up in deſpair."

Suicide ‖ Suit.

confiſcated." But this puniſhment only took place when confiſcation of goods happened to be the penalty appointed by the law for the crime of which the ſelf-murderer was accuſed or found guilty, and was not inflicted for ſuicide committed in any other circumſtances.

20 nd by Chriſtians.

When the Chriſtian church had extended its juriſdiction in the Roman empire, it was decreed in the ſixth century, that no commemoration ſhould be made in the euchariſt for ſuch as deſtroyed themſelves; neither ſhould their bodies be carried out to burial with pſalms, nor have the uſual ſervice ſaid over them. This eccleſiaſtical law continued till the reformation, when it was admitted into the ſtatute code of England by the authority of parliament. As an additional puniſhment, however, confiſcation of land and goods ſeems to have been adopted from the Danes, as we learn from Bracton ‡. At preſent the puniſhment conſiſts in confiſcating all the perſonal property of a *felo de ſe* for the uſe of the crown, and in excluding his body from interment in conſecrated ground. The warrant of the coroner requires that the body ſhould be buried in ſome public highway, and a ſtake driven through it to increaſe the ignominy.

‡ De Legi- us et Con- uetudini- us An- liæ, Lib. ii. Tract. I.

21 Difficult to leviſe a pu- iſhment hat would e an effec- ual pre- entive.

To inquire into the prevalence and cauſes of crimes, in order to diſcover the moſt judicious methods of preventing them, is the duty of the patriot and the Chriſtian. Suicide, we find, is a common and an increaſing evil: but it is a difficult matter to find an effectual remedy; for what motives can be held out ſufficient to influence that man's mind who is deaf to the voice of nature ſpeaking within him, and to the voice of nature's God declaring that he is ſtationed at a poſt which it is his duty to maintain? His reputation and property are indeed within the reach of the laws, his body may be treated with ignominy, and his property confiſcated; but this puniſhment will not be a preventive, even if it could be always inflicted; and that it is ſeldom inflicted, though the laws have decreed it, is well known. The humanity of the preſent age diſpoſes us to ſympathiſe with the relations of the deceaſed, inſtead of demanding that the ſentence of the law ſhould be executed. It is a generally received opinion, and a juſt one, that puniſhments decreed by human laws ſhould be directed only againſt ſuch crimes as are injurious to ſociety; but when it is hence inferred, that ſuicide ought not to be ſubject to the cognizance of human laws, every rule of logic is violated. There is no man, however mean in ſtation and in talents, whoſe life may not, on ſome occaſions, be uſeful to the community at large; and to conclude, that a perſon who fancies himſelf uſeleſs may therefore lawfully put a period to his life, is as falſe reaſoning as it would be to conclude, that by killing a poor man, who lives on the public, we ſhould perform an action not only innocent but meritorious, as we ſhould thereby free ſociety from one of its burdens.

SUIDAS, a Greek writer, according to ſome, flouriſhed in the 11th century, under the reign of the Emperor Alexius Comnenus; according to others, before the 10th century. He wrote in Greek an Hiſtorical and Geographical Dictionary or Lexicon; a work which, though not always ſtrictly accurate, is nevertheleſs of great importance, as it contains many things taken from the ancients that are nowhere elſe to be found. The beſt edition of Suidas is that of Kuiſter, in Greek and Latin, with notes, printed in 3 vols fol. which has been much improved by Toup.

Lapis SUILLUS. See *Swine-Stone.*

Suit.

SUIT, is uſed in different ſenſes; as, "1. Suit of court, or ſuit-ſervice, which is an attendance the tenant owes to his lord's court. 2. Suit-covenant, where a perſon has covenanted to do ſervice in the court of the lord. 3. Suit-cuſtom, which is where one and his anceſtors have owed ſuit time out of mind. 4. It is uſed for a petition to the king or any perſon of dignity, where a lord diſtrains his tenant for ſuit, and none is due. In this caſe, the party may have an attachment againſt him to appear in the king's court."

Blackſt. Comment.

Suit, in law, the ſame with action. The Romans introduced pretty early ſet forms for actions and ſuits into their law, after the example of the Greeks; and made it a rule, that each injury ſhould be redreſſed by its proper remedy only. "*Actiones*, (ſay the Pandects) *compoſitæ ſunt quibus inter ſe homines diſceptarent, quas actiones ne populus prout vellet inſtitueret, certas ſolemneſque eſſe voluerunt.*" The forms of theſe actions were originally preſerved in the books of the pontifical college as choice and ineſtimable ſecrets, till one Cneius Flavius, the ſecretary of Appius Claudius, ſtole a copy and publiſhed them to the people. The concealment was ridiculous: but the eſtabliſhment of ſome ſtandard was undoubtedly neceſſary to fix the true ſtate of queſtion of right; leſt, in a long and arbitrary proceſs, it might be ſhifted continually, and be at length no longer diſcernible. Or, as Cicero expreſſes it, "*ſunt jura, ſunt formulæ, de omnibus rebus conſtitutæ, ne quis aut in genere injuriæ, aut in ratione actionis, errare poſſit. Expreſſæ enim ſunt ex uniuſcujuſque damno, dolore, incommodo, calamitate, injuria, publicæ à prætore formulæ, ad quas privata lis accommodatur.*" And in the ſame manner Bracton, ſpeaking of the original writs upon which all our actions are founded, declares them to be fixed and immutable, unleſs by authority of parliament. And all the modern legiſlators of Europe have found it expedient, from the ſame reaſons, to fall into the ſame or a ſimilar method. In England, the ſeveral ſuits, or remedial inſtruments of juſtice, are, from the ſubject of them, diſtinguiſhed into three kinds; actions *perſonal*, *real*, and *mixed*.

Perſonal actions are ſuch whereby a man claims a debt, or perſonal duty, or damages in lieu thereof; and likewiſe whereby a man claims a ſatiſfaction in damages for ſome injury done to his perſon or property. The former are ſaid to be founded upon contracts, the latter upon *torts* or wrongs: and they are the ſame which the civil law calls "*actiones in perſonam, quæ adverſus eum intenduntur qui ex contractu vel delicto obligatus eſt aliquid dare vel concedere.*" Of the former nature are all actions upon debt or promiſes; of the latter are all actions of treſpaſſes, nuiſances, aſſaults, defamatory words, and the like.

Real actions (or, as they are called in the Mirror, *feodal actions*), which concern real property only, are ſuch whereby the plaintiff, here called the *demandant*, claims title to have any lands or tenements, rents, commons, or other hereditaments, in fee-ſimple, fee-tail, or for term of life. By theſe actions formerly all diſputes concerning real eſtates were decided; but they are now pretty generally laid aſide in practice, upon account of the great nicety required in their management, and the inconvenient length of their proceſs; a much more expeditious method of trying titles being ſince introduced, by other actions perſonal and mixed.

Mixed actions are ſuits partaking of the mixture of the other two, wherein ſome real property is demanded, and alſo perſonal damages for a wrong ſuſtained. As for inſtance, an action of waſte: which is brought by him who hath the inheritance, in remainder or reverſion, againſt the tenant for life, who hath committed waſte therein, to recover not only the land waſted, which would make it merely a real action; but alſo treble damages, in purſuance of the ſtatute of Glouceſter, which is a perſonal recompenſe; and ſo both, being joined together, denominate it a *mixed action.*

The ordinary parts of a ſuit are theſe: 1. The original *writ*. 2. The *proceſs*. 3. The *pleadings*. 4. The *iſſue* or demurrer. 5. The *trial*. 6. The *judgment*, and its incidents. 7. The proceedings in nature of *appeals*. 8. The *execution*. See theſe articles.

SULLY. See Bethune.

SULPHAT, in the new chemical nomenclature, denotes a compound of the ſulphuric acid with ſome other ſubſtance.

SULPHUR, a well known ſubſtance, which is yellow, taſteleſs, hard, brittle, and when rubbed becomes electric. Its ſpecific gravity is from 1,9 to 2,35. According to Bergman it gently evaporates at 170, melts at 185, and flames at 302 of Fahrenheit. It burns with a blue flame, and a diſagreeable ſuffocating ſmell; in cloſe veſſels it ſublimes without decompoſition, or only a decompoſition proportionable to the quantity of air they contain; when melted it becomes red, but recovers its colour on cooling. It is inſoluble in water, though by long trituration it is ſaid water will take up ſome of it, but it is rather diffuſed than diſſolved in it; neither can ſpirit of wine unite to it, except when both are in a vaporous ſtate, and then 72 parts of ſpirit of wine take up 1 of ſulphur; it is ſoluble in hot oils, and alſo in fixed alkalis, both in the dry and liquid way; it is decompoſed by boiling in concentrated nitrous acid, partly decompoſed and partly diſſolved by the vitriolic and oxygenated muriatic acid. See Chemistry-*Index*.

Kirwan's Mineralogy.

Sulphur was formerly ſuppoſed to conſiſt of ſulphuric acid and phlogiſton, in the proportion of 60 parts of the former to 40 of the latter; but by the new ſyſtem which is now generally adopted, ſulphur is reckoned a ſimple ſubſtance, and the ſulphuric acid a compound of ſulphur and oxygene or vital air. This concluſion is founded on the following facts: 1. Sulphur does not burn unleſs vital air have acceſs to it. 2. During combuſtion it abſorbs vital air from the atmoſphere. 3. The ſulphuric produced by the combuſtion of ſulphur is equal in weight to the ſulphur employed and the quantity of air that has been conſumed.

Sulphur is found ſometimes pure, and ſometimes in combination with other ſubſtances. Of pure ſulphur there are ſeven varieties. 1. Tranſparent ſulphur, in eight-ſided cryſtals, with two truncated pyramids. It is generally depoſited by water on the ſurface of calcareous ſpar. Cadiz ſulphur is of this kind. 2. Tranſparent ſulphur in irregular fragments. Such is the ſulphur of Switzerland. 3. Whitiſh pulverulent ſulphur, depoſited in ſiliceous geodes. In Franche Compté there are flints full of ſulphur. 4. Pulverulent ſulphur depoſited on the ſurface of mineral waters, ſuch as thoſe of Aix-la-Chapelle. 5. Cryſtalline ſulphur that has been ſublimed, found in the neighbourhod of volcanoes. 6. Pulverulent ſulphur ſublimed from volcanoes, found in abundance at Solfatara in the vicinity of Naples. 7. Sulphur in ſtalactites, formed by volcanic fires.

Fourcroy's Chemiſtry.

Sulphur is alſo found united with different ſubſtances, as with metals, when it is called *pyrites*; a ſhort account of which may be ſeen under the article Pyrites. Sometimes it is combined with calcareous earth, as in fetid calcareous ſtones and ſwine-ſtone. It has lately been diſcovered, that ſulphur is formed by a natural proceſs in animals and vegetables beginning to putrefy. It is found on ſtable-walls and in privies. It is alſo extracted from vegetables, from dock-root, cochlearia, &c. M. Deyeux obtained it from the white of eggs. It has been alſo procured from horſe-dung.

The ſulphur uſed in Great Britain is generally brought in a pure ſtate from volcanic countries, where it abounds in an inexhauſtible quantity. It is well known, however, that ſome of the metallic ores in that country abound with it; but from the common mode of purifying them, the ſulphur is diſſipated and loſt. Dr Watſon has ſhown, in a paper on lead-ore in the Philoſophical Tranſactions, that not leſs than 700 tons are annually diſſipated in the various lead-mines of England.

It is extracted from pyrites in the following manner in Saxony and Bohemia. The pyrites is put in ſmall pieces into earthen tubes: one of the tubes is placed on a furnace, and the other paſſes into a ſquare veſſel of caſt iron containing water. The ſulphur is diſunited by the heat from the pyrites, and paſſes into the veſſel; but it is then very impure. It is afterwards melted in an iron ladle, when the earthy and metallic particles are depoſited by their weight, and the ſulphur being light riſes to the top. It is then poured off into a copper boiler, where it is farther purified, and afterwards poured into cylindrical moulds of wood, from which it receives the ſhape in which it is uſually ſold.

When melted ſulphur is gently heated, it flies off in a yellow powder, which is called *flowers of ſulphur*. The operation is performed in this manner: Common ſulphur in powder is put into an earthen cucurbit, to the top of which a number of earthen pots inſerted in one another is fixed, known by the name of *aludels*. The cucurbit is then heated till the ſulphur becomes liquid; it then riſes and attaches itſelf to the ſides of the aludels.

Sulphur combined with an alkali is called *hepar ſulphuris*, *liver of ſulphur*, becauſe it reſembles in colour the liver of animals. In the French nomenclature it is called *ſulphure*, and by thoſe Britiſh chemiſts who have adopted the new ſyſtem *ſulphuret*.

Water decompoſes the ſulphuret. The ſulphur is precipitated by acids, when a particular gas is extricated commonly called *hepatic gas*, or, what is more expreſſive of its compoſition, *ſulphurated hydrogenous gas*. The fetor of this gas is inſufferable, and is fatal to animals. It communicates a green colour to ſyrup of violets, and burns with a light-blue flame. It acts on metals and metallic oxides, eſpecially thoſe of lead and biſmuth, which it ſoon blackens. It is decompoſed by vital air; and accordingly, when it comes into contact with atmoſpheric air, a portion of the ſulphur is ſeparated. For this reaſon ſulphureous waters do not contain genuine liver of ſulphur.

The mineral acids act differently on ſulphur. If the ſulphuric acid be boiled on ſulphur, the acid acquires an amber colour, and a ſulphureous ſmell; the ſulphur melts and ſwims like oil. When cooled, it concretes into globules of a greeniſh hue; but a ſmall portion of the ſulphur is diſſolved in the acid, which may be precipitated by an alkali. The flaming red nitrous acid acts powerfully on ſulphur. When poured upon melted ſulphur, it occaſions detonation and inflammation. The common muriatic acid produces no effect upon it; but the oxygenated muriatic acid acts upon it with force.

Sulphur unites readily with all metallic ſubſtances, excepting gold, platina, and zinc; at leaſt we have not found the means of uniting it with theſe directly, and without ſome intermediate ſubſtance. The degrees of affinity with which ſulphur combines with thoſe metals to which it may be readily united are different; for it not only unites more eaſily and abundantly with ſome than with others, but it alſo quits thoſe with which it has a leſs affinity, to unite with others to which it has a ſtronger affinity.

The affinities of ſulphur, according to Mr Geoffroy's table, are, fixed alkali, iron, copper, lead, ſilver, regulus of antimony, mercury, and gold; and, according to Mr Gellert's table, they are, iron, copper, tin, lead, ſilver, biſmuth, regulus of antimony, mercury, arſenic, and cobalt: gold and zinc are marked in this table as being incapable of uniting with ſulphur.

The compounds formed by ſulphur with different metals are different; but all of them poſſeſs a metallic luſtre, without any ductility: theſe combinations of ſulphur and of metals are very frequently ſound in a natural ſtate. Almoſt all the metals which we dig from the earth are naturally found combined with ſulphur, forming moſt of the ores and metallic minerals.

It is a curious phenomenon, that nitre mixed with ſulphur burns rapidly, even in cloſe veſſels; this is eaſily explained by the new ſyſtem. Nitre, when heat is applied to it, yields a great quantity of vital air; and ſulphur is a combuſtible body, or, which is the ſame thing, has a ſtrong attraction for vital air. As vital air is thus ſupplied, which is the only principle neceſſary to combuſtion, communication with the atmoſpheric air is unneceſſary. The ſulphur will burn till the whole vital air which the nitre furniſhes be conſumed. The products obtained by this proceſs are different according to the proportions of nitre and ſulphur which are employed. If eight parts of ſulphur and one of nitre be ſet on fire in a cloſe veſſel, ſulphuric acid is produced; and this is the method by which oil of vitriol or ſtrong ſulphuric acid was formerly made in Great Britain. The veſſels in which the operation was performed were large glaſs balloons, with very large necks, each containing 400 or 500 pints. But it was attended with great expence, on account of the high price and brittleneſs of the balloons. A few years ago a cheaper method has been attempted with ſucceſs in France. The ſulphur is burned on a kind of gridirons, in large apartments lined with lead. As the acid condenſes it is conveyed by gutters into a reſervoir, and afterwards concentrated. It muſt be obſerved, that the ſulphuric acid thus obtained is always combined with a little ſulphur and ſulphat of pot-aſh, a ſmall quantity of aluminous ſulphat and ſulphat of lead; but theſe ſubſtances are in ſo ſmall a proportion, that for common uſe it is not neceſſary to ſeparate them. If neceſſary, however, it may eaſily be done by diſtilling the acid to dryneſs.

Gunpowder, the terrible effects of which are owing to its ſtrong tendency to combuſtion, is a mixture of ſulphur, nitre, and charcoal. (See GUNPOWDER). But there is another mixture of which ſulphur is an ingredient ſtill more violent in its effects: This is called *fulminating powder*, and is compoſed of three parts of nitre, two parts of the carbonate of pot-aſh, and one of powdered ſulphur. Theſe being cloſely united together by trituration in a hot marble mortar, when expoſed to a ſlight degree of heat, will melt, and produce a violent detonation like the report of a cannon. A dram of this mixture is ſufficient for the experiment.

Sulphur is of great uſe in chemiſtry, in medicine, and the arts. Sulphur is uſeful in making ſome fuſions, precipitations, and ſeparations of metals and minerals; but is particularly uſeful, as being the ſubſtance from which the ſulphuric acid is obtained. Hepar ſulphuris is employed in chemiſtry for making ſeveral ſolutions.

Sulphur is employed in medicine both internally and externally. It is given either in flowers or in lozenges, made up with ſugar, or joined to magneſia, cryſtals of tartar, manna, caſſia, lenitive electuary, &c. Two or three drams generally prove laxative; and it is given in ſuch doſes in caſes of piles, of uterine, and other hæmorrhagies; becauſe it does not ſtimulate nor heat during its operation, nor leave a diſpoſition to coſtiveneſs, as rhubarb, aloes, and other hot reſinous purges do. Sulphur was formerly much recommended in coughs and diſeaſes of the breaſt, but of late its virtues as a pectoral have been much doubted. When applied externally, it is mixed with ſome unctuous ſubſtance, as hogs-lard, butter, &c. and is rubbed on ſuch parts of the body as are affected with eruptions.

Some phyſicians and chemiſts, conſidering that ſulphur is inſoluble in water, and capable of reſiſting the action of moſt menſtruums, have affirmed, that it can produce no effect when taken internally, ſingle and unaltered; but this aſſertion ſeems to be without foundation; for it is certain, that the ſweat and perſpiration of thoſe who take ſulphur internally have a ſmell evidently ſulphureous. Beſides, ſulphur is much more ſoluble than is generally believed. It is attacked by all oily and ſaponaceous ſubſtances, and conſequently by almoſt all animal liquors.

We cannot eaſily form a very diſtinct and clear idea of the manner in which ſulphur acts internally upon our bodies; but, from obſervations made upon its effects, it appears to be dividing, ſtimulating, and ſomewhat heating: it principally acts upon the perſpirable parts of the body, the chief of which are the ſkin and lungs; and from this property it is particularly uſeful in ſome diſeaſes of theſe parts.

Sulphur is alſo a powerful repellent, as appears from its curing ſeveral kinds of itch, merely by external application, in form of ointments and pomatums. Several mineral waters, which are drunk or uſed as baths for ſome diſeaſes, owe their good qualities to ſulphur contained in them.

Sulphur is alſo uſed in ſeveral arts. By means of it fine impreſſions of engraved ſtones are taken. Matches are formed of it; and its utility as an ingredient in the preparation of gunpowder and fireworks is well known. Laſtly, it is uſed for whitening wool, ſilk, and many other matters expoſed to its vapour during its combuſtion; the colours and redneſs of which could not be deſtroyed by any other ſubſtance, but are quickly effaced by this acid vapour.

SULPHUR-Wort, in botany. See PEUCEDANUM.

SULPHURIC-ACID, the name adopted by the French chemiſts for the vitriolic acid. It is formed by a combination of ſulphur with vital air, as deſcribed under the article SULPHUR. When ſulphur is burned with a low degree of heat, it burns with a blue flame, and diffuſes a ſuffocating vapour, which, when collected, is called *ſulphureous ocid*. When ſulphur is expoſed to ſtrong heat it burns rapidly, and emits a lively white flame, and has no ſmell; the reſidue is called *ſulphuric acid*. The ſulphureous is a weaker acid than the ſulphuric, owing to its containing a leſs quantity of oxygene.

SULPICIA, an ancient Roman poeteſs, who lived under the reign of Domitian, and has been ſo much admired as to be termed the *Roman Sappho*. We have nothing, however, left of her writings but a ſatire, or rather the fragment of one, againſt Domitian, who publiſhed a decree for the baniſhment of philoſophers from Rome: which ſatire is to be found in Scaliger's *Appendix Virgiliana*. She is mentioned by Martial and Sidonius Apollinaris; and is ſaid to have addreſſed a poem on conjugal love to her huſband Calenus, a Roman knight.

SULPICIUS (Severus), an eccleſiaſtical writer who flouriſhed about the beginning of the 5th century, and was contemporary with Rufinus and St Jerome. He was the diſciple of St Martin of Tours, whoſe life he has written; and the friend of Paulinus biſhop of Nola, with whom he held an intimate correſpondence. The principal of his works is his *Hiſtoria Sacra*, from the creation of the world to the conſulate of Stilicho and Aurelian, about the year 400; in which his ſtyle is elegant beyond the age he lived in.

SULTAN, or SOLDAN, a title or appellation given to the emperor of the Turks.

Vattier will have the word Turkiſh, and to ſignify *king* *of kings*; adding, that it was firſt given to the Turkiſh princes Angrolipex and Maſgud, about the year 1055: others will have it originally Perſian, alleging, in proof hereof, an ancient medal of Coſroe: others derive it from *ſoldanus, quaſi ſolus dominus*: others from the Hebrew שלט, *ſchalat* or *ſheleth*, "to rule, reign."

It had its riſe under Mahmoud, ſon of Sebecteghin, the firſt emperor of the dynaſty of the Gaznevides, towards the cloſe of the fourth century of the era of the Hegira: when that prince going to Segeſtan to reduce Kalaf governor of that province, who affected the ſovereignty, Kalaf was no ſooner advertiſed of his coming than he went out to meet him, delivered the keys of his fortreſs, and owned him his *ſultan*, that is, his lord or commander. The title pleaſed Mahmoud ſo well, that he aſſumed it ever afterwards; and from him it paſſed to his deſcendants, and to other Mahometan princes. It is chiefly confined to the Turkiſh and Perſian monarchs.

SULZER (M.), a celebrated philoſopher, was born at Winterthun, in the canton of Zurich, October 16. 1720. He was the youngeſt of 25 children. His early education did not promiſe much, tho' it was by no means neglected. He had little inclination for what is called in the ſchools the ſtudy of *humanity*, and made but a ſmall progreſs in the learned languages, which were to prepare him for the ſtudy of theology, for which profeſſion his parents deſigned him. At the age of 16, when he went to the academical ſchool of Zurich, he had not the ſmalleſt notion of the ſciences, or of elegant literature, and conſequently no taſte for ſtudy. The firſt incident that developed a hidden germ of philoſophical genius, was his meeting with Wolfe's Metaphyſics: this was the birth of his taſte for ſcience; but he wanted a guide. The clergyman with whom he lodged was an ignorant man; and the academical prelections were, as yet, above the reach of his comprehenſion. On the other hand, a ſedentary life was not the thing he liked, nor to which he had been accuſtomed; and, moreover, a ſociable turn of mind led him often into company, where he loſt much time in frivolous amuſements, yet without corrupting his morals. Who, that obſerved him at this period, ſays Mr Formey in his *Eulogium*, would have thought that Sulzer would one day be numbered among the moſt knowing and wiſe men of his time? The learned Geſner was the inſtrument of Providence that rendered Sulzer's inclination to ſtudy triumphant over his paſſion for amuſement and company. Animated by the counſels and example of this worthy and learned man, he applied himſelf to philoſophy and mathematics with great ardour, and reſumed the purſuit of Grecian literature and the Oriental languages. The contemplation of nature became his noble and favourite paſſion. An eccleſiaſtical ſettlement in a rural ſcene, that exhibited happy objects and occaſions for this delightful ſtudy, began to render his days happy and uſeful; and he publiſhed, in 1741, *Moral Contemplations of the Works of Nature*; and the year following an *Account* of a journey he had made through the Alps; which ſhowed, at the ſame time, his knowledge of natural hiſtory, and the taſte and ſenſibility with which he ſurveyed the beauties of nature, and the grandeur and goodneſs of its Author. He afterwards became private tutor to a young gentleman at Magdeburg. This procured him the acquaintance of Meſſrs Maupertuis, Euler, and Sack, which opened to his merit the path of preferment, and advanced him ſucceſſively to the place of mathematical profeſſor in the King's College at Berlin, in 1747, and to that of member of the Royal Academy in 1750.

In this laſt quality he diſtinguiſhed himſelf in a very eminent manner, enriched the claſs of ſpeculative philoſophy with a great number of excellent memoirs, and was juſtly conſidered as one of the firſt-rate metaphyſicians in Germany. But his genius was not confined to this branch of ſcience. His *Univerſal Theory of the Fine Arts* is a valuable production. A profound knowledge of the arts and ſciences, and a perfect acquaintance with true taſte, are eminently diſplayed in this work, and will ſecure to its author a permanent and diſtinguiſhed rank in the republic of letters. The firſt volume of this excellent work was publiſhed in 1771, and the ſecond in 1774. We ſhall not here give a catalogue of the writings of M. Sulzer; but we cannot help mentioning his *Remarks on the Philoſophical Eſſays* of the late Mr Hume, as a work of real merit, which does juſtice to the acuteneſs, while it often detects the ſophiſtry, of the Britiſh Bayle. The moral character of M. Sulzer was amiable and virtuous: ſociability and beneficence were its characteriſtical lines; and his virtues were animated by that ſacred philoſophy that forms the Chriſtian, ennobles man, and is the only ſource of that heart-felt ſerenity and ſedate fortitude which ſupport humanity, when every other object of confidence fails. His dying moments were calm, humble, and ſublime; and when he expired, the placid and compoſed air of his countenance made his mourning friends doubt, for ſome time, whether it was death or ſleep that had ſuſpended his converſation. He had no enemy; and his friends were numerous, affectionate, and worthy of the tender returns he made them.

The king of Pruſſia diſtinguiſhed him by repeated marks of munificence and favour. We learn, however, that his royal protector had never ſeen him before the end of the year 1777, though he had been member of the academy from the year 1750. The audience, indeed, though late vouchſafed, was honourable to M. Sulzer, with whom the monarch converſed for a long time with the greateſt affability and condeſcenſion.

SUM, ſignifies the quantity that ariſes from the addition of two or more magnitudes, numbers, or quantities together.

SUMACH, in botany. See Rhus.

SUMATRA, an iſland of Aſia, the moſt weſtern of the Sunda Iſlands, and conſtituting on that ſide the boundary of the Eaſtern Archipelago. Its general direction is nearly north-weſt and ſouth-eaſt. The equator divides it into almoſt equal parts, the one extremity being in 5. 33. N. and the other in 5. 56. S. Lat. Acheen head, at the north extremity of the iſland, is in longitude 95. 34. eaſt. It lies expoſed on the ſouth-weſt ſide to the Indian Ocean; the north point ſtretches into the bay of Bengal; to the north eaſt it is divided from the peninſula of Malacca by the ſtraits of that name; to the eaſt by the ſtraits of Banca, from the iſland of that name; to the ſouth-eaſt by the commencement of what are called the *Chineſe Seas*; and on the ſouth by the ſtraits of Sunda, which ſeparate it from the iſland of Java. It is about 900 miles in length, but from 100 to 150 only in breadth. No account had been given of this iſland by any Engliſhman till the year 1778, when Mr Charles Miller (ſon of the late botanical gardener) publiſhed an account of the manners of a particular diſtrict, in the 68th volume of the Philoſophical Tranſactions. Theſe were the Battas, a people who live in the interior parts, called the *Caſſia Country*. They differ from all the other inhabitants in language, manners, and cuſtoms. They eat the priſoners whom they take in war, and hang up their ſkulls as trophies in their houſes. He obſerves, however, that human fleſh is eaten by them *in terrorem*, and not as common food, though they prefer it to all others, and ſpeak with peculiar raptures of the ſoles of the feet and palms of the hands. They expreſſed much ſurpriſe that the white people did not kill, much leſs eat, their priſoners. From

Brooke's Gazetteer.

this country the greateſt part of the caſſia that is ſent to Europe is procured. It abounds alſo with the camphire trees, which conſtitute the common timber in uſe; and in theſe trees the camphire is found native, in a concrete form. It is remarkable, that in this ſtate it is ſold to the Chineſe at the price of 250l. or 300l. *per* cwt. but theſe dexterous artiſts contrive to furniſh the Europeans with it at about a quarter of that price. In 1783, Mr Marſden, who had been ſecretary to the preſident and council of Fort Marlborough, publiſhed a Hiſtory of Sumatra, with very copious particulars of the iſland. He repreſents it as ſurpaſſed by few in the beautiful indulgences of nature. A chain of high mountains runs through its whole extent; the ranges in many parts being double and treble; their altitude, though great, is not ſufficient to occaſion their being covered with ſnow during any part of the year. Between theſe ridges are extenſive plains, conſiderably elevated above the ſurface of the maritime lands. In theſe the air is cool; and from this advantage they are eſteemed the moſt eligible portion of the country, are the beſt inhabited, and the moſt cleared from woods, which elſewhere, in general, throughout Sumatra, cover both hills and valleys with an eternal ſhade. Here too are found many large and beautiful lakes, that facilitate much the communication between the different parts. The heat of the air is far from being ſo intenſe as might be expected from a country occupying the middle of the Torrid Zone; and it is more temperate than many regions within the Tropics; the thermometer at the moſt ſultry hour, about two in the afternoon, generally fluctuating between 82 and 85 degrees. Mr Marſden divides the inhabitants into Malays, Acheneſe, Battas, Lampoons, and Rejangs; and he takes the latter as his ſtandard of deſcription, with reſpect to the perſons, manners, and cuſtoms, of the inhabitants. They are rather below the middle ſtature; their bulk in proportion; their limbs for the moſt part ſlight, but well ſhaped, and particularly ſmall at the wriſts and ancles; and, upon the whole, they are gracefully formed. Their hair is ſtrong, and of a ſhining black. The men are beardleſs, great pains being taken to render them ſo when boys, by rubbing their chins with a kind of quicklime. Their complexion is properly yellow, wanting the red tinge that conſtitutes a copper or tawny colour. They are in general lighter than the Meſtees, or half-breed, of the reſt of India; thoſe of the ſuperior claſs, who are not expoſed to the rays of the ſun, and particularly their women of rank, approaching to a degree of fairneſs. If beauty conſiſted in this one quality, ſome of them would ſurpaſs the brunettes in Europe. The major part of the females are ugly, many of them even to diſguſt; yet among them are ſome whoſe appearance is ſtrikingly beautiful, whatever compoſition of perſon, features, and complexion, that ſentiment may be the reſult of. Some of the inhabitants of the hilly parts are obſerved to have the ſwelled neck or goitre; but they attempt no remedy for it, as theſe wens are conſiſtent with the higheſt health. The rites of marriage among the Sumatrans conſiſt ſimply in joining the hands of the parties, and pronouncing them man and wife without much ceremony, excepting the entertainment which is given upon the occaſion by the father of the girl. The cuſtoms of the Sumatrans permit their having as many wives as they can purchaſe, or afford to maintain; but it is extremely rare that an inſtance occurs of their having more than one, and that only among a few of the chiefs. This continence they owe, in ſome meaſure, to their poverty. The dictates of frugality are more powerful with them than the irregular calls of appetite, and make them decline an indulgence from which their law does not reſtrain them. Mothers carry their children, not on the arm as our nurſes do, but ſtraddling on the hip, and uſually ſupported by a cloth which ties in a knot on the oppoſite ſhoulder. The children are nurſed but little; are not confined by any ſwathing or bandages; and being ſuffered to roll about the floor, ſoon learn to walk and ſhift for themſelves. When cradles are uſed, they ſwing ſuſpended from the ceilings of the rooms.

The Sumatrans are ſo fond of cock-fighting, that a father on his death-bed has been known to deſire his ſon to take the firſt opportunity of matching a cock for a ſum equal to his whole property, under a blind conviction of its being invulnerable. When a cock is killed, or runs, the other muſt have ſufficient ſpirit and vigour left to peck at him three times on his being held up to him for that purpoſe, or it becomes a drawn battle; and ſometimes an experienced cocker will place the head of his vanquiſhed bird in ſuch an uncouth ſituation as to terrify the other, and render him unable to give this proof of victory.

The wild beaſts of Sumatra are tigers, elephants, rhinoceroſes, bears, and monkeys. The tigers prove to the inhabitants both in their journeys and even their domeſtic occupations moſt deſtructive enemies. The number of people annually ſlain by theſe rapacious tyrants of the woods is almoſt incredible. Whole villages have been depopulated by them; yet from a ſuperſtitious prejudice, it is with difficulty they are prevailed upon, by a large reward which the India Company offers, to uſe methods of deſtroying them, till they have ſuſtained ſome particular injury in their own family or kindred. The ſize and ſtrength of the ſpecies which prevails on this iſland is prodigious. They are ſaid to break with a ſtroke of their fore paw the leg of a horſe or a buffalo; and the largeſt prey they kill is without difficulty dragged by them into the woods. This they uſually perform on the ſecond night, being ſuppoſed on the firſt to gratify themſelves with ſucking the blood only. Time is by this delay afforded to prepare for their deſtruction, either by ſhooting them, or placing a veſſel of water ſtrongly impregnated with arſenic near the carcaſe, which is faſtened to a tree to prevent its being carried off. The tiger having ſatiated himſelf with the fleſh, is prompted to aſſuage his thirſt with the tempting liquor at hand, and periſhes in the indulgence. Their chief ſubſiſtence is moſt probably the unfortunate monkeys with which the woods abound. They are deſcribed as alluring them to their fate by a faſcinating power, ſimilar to what has been ſuppoſed of the ſnake; and, ſays Mr Marſden, "I am not incredulous enough to treat the idea with contempt, having myſelf obſerved, that when an alligator or a crocodile, in a river, comes under an overhanging branch of a tree, the monkeys, in a ſtate of alarm and diſtraction, crowd to the extremity, and, chattering and trembling, approach nearer and nearer to the amphibious monſter that waits to devour them as they drop, which their fright and number render almoſt unavoidable." Theſe alligators likewiſe occaſion the loſs of many inhabitants, frequently deſtroying the people as they bathe in the river, according to their regular cuſtom, and which the perpetual evidence of the riſk attending it cannot deter them from. A ſuperſtitious idea of their ſanctity alſo preſerves them from moleſtation, although, with a hook of ſufficient ſtrength, they may be taken without much difficulty. The other animals of Sumatra are buffaloes, a ſmall kind of horſes, goats, hogs, deer, bullocks, and hog-deer. This laſt is an animal ſomewhat larger than a rabbit, the head reſembling that of a hog, and its ſhanks and feet like thoſe of the deer. The bezoar-ſtone found in this animal has been valued at 10 times its weight in gold; it is of a dark brown colour, ſmooth on the outſide; and the coat being taken off, it appears ſtill darker, with ſtrings running underneath the coat: it will ſwim on the top of the water. If it be infuſed in any liquid, it makes it extremely bitter: the virtues uſually attributed to this ſtone are cleanſing the ſtomach, creating an appetite, and ſweetening the blood.

Of birds they have a greater variety than of beaſts. The coo-ow, or Sumatran pheaſant, is a bird of uncommon beauty. They have ſtorks of prodigious ſize, parrots, dung-hill fowls, ducks, the largeſt cocks in the world, wood-pigeons, doves, and a great variety of ſmall birds, different from ours, and diſtinguiſhed by the beauty of their colours. Of their reptiles, they have lizards, flying-lizards, and cameleons. The iſland ſwarms with inſects, and their varieties are no leſs extraordinary than their numbers. Rice is the only grain that grows in the country; they have ſugar-canes, beans, peas, radiſhes, yams, potatoes, pumkins, and ſeveral kinds of pot-herbs unknown to Europe; and here are to be found moſt of the fruits to be met with in other parts of the Eaſt Indies, in the greateſt perfection. Indigo, Braſil-wood, two ſpecies of the bread-fruit tree, pepper, benjamin, coffee, and cotton, are likewiſe the produce of this iſland, as well as caſſia and camphire mentioned above. Here alſo is the cabbage-tree and ſilk cotton tree; and the foreſt contains a great variety of valuable ſpecies of wood, as ebony, pine, ſandal, eagle or aloes, teek, manchineel, and iron-wood, and alſo the banyan tree. Gold, tin, iron, copper, and lead, are found in the country; and the former is ſuppoſed to be as plentiful here as in Peru or Mexico. The fineſt gold and gold-duſt are found in the country of *Limong*, immediately contiguous to the preſidency of *Fort Marlborough*, to which the merchants repair annually for the purchaſe of opium, and ſuch other articles as they may be in want off, and give for them gold of ſo pure a nature as to contain little or no alloy. The native indolence of the *Malay* diſpoſition prevents them from collecting more than is ſufficient to ſupply the few and ſimple wants of a race of men as yet unenlightened by civilization and ſcience, and ignorant of the full extent of the advantages of the country inhabited by them. The roads leading to this golden country are almoſt impervious; affording only a ſcanty path to a ſingle traveller, where whole nights muſt be paſſed in the open air, expoſed to the malignant influence of a hoſtile climate, in a country infeſted by the moſt ferocious wild beaſts. Theſe are circumſtances that have hitherto checked curioſity; but perſeverance and ſtudied precaution will ſurmount the obſtacles they furniſh, and ſuch diſcoveries might be made as would amply compenſate for the difficulties leading to them. The gold merchants who come from the neighbouring and leſs rich conntries, give us ſuch accounts of the facility of procuring gold as border nearly on the marvellous, and would be altogether incredible, if great quantities of that metal produced by them did not in ſome degree evince the certainty of their accounts.

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This great abundance of gold in Sumatra induces Mr Marſden to ſuppoſe that iſland to be the Ophir of Solomon; a conjecture which, in his opinion, derives no ſmall force from the word *Ophir's* being really a *Malay* ſubſtantive, of a compound ſenſe, ſignifying a mountain containing gold. The natives, he confeſſes, have no oral tradition on the ſubject; and we have elſewhere made it probable, that Ophir was ſituated in a different quarter of the world (ſee OPHIR). Beſides the metals and different ſpecies of wood which we have mentioned, Sumatra produces ſulphur, arſenic, ſaltpetre, and bees-wax, with edible birds neſts, which are there commodities of great importance (ſee *BIRDS-Neſts*).

The Engliſh and Dutch have factories on this iſland; the principal one of the former being Fort Marlborough, on the ſouth-weſt coaſt. The original natives of Sumatra are Pagans; but it is to be obſerved, that when the Sumatrans, or any of the natives of the eaſtern iſlands, learn to read the Arabic character, and ſubmit to circumciſion, they are ſaid to become Malays; the term *Malay* being underſtood to mean *Muſſulman*. See ACHEEN.

SUMMARY, in matters of literature. See ABRIDGEMENT.

SUMMER, the name of one of the ſeaſons of the year, being one of the quarters when the year is divided into four quarters, or one half when the year is only divided into two, ſummer and winter. In the former caſe, ſummer is the quarter during which, in northern climates, the ſun is paſſing through the three ſigns Cancer, Leo, Virgo, or from the time of the greateſt declination, till the ſun come to the equinoctial again, or have no declination,; which is from about the 21ſt of June till about the 22d of September. In the latter caſe, ſummer contains the ſix warmer months, while the ſun is on one ſide of the equinoctial; and winter the other ſix months, when the ſun is on the other ſide of it. It is ſaid that a froſty winter produces a dry ſummer, and a mild winter a wet ſummer.

SUMMER-Iſlands. See BERMUDAS.

SUMMER Red-Bird. See MUSCICAPA.

SUMMIT, the top or vertex of any body or figure, as of a triangle, cone, pyramid, &c.

SUMMONS, in law, a citing or calling a perſon to any court, to anſwer a complaint or to give his evidence

SUMMONS, in war. To ſummon a place, is to ſend a drum or trumpet to command the governor to ſurrender, and to declare that if the place be taken by ſtorm, all muſt ſubmit to the mercy of the conqueror. See CAPITULATION and CHAMADE.

SUMMUM BONUM, in ethics, the chief good.

SUMP, in metallurgy, a round pit of ſtone, lined with clay within, for the receiving the metal on its firſt fuſion from the ore.

SUMP, in the Britiſh ſalt-works, where ſea-water is boiled into ſalt, is the name of a ſort of pond, which is made at ſome diſtance from the ſaltern on the ſea-ſhore, between full ſea and low water mark. From this pond a pipe is laid, through which, when the ſea is in, the water runs into a well adjoining to the ſaltern; and from this well it is pumped into troughs, through which it is carried to the ciſterns, in order to be ready to ſupply the pans. See SALT.

SUMPH, in mining, denotes a pit ſunk down in the bottom of the mine, to cut or prove the lode ſtill deeper than before; and in order to ſlope and dig it away if neceſſary, and alſo to drive on the lode in depth. The ſumph principally ſerves as a baſon or reſervoir, to collect the water of a mine together, that it may be cleaned out by an engine or machine.

SUMPTER-HORSE, is a horſe that carries proviſions and neceſſaries for a journey.

SUMPTUARY LAWS (*Leges Sumptuariæ*), are laws made to reſtrain exceſs in apparel, coſtly furniture, eating, &c.

Moſt ages and nations have had their ſumptuary laws; and ſome retain them ſtill, as the Venetians, &c. But it is obſerved, that no laws are worſe executed than ſumptuary laws. Political writers have been much divided in opinion with reſpect to the utility of theſe laws to a ſtate. Monteſquieu obſerves, that luxury is neceſſary in monarchies, as in France, but ruinous to democracies, as in Holland. With regard to England, whoſe government is compounded of both ſpecies, it may ſtill be a dubious queſtion, ſays judge Blackſtone, how far private luxury is a public evil; and as ſuch cognizable by public laws.

The ſumptuary laws of that ancient Locrian legiſlator Zaleucus are famous: by theſe it was ordained, that no woman ſhould go attended with more than one maid in the ſtreet except ſhe were drunk: that he ſhould not go out of the city in the night, unleſs ſhe went to commit fornication: that ſhe ſhould not wear any gold or embroidered apparel, unleſs ſhe propoſed to be a common ſtrumpet; and that men ſhould not wear rings or tiſſues except when they went a whoring, &c.

Among the Romans, the ſumptuary laws were very numerous: By the *Lex Orchia*, the number of gueſts at feaſts was limited, though without any limitation of the charges: by the Fannian law, made 22 years afterwards, it was enacted, that more that 10 *aſſes* ſhould not be ſpent at any ordinary feaſt: for the ſolemn feaſts, as the Saturnalia, &c. an hundred aſſes were allowed; ten of which, Gellius informs us, was the price of a ſheep, and an hundred of an ox. By the Didian law, which was preferred 18 years after, it was decreed, that the former ſumptuary laws ſhould be in force, not only in Rome, but throughout all Italy; and that for every tranſgreſſion, not only the maſter of the feaſt, but all the gueſts too, ſhould be liable to the penalty.

The Engliſh have had their ſhare of ſumptuary laws, chiefly made in the reigns of Edw. III. Edw. IV. and Henry VIII. againſt ſhoes with long points, ſhort doublets, and long coats; though all repealed by ſtatute 1 Jac. I. c. 25. As to exceſs in diet, there remains ſtill one law unrepealed. Under King Henry IV. Camden tells us, pride was got ſo much into the foot, that it was proclaimed, that no man ſhould wear ſhoes above ſix inches broad at the toes. And their other garments were ſo ſhort, that it was enacted, 25 Edw. IV. that no perſon, under the condition of a lord, ſhould, from that time, wear any mantle or gown, unleſs of ſuch length, that, ſtanding upright, it might cover his privy members and buttocks.

SUN, SOL, ☉ in aſtronomy, the great luminary which enlightens the world, and by its preſence conſtitutes day. See ASTRONOMY-*Index*.

Mock-Sun. See PARHELION.

Sun-Fiſh of the Iriſh. See SQUALUS.

Sun-Flower, in botany. See HELIANTHUS.

Sun-Dew, in botany. See DROSERA.

SUNDA-ISLANDS, a general name for a cluſter of iſlands in the India Ocean, between 93° and 120° of eaſt longitude, and between 8° north and 8° ſouth latitude. The particular names of the iſlands are *Borneo*, *Sumatra*, *Java*, *Bally*, *Banca*, &c.

SUNDAY, or the LORD'S-DAY, a ſolemn feſtival obſerved by Chriſtians on the firſt day of every week, in memory of our Saviour's reſurrection. SABBATH.

In the breviary and other offices we meet with Sundays of the firſt and ſecond claſs. Thoſe of the firſt claſs are, Palm, Eaſter, Advent, and Whitſunday, thoſe of *Quaſimodo* and *Quadrageſima*. Thoſe of the ſecond claſs are the common Sundays. Anciently each Sunday in the year had its particular name, which was taken from the introit of the day; which cuſtom has only been continued to ſome few in lent; as *Reminiſcere*, *Oculi*, *Lætare*, *Judica*.

Some are of opinion that the Lord's-day, mentioned in the Apocalypſe, is our Sunday; which they believe was ſo early inſtituted by the apoſtles. Be this as it will, it is certain a regard was had to this day even in the earlieſt ages of the church; as appears from the firſt apology of Juſtin Martyr, where he deſcribes the exerciſe of the day not much unlike to ours.

But it was Conſtantine the Great who firſt made a law for the proper obſervation of Sunday; and who, according to Euſebius, appointed it ſhould be regularly celebrated throughout the Roman empire. Before him, and even in his time, they obſerved the Jewiſh Sabbath as well as Sunday; both to ſatiſfy the law of Moſes and to imitate the apoſtles, who uſed to meet together on the firſt day.

By Conſtantine's law, made in 321, it was decreed, that for the future the Sunday ſhould be kept a day of reſt in all cities and towns; but he allowed the country people to follow their work. In 538, the council of Orleans prohibited country labour; but becauſe there were ſtill many Jews in Gaul, and the people fell into many ſuperſtitious uſages in the celebration of the new Sabbath, like thoſe of the Jews among that of the old, the council declares, that to hold it unlawful to travel with horſes, cattle, and carriages, to prepare food, or to do any thing neceſſary to the cleanlineſs and decency of houſes or perſons, ſavours more of Judaiſm than of Chriſtianity. See SABBATH-*Breaking*.

SUNDAY-*Schools*. See *Sunday*-SCHOOLS.

SUOVETAURILIA, an ancient Roman ſacrifice, ſo called becauſe it conſiſted of a pig (*ſus*), a ſheep or rather ram (*ovis*), and a bull (*taurus*). They were all males, to denote the maſculine courage of the Roman people. It was likewiſe called *ſolitaurilia*, becauſe the animals offered up were always *ſolida*, whole or uncut.

SUPERCARGO, a perſon employed by merchants to go a voyage, and overſee their cargo or lading, and diſpoſe of it to the beſt advantage.

SUPERCILIUM, in anatomy, the eye-brow. See ANATOMY, n° 142.

SUPEREROGATION, in theology, what a man does beyond his duty, or more than he is commanded to do. The Romaniſts ſtand up ſtrenuouſly for works of ſupererogation, and maintain that the obſervance of evangelical councils is ſuch. By means hereof, a ſtock of merit is laid up, which the church has the diſpoſal of, and which ſhe diſtributes in indulgences to ſuch as need.

This abſurd doctrine was firſt invented towards the cloſe of the 12th century, and modified and embelliſhed by St Thomas in the 13th: according to which, it was pretended that there actually exiſted an immenſe treaſure of merit, compoſed of the pious deeds and virtuous actions which the ſaints had performed beyond what was neceſſary for their own ſalvation, and which were therefore applicable to the benefit of others; that the guardian and diſpenſer of this precious treaſure was the Roman pontiff; and that of conſequence he was empowered to aſſign to ſuch as he thought proper a portion of this inexhauſtible ſource of merit, ſuitable to their reſpective guilt, and ſufficient to deliver them from the puniſhment due to their crimes.

The reformed churches do not allow of any work of ſupererogation; but hold with the apoſtles, that when we have done our beſt, we are but unprofitable ſervants.

SUPERFETATION, in medicine, a ſecond or after-conception, happening when the mother, already pregnant, conceives of a later coition; ſo that ſhe bears at once two fœtuſes of unequal age and bulk, and is delivered of them at different times. We meet with inſtances of ſuperfetations in Hippocrates, Ariſtotle, Du Laurens, &c.: but they are ſaid to be much more frequent in hares and ſwine.

SUPERFICIES, or SURFACE, in geometry, the outſide or exterior face of any body. This is conſidered as having the two dimenſions of length and breadth only, but no thickneſs; and therefore it makes no part of the ſubſtance or ſolid content or matter of the body.

The terms, or bounds, or extremities, of a ſuperficies, are lines; and ſuperficies may be conſidered as generated by the motions of lines. Superficies are either rectilinear, curvilinear, plane, concave, or convex. A rectilinear ſuperficies is that which is bounded by right lines. Curvilinear ſuperficies is bounded by curve lines. Plane ſuperficies is that which has no inequality in it, nor riſings, nor ſinkings, but lies evenly and ſtraight throughout, ſo that a right line may wholly coincide with it in all parts and directions. Convex ſuperficies is that which is curved and riſes outwards. Concave ſuperfices is curved and ſinks inward. See Geometry.

SUPERFINE, in the manufactories, a term uſed to expreſs the ſuperlative fineneſs of a ſtuff: thus a cloth, a camblet, &c. are ſaid to be ſuperfine when made of the fineſt wool, &c. or when they are the fineſt that can be made.

SUPERFLUOUS interval, in muſic, is one that exceeds a true diatonic interval by a ſemitone minor. See Interval.

SUPERINTENDANT, denotes an eccleſiaſtical ſuperior in ſeveral reformed churches where epiſcopacy is not admitted: particularly among the Lutherans in Germany, and the Calviniſts in ſome other places.

The ſuperintendant is ſimilar to a biſhop; only his power is ſomewhat more reſtrained than that of Engliſh dioceſan biſhops. He is the chief paſtor, and has the direction of all the inferior paſtors within his diſtrict or dioceſe. In Germany they had formerly ſuperintendants general, who were ſuperior to the ordinary ſuperintendants. Theſe, in reality, were archbiſhops; but the dignity is ſunk into diſuſe; and at preſent none but the ſuperintendant of Wirtemberg aſſumes the quality of ſuperintendant general.

SUPERIOR, a perſon raiſed above another in rank, office, or talents.

Superior, in Scots law. See Law, N° clxiv. 3. clxv. 2. & clxvi.

SUPERLATIVE, in grammar, one of the three degrees of compariſon, being that inflection of adjective nouns that ſerves to augment and heighten their ſignification, and ſhows the quality of the thing denoted to be in the higheſt degree. See Grammar.

SUPERNUMERARY, ſomething over and above a fixed number. In ſeveral of the offices are ſupernumerary clerks, to be ready on extraordinary occaſions.

SUPERPARTICULAR proportion, or *Ratio*, is that in which the greater term exceeds the leſs by unit or 1. As the ratio of 1 to 2, or 2 to 3, or 3 to 4, &c.

SUPERPARTIENT proportion, or *Ratio*, is when the greater term contains the leſs term once, and leaves ſome number greater than 1 remaining. As the ratio

of 3 to 5, which is equal to that of 1 to $1\frac{2}{3}$;
of 7 to 10, which is equal to that of 1 to $1\frac{3}{7}$, &c.

SUPERSEDEAS, in law, a writ iſſued in divers caſes, importing in general a command to ſtay or forbear ſome ordinary proceedings in law, which in appearance ought to be done or purſued, were it not for the cauſe whereon this writ is granted.

Thus a man regularly is to have a ſurety of peace againſt him of whom he will ſwear he is afraid; and the juſtice required hereunto cannot deny it him: yet, if the party be formerly bound to the peace, either in chancery or elſewhere, this writ lies to ſtay the juſtice from doing that which otherwiſe he ought not to deny.

SUPERSTITION, a word that has been uſed ſo indefinitely, that it is difficult to determine its preciſe meaning. From its reſemblance in ſound to the Latin word *ſuperſtes*, "a ſurvivor," it is evidently derived from it, and different attempts have been made to trace their connection in ſignification. Balbus, in the dialogue *De Natura Deorum* of Cicero, ſays, that they who prayed and ſacrificed whole days that their children might *ſurvive* them, were called ſuperſtitious. Lactantius cenſures this etymology, and ſays they were not called ſuperſtitious who wiſhed that their children might ſurvive them (for this we all wiſh), but becauſe they who ſurvived their parents worſhipped their images. Others again ſay, that ſuperſtition is derived from *ſuperſtes*, becauſe it conſiſted in conſidering the dead as if they were alive. But theſe etymologies are ſolely conjectural; and we conſider conjectures as abſurd in philology as we do in ſcience; they may miſlead, but are ſeldom of any benefit. The uſual meaning affixed to the word *ſuperſtition*, both in the Latin and Engliſh languages, is ſo different from *ſuperſtes*, that its change of meaning muſt be owing to ſome accident which it is in vain to inquire after. If we had not known that the word *paganus* "a pagan" was derived from *pagus* "a village," becauſe the heathens in a certain period of the Chriſtian hiſtory lived in villages, the whims and fancies of etymologiſts would not have thrown much light on the ſubject.

Without labouring, from the aid of etymology, to define ſuperſtition, which is a word of a very extenſive ſignification, we will conſider to what objects it is applied; and then, by obſerving what is common to them all, we ſhall be enabled to fix with ſome degree of preciſion the meaning of the term. We apply it to the idolatry of the heathens; we apply it alſo to the Jews, who made the will of God of no effect by their traditions, and ſubſtituted ceremonies in place of the religion of their fathers. We ſay alſo that Chriſtians are guilty of ſuperſtition; the Roman Catholics, who believe in tranſubſtantiation and in the efficacy of prayers to ſaints; and thoſe Proteſtants who eſteem baptiſm and the Lord's ſupper, and the punctual performance of other ceremonies, without regard to morality, as ſufficient to enſure ſalvation. Thoſe perſons alſo are reckoned ſuperſtitious who believe, without any evidence, that prophecies are ſtill uttered by the divine inſpiration, and that miracles are ſtill performed. The word is alſo extended to thoſe who believe in witchcraft, magic, and apparitions, or that the divine will is declared by omens or augury; that the fortune of individuals can be affected by things indifferent, by things deemed lucky or unlucky, or that diſeaſes can be cured by words, charms, and incantations.

Through all the particulars which we have enumerated, there runs one general idea, the belief of what is falſe and contrary to reaſon. From this, however, we muſt not ſuppoſe that whatever is falſe and contrary to reaſon may be denominated ſuperſtition. We think that it is falſe and irrational to ſuppoſe that there ever lived on earth a race of men who walked on one leg, and had their eyes in their breaſt; or that there were giants 90 feet high: yet we do not call the philoſopher who believes theſe chimeras ſuperſtitious, but credulous. Superſtition has always a reference to God, to religion, or to beings ſuperior to man. We do not however diſtinguiſh all falſe and irrational opinions in religion by the name of ſuperſtition. We do not, for inſtance, apply this name to the opinions which ſome of the ancients entretained, that God is the ſoul of the world, and that men are only portions of him ſeparated for a time, or that the ſoul after death lives ſucceſſively in different bodies. If we examine the ſubject with more attention, we ſhall diſcover that the foundation of ſuperſtition is ignorance of the moral attributes of God; for we never ſay a man is ſuperſtitious for entertaining erroneous opinions of the natural attributes of God. Some of the Socinians have denied the preſcience of God; and a French philoſopher has not only rejected the belief that He is a ſpirit, but has preſumed to ſay that he is compoſed of a ſpecies of cryſtals. The firſt of theſe opinions diſcovers very imperfect ideas of God, and the ſecond is the height of impiety and abſurdity; yet the

Socinians have not been accuſed of ſuperſtition, nor can this French philoſopher be ſuſpected of it. We do not call every falſe opinion concerning the unity or moral attributes of God by the name of ſuperſtition, as, for inſtance, the opinion which ſome ſceptics have ſupported, that God is not good; for, as was mentioned before, ſuperſtition always involves the idea of credulity. It does not conſiſt in falſely denying that God poſſeſſes any particular moral attributes, but in believing more than what is true concerning them; in forming mean, unworthy ideas of them; in ſuppoſing that he is guided by blind paſſion like mankind, and enjoins upon his creatures commandments which are irrational and abſurd.

As ſuperſtition ariſes from ignorance and credulity in the underſtanding, ſo it has alſo a ſeat in the paſſions. Fear has been commonly conſidered as the paſſion of the human mind from which it chiefly derives its origin; and there is no doubt that more ſuperſtition has ariſen from fear united with ignorance and credulity than from any other paſſion. Yet it would certainly be improper to exclude all other paſſions. We cannot account for the ſuperſtition of the Egyptians, without ſuppoſing that much of it aroſe from gratitude. They worſhipped the Nile, becauſe it diſtributed fertility and abundance over the land of Egypt; and they worſhipped ſome animals, merely becauſe they prevented the increaſe of other animals which were noxious. Thus they adored the ibis, becauſe it deſtroyed the eggs of the crocodile.

Having thus endeavoured to analyze the ideas comprehended under the word ſuperſtition, we may ſum them up in a few words. It reſpects God and beings ſuperior to man, and extends to our religious opinions, worſhip, and practices; and may be defined *abſurd opinions and actions ariſing from mean and defective ideas of the moral attributes of God.* Let us apply this definition to the different ſpecies of ſuperſtition already mentioned.

But before entering upon this application, it may be proper to obſerve, that ſuperſtition involves the idea of a blameable inattention to reaſon, or a credulity ariſing from an indolence of underſtanding. We generally make a diſtinction between the imperfect opinions which a ſavage, from the neceſſary effects of his ſituation, forms of the attributes of God, and thoſe which civilized nations entertain. We ſay the ſavage is ignorant, and we aſcribe his ignorance to his ſituation; but we call the Roman Catholic ſuperſtitious, and we blame him for not having thoſe juſt ideas of God which he might have obtained by opening his Bible, or by the exerciſe of his underſtanding in the favourable ſituation in which he is placed. Superſtition then does not originate ſo much from the natural weakneſs of the human underſtanding, as from a miſapplication or a neglect of it (A).

Theophraſtus's Characters, xvi.

We cannot therefore with any propriety apply the name *ſuperſtition* to polytheiſm in general; for what all the ancient philoſophers, after much ſtudy and reflection, concluded to be true, could never proceed from credulity and inattention, but from their ſituation. We ſpeak very properly, however, when we call idolatry by the name of ſuperſtition; becauſe there is no man ſo devoid of underſtanding as not to be capable of diſcovering, that a piece of metal, or wood, or ſtone, can neither hear nor anſwer petitions. *Superſtition* was a name which the ancient philoſophers gave to thoſe who entertained mean opinions of the gods, or did fooliſh things to obtain their favour. According to Theophraſtus, the ſuperſtitious man is one who, having waſhed his hands, and ſprinkled himſelf all round, leaves the temple with a laurel leaf in his mouth, with which he walks about the whole day. Or, if a weaſel ſhould croſs the road, he will not advance a ſtep till he has thrown three ſtones over the road. If he finds a ſerpent in his houſe, he rears a place of devotion on the ſpot. He purifies his houſe often, will not ſit upon a grave, nor touch a dead perſon. He is anxious about the interpretation of his dreams, will not offer a ſacrifice unleſs his wife go along with him, or, if ſhe is engaged, he takes the nurſe and the little children. He purifies himſelf with onions; and when he ſees a mad or an epileptic perſon, he ſpits in their boſom. Such was the character of ſuperſtition in the days of Theophraſtus. All theſe whimſical ceremonies were done to prevent miſchief, and to avert the wrath of the gods; and therefore perfectly correſpond with the definition given above.

It is only neceſſary to conſider a little the ſuperſtitious opinions and practices among Jews and Chriſtians, to be ſenſible that they have all ariſen from mean and abſurd ideas of the moral attributes of God; for they have generally entertained noble opinions of his natural attributes. The Jews conſidered God as a partial Being, who had a predilection for their nation in preference to all others, and preferred external homage and ceremony to moral purity. If the Roman Catholics think conſiſtently, they muſt eſteem God as a Being who can be prevailed upon by the importunity of one dead man to aſſiſt another, or as a Being whoſe patience would be fatigued with hearing prayers conſtantly. Hence their practice of praying to ſaints. They in effect believe, however they may deceive themſelves, that God is unjuſt, or they could not believe tranſubſtantiation; for it ſuppoſes that God can give commands directly contrary to thoſe principles of belief with which he has endued the human mind. They conſider a ſtrict adherence to a variety of ceremonies, to forms, to pomp, and ſhow, as eſſential to the worſhip of God: this is treating God as a vainglorious Being. They thought it their duty to extirpate heretics: this was ſuppoſing God a cruel and revengeful Being. Even among Proteſtants, we are ſorry to ſay, a great deal of ſuperſtition remains: we have not yet learned to conſider God as a ſpirit, who is to be worſhiped in ſpirit and in truth, as a pure moral benevolent Being; and hence ariſes all the ſuperſtitious practices which prevail among us.

Beſides thoſe ſuperſtitious opinions and practices which entirely reſpect our duty to God, there are others which may be termed *vulgar ſuperſtitions*. Theſe alſo ariſe from imperfect and mean ideas of the moral attributes of God. To believe vulgar prophecies, which are always the effuſions of madneſs or knavery, is to ſuppoſe that God, who has drawn a veil over futurity, and only delivers prophecies to accompliſh ſome great moral purpoſe, ſometimes gives them for no purpoſe at all, or to gratify idle curioſity, or to diſcloſe ſuch a knowledge of what is to happen as is inconſiſtent with the free agency of man and the moral adminiſtration of the world. Nor is it leſs ſuperſtitious to believe in vulgar miracles. To believe in them, is to believe that God ſuſpends the laws of nature for the moſt trivial purpoſes, or to countenance fraud and worldly ambition: it is to receive the moſt extraordinary facts upon the moſt unſatisfactory evidence. The belief of witchcraft, of apparitions, and the ſecond ſight, may be reſolved into the ſame principle. To ſuppoſe that God would communicate the power of doing miſchief, and of controling his laws, to any being merely for gratifying their own paſſions, is unworthy of God. The belief of apparitions is equally inconſiſtent with the goodneſs of God (ſee SPECTRE). The ſame objection riſes againſt the ſecond ſight as againſt the belief of vulgar prophecies, and may alſo be extended to omens, to aſtrology, to things lucky and unlucky, to fortune-telling, &c. As to the different devices and charms for preventing and curing diſorders, they reſemble in every reſpect falſe miracles.

(A) We do not pretend to ſay that this is the ſenſe in which ſuperſtition is always uſed, becauſe it is often uſed improperly.

Superſtition.

A judicious hiſtory of ſuperſtition would be a curious and entertaining work, and would exhibit the human character in a remarkable point of view. Superſtition is moſt prevalent among men of weak and uncultivated minds; it is more frequent in the female ſex than among men; and abounds more in the rude than in the refined ſtages of ſociety. The general features of it have been the ſame in all ages; but it aſſumes certain peculiarities according to the diverſity of character of different nations. It gained admiſſion into the ſcience of medicine at an early period. He who was endowed with ſuperior genius and knowledge was reckoned a magician. Dr Bartolo was ſeized by the inquiſition at Rome in the laſt century, becauſe he unexpectedly cured a nobleman of the gout. Diſeaſes were imputed to faſcination, and hundreds of poor wretches were dragged to the ſtake for being acceſſary to them. Mercatus, phyſician to Philip II. of Spain, a writer of uncommon accuracy and information, appears ſtrongly inclined to deny the exiſtence of faſcinatory diſeaſes: but he is conſtrained to acknowledge them for two reaſons 1*ſt*, Becauſe the inquiſition had decided in favour of their reality; 2*dly*, Becauſe he had ſeen a very beautiful woman break a ſteel-mirror to pieces, and blaſt ſome trees by a ſingle glance of her eyes.

Mancheſter Tranſactions, vol. iii.

As the opinions concerning the cauſes of diſeaſes were ſuperſtitious, thoſe concerning the method of curing them were not leſs ſo. In the Odyſſey we read of a cure performed by a ſong. Joſephus relates, that he ſaw a certain Jew, named *Eleazar*, draw the devil out of an old woman's noſtrils by the application of Solomon's ſeal to her noſe in preſence of the Emperor Veſpaſian. Many different kinds of applications were uſed for expelling the devil. Flagellation ſometimes ſucceeded admirably; purgatives and antiſpaſmodics were other modes of diſcharging him. Dr Mynſight cured ſeveral bewitched perſons with a plaſter of aſſafœtida. How the aſſafœtida was ſo efficacious, was much diſputed. Some thought the devil might conſider ſo vile an application as an inſult, and run off in a paſſion; but others very ſagely obſerve, that as devils are ſuppoſed to have eyes and ears, it is probable they may have noſes too.

Nor was it only in medicine theſe ſuperſtitious opinions were entertained; they prevailed alſo in natural philoſophy. The pernicious effects in mines, which we now know are occaſioned by noxious air, were confidently imputed to the demons of the mine. Even Van Helmont, Bodinus, Strozza, and Luther, attributed thunder and meteors to the devil. Chemiſts were employed for centuries in ſearch of the philoſopher's ſtone, with which they were to do miracles. It was a common queſtion among philoſophers in the laſt century, whether the imagination could move external objects? A queſtion generally decided in the affirmative.

Though ſuperſtition be generally the mark of a weak mind, ſuch is the infirmity of human nature, that we find many inſtances of it among men of the moſt ſublime genius and moſt enlightened minds. Socrates believed that he was guided by a demon. Lord Bacon believed in witchcraft; and relates that he was cured of warts by rubbing them with a piece of lard with the ſkin on, and then nailing it with the fat towards the ſun on the poſt of a chamber window facing the ſun. Henry IV. one of the moſt illuſtrious of monarchs, was very uneaſy before his aſſaſſination on account of ſome prophecies*. Sully declares, that one of the conſiderations that kept him faithful to his maſter in the moſt unpromiſing ſtate of his affairs, was a prediction of La Broſſe, that Henry would make his fortune†. The aſtrologer Morin directed Cardinal Richelieu's motions in ſome of his journeys‡. The enlightened Cudworth defended prophecies in general, and called thoſe who oppoſed the belief of witchcraft by the name of *atheiſts;* and the predictions of Rice Evans have been ſupported in the preſent century by the celebrated names of *Warburton* and *Jortin*. Dr Hoffman, the father of the Modern Theory and Practice of Medicine, in a diſſertation publiſhed in the large edition of his works in 1747, ſays, that the devil can raiſe ſtorms, produce inſects, and act upon the animal ſpirits and imagination; and, in fine, that he is an *excellent optician and natural philoſopher* on account of his long experience. Dr Johnſon, the leviathan of literature is ſuppoſed to have believed the ſecond ſight.

With reſpect to the effects of ſuperſtition on the human mind, they are indeed deplorable. It chains down the underſtanding, and ſinks it into the moſt abject and ſordid ſtate, and keeps it under the dominion of fear, and ſometimes of cruelty. Where once it takes poſſeſſion, it has a tendency to become extreme, and generally becomes ſo intolerable, that men of reflection and learning conſpire its deſtruction. The Chriſtian religion gave a violent ſhock to the heathen ſuperſtition; the reformation in a great meaſure demoliſhed the ſuperſtition of the church of Rome; and the ſuperſtition which remained among Proteſtants after their ſeparation from that church has been gradually yielding to the influence of enlightened reaſon, or to the bold and daring attacks of infidelity and deiſm. We behold the proſpect of its ruins with pleaſure, and thank the deiſts for their zeal; but it is from the firm hope that the religion of Jeſus will ariſe in all its beauty and ſimple majeſty, and be admired and reſpected as it deſerves: for mean and contemptible as ſuperſtition certainly is, we would rather ſee men do what they reckon their duty from ſuperſtitious principles, than ſee anarchy and vice prevail, even though attended with all the knowledge and liberality of ſentiment which deiſm and infidelity can inſpire.

Superviſor || Supper.

SUPERVISOR, a ſurveyor or overſeer.

SUPINATION, in anatomy, the action of a ſupinator muſcle, or the motion whereby it turns the hand ſo as that the palm is lifted up towards heaven.

SUPINE, in Latin grammar, part of the conjugation of a verb, being a verbal ſubſtantive of the ſingular number and the fourth declenſion.

There are two kinds of ſupines: One, called the *firſt ſupine*, ending in *um* of the accuſative caſe, which is always of an active ſignification, and follows a verb of motion; as *abiit deambulatum*. The other, called the *laſt ſupine*, and ending in *u* of the ablative caſe, is of a paſſive ſignification, and is governed by ſubſtantives or adjectives; as, *facile dictu*, &c.

They have their name, ſays Probus, and after him Voſſius, *quod ad inſtar* ſupinorum & *otioſorum hominum omnia habent confuſa:* or, according to Priſcian, *quod naſcantur a participiis paſſivis, quæ* ſupina *appellata ſunt, quia in infimo loco ſita, totam conjugationis molem ſuſcipiunt.*

SUPPER, the evening repaſt.—Suppers that are heavy ſhould be avoided, becauſe the ſtomach is more oppreſſed with the ſame quantity of food in an horizontal poſture than in an erect one, and becauſe digeſtion goes on more ſlowly when we ſleep than when we are awake. They ſhould be eaten long enough before bed-time, that they may be nearly digeſted before going to ſleep; and then a draught of pure water will dilute that which remains in the ſtomach.

1 Definition.

Supper *of the Lord*, otherwiſe called the *Euchariſt*, is a ſacrament ordained by Chriſt in his church, of which the outward part is bread and wine, and the inward part or thing ſignified the body and blood of Chriſt, which the majority of Chriſtians believe to be in ſome ſenſe or other taken and received by the faithful communicants. See Sacrament.

There is no ordinance of the Goſpel which has been the ſubject of more violent controverſies between different churches, and even between different divines of the ſame church,

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* Memoirs of Sully.

† Ibid.

‡ Bayle, Art. Morin.

2 ontrover- s about e out- ard and ible ſign,

church, than this ſacrament: and though all confeſs that one purpoſe of its inſtitution was to be a bond of love and union among Chriſtians, it has, by the perverſeneſs of mankind, been too often converted into an occaſion of hatred. The outward and viſible ſign, and the inward and ſpiritual grace, have equally afforded matter of diſputation to angry controvertiſts. Many members of the church of Rome condemn the Greek church and the Proteſtants for uſing leavened bread in the Lord's Supper, contrary to the example ſet them by our Saviour; whilſt the Greek church in general, and ſome Proteſtant ſocieties in particular, unite with the church of Rome in cenſuring all churches which mix not the wine with water, as deviating improperly from primitive practice. See **Eucharist**.

That it was unleavened bread which our Lord bleſſed and brake and gave to his diſciples as his body, cannot be queſtioned; for at the time of the paſſover, when this ordinance was inſtituted, there was no leavened bread to be found in Jeruſalem.[*] For the mixed cup, the evidence is not ſo deciſive. It is indeed true, as we have obſerved under the article **Eucharist**, that the primitive Chriſtians uſed wine diluted with water; and if we may believe Maimonides,[†] it was the general cuſtom of the Jews, as well at their paſſover as at their ordinary meals, to add a little water to their wine on account of its great ſtrength; but that this was *always* done, or that it was done by our *Saviour in particular*, there is no clear evidence. Origen indeed affirms,[‡] that our Lord adminiſtered in wine unmixed; and he was not a man to hazard ſuch an affirmation, had there been in his days any certain tradition, or ſo much as a general opinion, to the contrary. On this account we have often heard with wonder the neceſſity of the mixed cup inſiſted on by thoſe who without heſitation make uſe of leavened bread; for if it be eſſential to the ſacrament that the very ſame elements be employed by us that were employed by our Saviour, the neceſſity of unleavened bread is certainly equal to that of wine diluted by water.

But the mixed cup is ſaid to be emblematical of the blood and water which flowed from the ſide of our Lord when pierced by the ſpear of the Roman ſoldier, while the abſence of leaven is emblematical of no particular circumſtance in His paſſion. This argument for the mixture is as old as the era of St Cyprian, and has ſince been frequently urged with triumph by thoſe who ſurely perceived not its weakneſs. The flowing of the blood and water from our Saviour's ſide was the conſequence either of the ſpear's having pierced the *pericardium*, or more probably of an *aſcites* or *hydrothorax*, occaſioned by his cruel and lingering death (ſee **Medicine**, n° 342, 343) But whatever was the cauſe of it, how can the mixing of wine with water in the ſacrament be emblematical of the flowing of blood and water ſeparately? Such a mixture ſurely bears a more ſtriking reſemblance to the reunion of the *ſerum* and *craſſamentum*, after they had been ſeparated by whatever cauſe. See **Blood**,

3 Frivolous.

We urge not theſe objections to the mixed cup from any diſlike that we have to the practice. It is unqueſtionably harmleſs and primitive; and we wiſh that greater regard were paid to primitive practices than the generality of Chriſtians ſeem to think they can claim: but let the advocates for antiquity be conſiſtent; let them either reſtore, together with the mixed cup, the uſe of unleavened bread, or acknowledge that neither the one nor the other is eſſential to the ſacrament. This laſt acknowledgment muſt indeed be made, if they would not involve themſelves in difficulties from which they cannot be extricated. If either the mixed cup or unleavened bread be abſolutely neceſſary to the validity of the ſacrament, why not wine made from the grapes of Judæa? why not that particular kind of wine which was uſed by our Saviour? and where is that wine to be found?

4 About the thing ſignified.

But the controverſies reſpecting the outward part or ſign of the Lord's Supper are of little importance when compared with thoſe which have been agitated reſpecting the inward part or thing ſignified; and of theſe we haſten to give as comprehenſive a view as the limits preſcribed to ſuch articles will admit.

Our Bleſſed Lord, in the ſame night that he was betrayed, "took bread, and bleſſed it, and brake it, and gave it to the diſciples, and ſaid, Take, eat; this is my body. And he took the cup, and gave thanks, and gave it to them, ſaying, Drink ye all of it; for this is my blood of the New Teſtament, which is ſhed for many for the remiſſion of ſins." Such was the inſtitution of the Lord's Supper as it is recorded in the Goſpel by St Matthew; and we have the ſame account of it, in almoſt the very ſame words, by three other inſpired writers, St Paul, St Mark, and St Luke. That it was the bread which Chriſt bleſſed and brake that is here called his body, and the wine over which he gave thanks that he ſtyles his blood of the New Teſtament, will admit of no reaſonable doubt (A); but in what ſenſe they became ſo, has been the ſubject of many controverſies.

5 Doctrine of the church of Rome.

The church of Rome, which holds, that after conſecration, Jeſus Chriſt, God and man, is really, truly, and ſubſtantially, contained under the outward appearances of the bread and wine, informs us, that about the middle of the maſs, when the prieſt, taking into his hand, firſt the bread and then the wine, pronounces over each ſeparately the ſacred words of conſecration, the ſubſtance of theſe elements is immediately changed by the almighty power of God into the body and blood of Chriſt; but that all the outward appearances of the bread and wine, and all their ſenſible qualities remain. This more than miraculous change is called TRANSUBSTANTIATION; and is founded on the philoſophy of Ariſtotle, which reſolves all bodies into *matter* and *form* (ſee METAPHYSICS, nº 142—150.); for it is only the *matter* or imperceptible ſubſtance which ſupports the *forms* or ſenſible qualities of bread and wine, that is changed into the *ſubſtance* or matter of the body and blood of Chriſt, ſo that this divine matter, coming into the place of the former earthly matter, ſupports the ſame identical *forms* which it ſupported. Hence we are told, "that Jeſus Chriſt, now preſent inſtead of the bread and wine, exhibits himſelf to us under thoſe very ſame outward *forms* or appearances which the bread and wine had before the change."

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[*] Exod. xii. 15, 19.

[†] In Miſhnam.

[‡] Hom. 12. in Hieremiam.

(A) Some over-zealous Proteſtants have indeed affirmed, that it was not the conſecrated bread and wine, but thoſe elements, *together with the whole action* of taking them into his hands, bleſſing them, breaking the bread, and diſtributing the bread and wine to the diſciples, that Chriſt calls his body and blood. This novel and ſingular opinion reſts upon no better foundation than a very childiſh criticiſm. Our Saviour, after bleſſing and breaking the bread, gave it to the diſciples, ſaying, in the original, Λαβετε, φαγετε· ΤΟΥΤΟ εστι το σωμα μου. Now, ſay our critics, τουτο, in the neuter gender, can never agree with the antecedent αρτος in the maſculine, but muſt refer to all the circumſtances of the action taken together, and conſidered as one complex neuter noun. But this noun, whether complex or ſimple, certainly denotes what could be *eaten;* and to ſuppoſe that our bleſſed Lord deſired his apoſtles to eat *actions*, is as repugnant to human reaſon as any doctrine of the church of Rome. The truth is, that the word τουτο, which is more properly a definite article than a demonſtrative pronoun (ſee **Grammar**, Chap. II.), refers directly to the thing, whatever it was, which our Saviour held in his hand and gave to the diſciples; and the clauſe, when completed, is τουτο ον εστι το σωμα μου; this *being*, this *ſubſtance, is my body*. There was no neceſſity for characteriſing that ſubſtance by any analogy to ſex, in order that it might be diſtinguiſhed from every other ſubſtance; for the apoſtles could not but ſee it in the hand of their Maſter.

Could this doctrine be true, it would be abundantly myſterious; but to add to the myſtery, we are farther informed, that under each kind is contained Jeſus Chriſt whole and entire, his body and blood, his ſoul and divinity; ſo that when a man eats what has the appearance of a wafer, he really and truly eats the body and blood, the ſoul and divinity, of Jeſus Chriſt; and when he afterwards drinks what has the appearance of wine, he drinks the very ſame body and blood, ſoul and divinity, which not a minute perhaps before he had wholly and entirely eaten! The ingenious author from whoſe work we have taken this account of the Romiſh doctrine concerning the real preſence, may perhaps reject our inference that the orthodox members of his church muſt believe the *ſoul* and *divinity* of Chriſt to be *eaten* and *drunk* in the Lord's Supper; but he cannot deny that, according to his ſtatement of the Catholic faith, the ſoul and divinity are both received whole and entire into the ſtomach of each communicant. He ſays indeed, that "communion conſiſts in receiving Jeſus Chriſt whole and entire, his ſacred body, his precious blood, his bleſſed ſoul, and his adorable divinity, into our *ſouls*;" but that which was formerly bread and wine unqueſtionably goes into the *ſtomachs* of the communicants; and ſince, according to him, it is now the body and blood of Chriſt, the ſoul and divinity muſt go thither with it, for theſe four cannot be ſeparated. This our author himſelf grants. "The Scripture (ſays he) poſitively declares, that *Chriſt riſing again from the dead, dieth no more; death ſhall no more have dominion over him* (Rom. vi. 9.) Conſequently his body, his blood, and his ſoul, ſhall never more be ſeparated from one another; and as the union of his divine and human natures can never more be broken, ſo neither can theſe, his two natures, united in his divine perſon, be ever ſeparated. From this it neceſſarily follows, that wherever the body of Chriſt is, there alſo his blood, his ſoul, and his divinity, muſt of neceſſity be in like manner."

Now, whether we ſuppoſe, with our author, that the ſoul and divinity of Chriſt directly carry his body and blood with them into the human ſoul, or, truſting in ſome degree to the evidence of ſenſe, believe that the body and blood carry the ſoul and divinity with them directly into the ſtomach of each communicant—is it credible, is it poſſible, that the high and lofty One, who inhabiteth eternity, and whom the oracles of truth aſſure us that even the heaven of heavens cannot contain, ſhould be *ſubſtantially* received *whole* and *entire* into a finite ſpirit like the human ſoul, or into a body ſo limited as the human ſtomach? Our author ſays it is; declaring that, "by the bleſſed *preſence* of Jeſus Chriſt, *whole and entire within us*, are communicated to our ſouls all the heavenly graces which are the effects of the holy communion: ſuch as the ſanctification of the ſoul by an increaſe of juſtifying grace; the rendering of it more pure, more holy, more beautiful, more agreeable, in the eyes of God; the cleanſing of the ſoul from all thoſe venial ſins and imperfections of which we repent, and preſerving us from falling into mortal ſins; the uniting of us in a moſt intimate manner with Jeſus Chriſt, who comes to us in this holy ſacrament on purpoſe to dwell in our ſouls and abide with us; and the giving us a pledge and earneſt of a glorious immortality, to the enjoyment of which it brings us at laſt, if we perſevere to the end in the grace of God."

The conſequence of the doctrine of tranſubſtantiation is the *ſacrifice of the maſs*, by which, it is ſaid, God's acceptance of Chriſt's ſacrifice on the croſs is obtained for the actual benefit of thoſe perſons in particular for whom the maſs is offered. In the work ſo often quoted, we are told, that "Jeſus Chriſt our redeemer, who is both our high-prieſt and our victim, who, in order to perfect the work of our redemption, and reconcile man with his offended Creator, offered himſelf once in a bloody manner upon the croſs, in order to communicate and apply to the ſouls of individuals thoſe graces, which, by his death, he merited for mankind in general, continues to offer himſelf daily upon the altar in an unbloody manner, by the miniſtry of his prieſts, in the *maſs*. The ſacrifice of the croſs and that of the maſs are both one and the ſame ſacrifice, becauſe in both the victim is the ſame and the high prieſt the ſame, viz. Jeſus Chriſt. The only difference is in the *manner* of offering. On the croſs he offered himſelf in a bloody manner and actually died; whereas on the altar he is offered up to God in an unbloody manner, not *actually* dead, but under the *appearance* of death;" ſo that the communicants not only eat the man Jeſus Chriſt, but even eat him alive (B)!

It is known to all our readers that this doctrine of tranſubſtantiation was one cauſe of the breach between the church of Rome and thoſe various ſocieties which call themſelves reformed churches. The real and ſubſtantial change of the bread and wine into the body and blood of our Lord is rejected by every reformer as a change contradictory and impoſſible, and fraught with the moſt impious conſequences; and volumes have been written to expoſe the weakneſs of thoſe arguments which have ſo often been vainly urged in its ſupport. It has been ſhown to imply numberleſs abſurdities, ſuch as, that the ſame thing can be in a million of different places, *whole* and *entire*, at the

6
Implies numberleſs contradictions.

(B) This whole account of the Romiſh doctrine reſpecting the ſacrament of the Lord's Supper is taken from a work in two ſmall volumes, called *The Sincere Chriſtian inſtructed in the Faith of Chriſt, from the Written Word*. Its author is a man of learning, and great perſonal worth; and as he fills a high ſtation in the church of Rome, we cannot doubt but that he has given a fair view of the doctrine of that church reſpecting this and every other article of which he treats. We are ſorry however that his zeal ſhould have impelled him, in a *popular* work, to write in the manner that he has done of the ſalvation of thoſe who are not members of his church, or who cannot embrace all his opinions; for if his doctrine on this ſubject be implicitly received by thoſe "over whom he has the rule, and for whoſe ſouls he is appointed to watch," they muſt neceſſarily look upon the majority of their fellow-citizens as reprobates doomed to eternal perdition. Let this be our apology for treating ſome of thoſe opinions, which he thinks ſo abſolutely the ſame inſtant of time; that it is near 1800 years old, and yet may be not more than one minute; that *forms* or ſenſible qualities are real things independent of their ſubject and the ſentient beings who perceive them; that the infinite and eternal God, who created and ſuſtains the univerſe, is himſelf wholly and ſubſtantially comprehended by the human ſoul; and that the half, or fourth, or tenth part of the body of Chriſt, is equal to the whole of that body. That theſe are neceſſary conſequences of tranſubſtantiation has been ſo completely proved in various works (C) to which every reader may have acceſs, that it is needleſs for us to repeat arguments ſo hackneyed; but there are two objections to that doctrine, which, as we do not remember to have met with them elſewhere, and as they appear to us abſolutely concluſive, it may be worth while to ſtate in this place.

7 Is contrary to Scripture,

The advocates for the real preſence in the Lord's Supper contend, that every word relating to that ordinance is to be taken in the ſtricteſt and moſt literal ſenſe, and they affect to triumph over the Proteſtants, becauſe their notions of the ſacrament cannot be ſupported without having recourſe to figure and metaphor. This however is a very vain triumph; for we heſitate not to affirm, that ſuppoſing tranſubſtantiation poſſible, and even capable of proof, there is not in the whole New Teſtament a ſingle word or a ſingle phraſe which, if interpreted *literally*, gives the ſlighteſt countenance to that wonderful doctrine. The reader will remember, that tranſubſtantiation, as we have ſtated it from a dignitary of the Romiſh church, and as it is in fact ſtated by the council of Trent (D), conſiſts in a change of the *matter*, *imperceptible ſubſtance*, or *ſubſtratum* of the bread and wine into the *matter*, *imperceptible ſubſtance*, or *ſubſtratum* of Chriſt's body and blood; for all parties agree that the ſenſible qualities of the bread and wine remain, and, according to the Romaniſt, are after conſecration either ſupported by the *matter* of Chriſt's body and blood, or hung upon nothing. But the phraſe τουτο εστι το σωμα μου, if taken in the literal ſenſe, cannot poſſibly denote the conſequence of ſuch a change as this; for every perſon at all acquainted with the Greek language, eſpecially the language of the Peripatetic ſchool, knows that το σωμα μου ſignifies, not the *matter* or *ſubſtratum* of my body diveſted of its ſenſible qualities; but the body of me in its natural ſtate, conſiſting of *matter* and *qualities*, or *matter* and *form united*. Unleſs therefore the *ſenſible qualities*, as well as the *matter* of the bread and wine, give place to the ſenſible *qualities* as well as the *matter* of our Saviour's body and blood, and unleſs he appear glorified on the altar as he appeared on the mount at his transfiguration, the words το σωμα μου muſt be interpreted figuratively. Had the apoſtles underſtood their Maſter's words in the ſenſe in which they are underſtood by the church of Rome, they would have rendered them into Greek, not τουτο εστι το σωμα μου, "this is my *body*," but τουτο εστι ἡ ὑλη του σωματος μου, "this is the *matter* of my body." In like manner, when St John relates ‖ that Jeſus ſaid, "Whoſo eateth my fleſh and drinketh my blood, hath eternal life, and I will raiſe him up at the laſt day," had he underſtood his adorable Maſter to ſpeak of his fleſh and blood in the Euchariſt in the ſenſe in which they are taught to be there by the church of Rome, he would have repreſented him as ſaying, not Ο᾽ τρωγων μου την σαρκα, και πινων μου το ἁιμα, but Ο᾽ τρωγων την ὑλην μου της σαρκος, και πινων την υλον μου του ἁιματος, "Whoſo eateth the *matter* of my fleſh, and drinketh the *matter* of my blood, hath eternal life, and I will raiſe him up at the laſt day."

‖ Chap. vi. verſe 54.

8 And incapable of proof.

But further, ſuppoſing this ſingular converſion poſſible in itſelf, it cannot be rendered credible, however ſtated in any language that ever was or ever will be ſpoken by man. At firſt ſight it may appear paradoxical to affirm, that a poſſible fact cannot be ſo related as to obtain credit; but that tranſubſtantiation, if poſſible, is ſuch a fact, will be apparent on the ſlighteſt conſideration.

The relation that ſubſiſts between things and words is arbitrary; ſo that what is termed *body* in Engliſh, is σωμα in Greek, and *corpus* in Latin; and the ſame thing might with equal propriety (had the authors of theſe languages ſo pleaſed) have been expreſſed in the firſt by *ſoul*, in the ſecond by νους, and in the third by *anima*. (See LANGUAGE, n° 3, &c.) The conſequences of this are, that there is no univerſal language ſpoken; that the natives of one country underſtand not the ſpeech of thoſe of another; and that different men ſpeaking the ſame language are perpetually liable to miſtake each other's meaning. Between the *ſubſtrata* of bodies and their *ſenſible qualities* there is a relation founded in nature, ſo that the ſenſible qualities which indicate the ſubſtance to which they belong, to be *gold*, for inſtance, in one country, indicate the ſame thing in every other country, and have done ſo from the beginning of time. The ſenſible appearances of bodies therefore are an univerſal language, the language of the Author of Nature, by which he declares to his creature man, that though the ὑλη πρωτη, or primary matter of all bodies, may be the ſame kind of ſubſtance; yet the ὑλη προσεχης of one body, or the internal combination of its primary parts, differs from that of another;

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neceſſary to ſalvation, with leſs ceremony than perhaps we ſhould have done, had he leſs poſitively pronounced our damnation for not having it in our power to embrace them. He is not indeed much leſs ſevere on the moſt virtuous heathens, though they never ſaw the New Teſtament, or heard the doctrines of his church preached. But perhaps this ſeverity may be occaſioned by the following queſtion of Cicero: "Cum fruges, *Cererem*; vinum, *Liberum* dicimus, genere nos quidem ſermonis utimur uſitato: ſed ECQUEM TAM AMENTEM eſſe putas, qui illud, quo veſcatur, deum credat eſſe?" *De Natura Deorum*, Lib. 3. Cap. 16.

(C) Among other works on this ſubject, we may confidently recommend to the reader a ſmall tract publiſhed by Dr Abernethy Drummond, about twenty years ago, in the form of *A Dialogue between Philalethes and Benevolus*. In that treatiſe, together with a defence of it, which were both printed for Balfour and Drummond, Edinburgh, the abſurd conſequences which we have mentioned are, by arguments unanſwerable, proved to flow from the doctrine of tranſubſtantiation; and the artful ſophiſtry, by which a very acute genius endeavoured to keep theſe conſequences out of ſight, is detected and expoſed on acknowledged principles of the ſoundeſt metaphyſics.

(D) The canon of that council which eſtabliſhes tranſubſtantiation is thus tranſlated by the author of *The Sincere Chriſtian Inſtructed*: "If any man ſhall ſay, that in the bleſſed ſacrament of the Euchariſt the ſubſtance of the bread and wine remains along with the body and blood of our Lord Jeſus Chriſt, and ſhall deny that wonderful and ſingular converſion of the whole ſubſtance of the bread into the body, and of the whole ſubſtance of the wine into the blood, the appearances of the bread and wine only remaining, which converſion the Catholic Church calls *tranſubſtantiation*, let him be anathema."

ther; that gold, for inſtance, has a different *ſubſtratum* or *baſis* from iron, lead, or ſilver; that the internal organization or ſtructure of the body of an ox is different from that of a horſe; and that the *internal ſubſtance* or *ſubſtratum* which exhibits the appearances of bread and wine is different from that which ſupports the ſenſible qualities of fleſh and blood (See METAPHYSICS, Part I. Chap. I. and Part II. Chap. I. and II. Suppoſing therefore the doctrine of tranſubſtantiation to be poſſible and even true, it would ſtill be impoſſible, by any ſtatement of it in human language, or by any argument urged in its ſupport, to render that doctrine an object of rational belief; for if it be ſaid that the words τουτο εστι το σωμα μου were ſpoken by a divine perſon, who could neither be deceived himſelf nor intended to deceive us, it may be replied, that the ſenſible appearances of bread and wine, which are confeſſed to remain, are likewiſe the language of a divine perſon, even of the Creator and Governor of heaven and earth; that this language addreſſed to the ſight, the taſte, the touch, and the ſmell, is equally intelligible to all nations; that ſince the creation of the world its meaning has never been miſtaken by the ſcholar or the clown, the ſage or the ſavage, except in this ſingle inſtance of our Lord's fleſh and blood exhibiting the ſenſible appearances of bread and wine; and that it is therefore infinitely more probable that the members of the church of Rome ſhould miſtake the meaning of the words τουτο εστι το σωμα μου, which, though ſpoken by Chriſt, are part of the language of men, and liable to all its ambiguities, than that all mankind ſhould miſtake the language of God himſelf, which is liable to no ambiguities, and which was never in any other inſtance miſunderſtood by a ſingle individual. Should tranſubſtantiation therefore be really true, its truth can never be proved or rendered probable, but by an immediate operation of the ſpirit of God on the mind of man; and he who is conſcious of no ſuch operation on his own mind, may reſt aſſured that the Father of mercies, who knows whereof he is made, will never bring upon him, for his incredulity in this inſtance, any of the anathemas denounced by the church of Rome upon thoſe who place implicit confidence in the univerſal language of Him who created them, in oppoſition to her figurative and contradictory interpretations of the written word. Of the tranſubſtantiation of the elements a viſible miracle would afford no proof. Had the water been changed into wine at the marriage in Cana of Galilee, for the expreſs purpoſe of bearing teſtimony to this ſingular converſion, what muſt have been the conſequence on the minds of thoſe who witneſſed that miracle? Nothing, we think, but ſcepticiſm or a diſtruſt of their own faculties; for they would have had the very ſame evidence that *no* ſubſtantial change was wrought on the elements, as that the water was *actually* turned into wine.

9
Doctrine of the Lutherans incredible.

Though the reformed churches unanimouſly reject the doctrine of tranſubſtantiation, and of courſe the ſacrifice of the maſs, its inſeparable conſequence, they are far from being agreed among themſelves reſpecting the nature of the Lord's Supper; and the notions of this ordinance entertained by ſome of them appear to us as untenable as any part of the doctrine of the church of Rome. The Lutherans believe, that the body and blood of Chriſt are really and ſubſtantially preſent with the bread and wine; that the body is really and truly eaten, and the blood really and truly drank, by the communicants; and that whatever motion or action the bread has the body has the ſame §. According to them, therefore, the ſame ſenſible appearances are exhibited by two ſubſtances united in ſome inexplicable manner, which is neither a perſonal union, nor incorporation, nor the incloſure of the body within the bread; nor does it laſt longer than while the ſacrament is celebrating. This union is generally called CONSUBSTANTIATION; but they reject the term, contenting themſelves with aſſerting the real preſence, without preſuming to define the mode by which the body and blood of Chriſt are united to the ſacramental elements.

It would be ſuperfluous to waſte time in replying to this doctrine. Every reader ſees that it implies the poſſibility of the ſame thing's being whole and entire in a million of places at one and the ſame inſtant of time, which has been ſo often urged as an unanſwerable objection to the Romiſh doctrine; and it is fraught with this additional abſurdity peculiar to itſelf, that two bodily ſubſtances may at once occupy the ſame place, which is directly contrary to our notions of ſolidity. It may be obſerved too, that whatever be the real ſenſe of our Saviour's words, he ſays expreſsly, "This is my body"—this thing which I give you, and which you ſee and feel; whereas, had he meant what Luther and his followers teach, he would ſurely have ſaid, "*With* this bread receive my body, *with* this cup receive my blood."

10
Of the early Calviniſts

The notions of ſome of the early Calviniſts reſpecting the Lord's Supper are very myſterious, and expreſſed in language of which we are not ſure that we underſtand the meaning. In the year 1561 an attempt was made in France to bring the Catholics and Proteſtants to an uniformity of doctrine on this great topic of controverſy; and deputies were appointed by both parties to meet at *Poiſſy*, and debate the queſtion in a friendly manner. The principal managers on the ſide of the Catholics were the cardinals of *Lorraine* and *Tournon*; thoſe on the ſide of the Proteſtants were *Beza* and *Peter Martyr*. After ſeveral meetings, diſputes, and violent ſeparations, the Proteſtant deputies declared their faith in the following words: "We confeſs, that Jeſus Chriſt, in the Supper, does truly give and exhibit to us the ſubſtance of his body and blood by the efficacy of his Holy Spirit; and that we do receive and eat ſpiritually, and by faith, *that very body which was offered and immolated for us*, ſo as to be bone of his bone and fleſh of his fleſh, to the end that we may be enlivened thereby, and receive what is conducive to our ſalvation. And becauſe faith, ſupported by the word of God, makes thoſe things preſent, which it apprehends, and by that faith we do in *deed* and *reality* receive the *true natural* body and blood of Chriſt, by the power of the Holy Spirit; by this means, we confeſs and acknowledge the preſence of his body and blood in the Supper." One of the Catholic delegates expreſſing his diſlike of this laſt clauſe, the Proteſtant miniſters gave the following explanation of their ſentiments: "No diſtance of place can hinder us from communicating of the body and blood of Chriſt, for the Lord's Supper is a heavenly thing; and though on earth we receive with our mouths bread and wine, which are the true ſigns of his body and blood, yet by faith, and the efficacy of the Holy Ghoſt, our minds, which are fed with this food, *are rapt up into heaven*, and enjoy the preſence of the body and blood; and that by this means it may be ſaid that the body is truly joined to the bread, and the blood to the wine; but after the manner of a ſacrament, and not at all according to place or natural poſition *."

11
Unintelligible.

If the reader can diſcover the preciſe meaning of theſe paſſages, his ſagacity exceeds ours. That the Proteſtant deputies believed, or profeſſed to believe, that the *natural* body and blood of Chriſt are by the faithful received in the Lord's Supper, is indeed evident; but their notions reſpecting the manner of this reception are very unintelligible, if not contradictory. In the former quotation, they confeſs that Chriſt's body and blood are really preſent in the ſacrament; that they are made preſent by faith (we ſuppoſe the faith of the communicants); and that the *very body* which was offered and immolated for us is eaten *ſpiritually* and by *faith*. In the latter quotation, they ſeem to ſay that Chriſt's body and blood are in heaven, at a great diſtance from the true ſigns of them; that on earth the communicants receive only theſe ſigns, which are bread and wine; but that, by faith and the efficacy of the Holy Spirit, their minds, during actual communion, are rapt up into heaven, where they enjoy the preſence of the body and blood; and that by this means the body and blood are truly joined to the bread and wine through the medium of the mind of the communicant, which is at once preſent both to the ſign and to the thing ſignified. To this myſterious doctrine it is needleſs to urge objections. Every man who is accuſtomed to think, and to uſe words with ſome determinate meaning, will at once perceive that the authors of this declaration muſt have had very confuſed notions of the ſubject, and have pleaſed themſelves with ſound inſtead of ſenſe, ſatisfied that they could not be wrong if they did not ſymbolize with the Lutherans or the Council of Trent.

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§ Luther. Cogit. MS. 400 Gerhard in Loc. Theol. de Sacra Cæna.

* Thuanus lib. 28. See alſo Johnſon's Unbloody Sacrifice, vol. I.

12
Of the churches of Britain.

The churches of England and Scotland, in their eſtabliſhed doctrines reſpecting the Lord's Supper appear to be Calviniſtical; but the compilers of the thirty-nine Articles and of the Confeſſion of Faith muſt have been much more rational divines than Beza and Peter Martyr. They agree in condemning the doctrine of tranſubſtantiation as contrary to common ſenſe, and not founded in the word of God; they teach, that to ſuch as rightly, worthily, and with faith, receive the ſacrament, the bread which we break is a partaking of the body of Chriſt, and the cup of bleſſing a partaking of the blood of Chriſt; and they add, that the body and blood of Chriſt are eaten and drunk, nor corporally or carnally, but only after a heavenly and ſpiritual manner, by which the communicants are made partakers of all the benefits of his death *. In one important circumſtance theſe two churches ſeem to differ. The Confeſſion of Faith, as we underſtand it ‡, affirms, that in the Lord's Supper there is no ſacrifice made at all. The thirty-firſt article of the church of England likewiſe condemns the Popiſh ſacrifice of the maſs as a *blaſphemous fable* and *dangerous deceit*; but in *the order for the adminiſtration of the Lord's Supper or Holy Communion*, the celebrator "beſeeches God muſt mercifully to accept the alms and *oblations* of the congregation," and again "to accept *their ſacrifice of praiſe* and thankſgiving:" from which petitions many have inferred that, in the Lord's Supper, that church offers a commemorative and euchariſtical ſacrifice. This inference ſeems not to be wholly without foundation. In the order for the adminiſtration of the Lord's Supper, according to the form of the Book of Common Prayer ſet forth by act of parliament in the ſecond and third years of king Edward the Sixth, the elements were ſolemnly offered to God as a ſacrifice of praiſe and thankſgiving; and though the prayer containing that oblation was, at the review of the liturgy ſome years afterwards, removed from the prayer of conſecration, to which it was orginally joined, and placed where it now ſtands in the poſt communion ſervice; yet the very act of parliament which authorized that alteration, calls king Edward's "a very godly order, agreeable to the word of God and the primitive church, and very comfortable to all good people deſiring to live in Chriſtian converſation."

* Articles of the Church of England, Art. 28. and Confeſſion of Faith, chap. 29.

‡ Chap. 29. § 3.

13
Some Engliſh divines hold the Lord's Supper to be a euchariſtical ſacrifice.

The Engliſh church, however, has not poſitively determined any thing reſpecting this great queſtion; and whilſt ſhe condemns the doctrine of the real preſence, with all its dangerous conſequences, ſhe allows her members to entertain very different notions of this holy ordinance, and to publiſh theſe notions to the world. Accordingly, many of her moſt eminent divines (E) have maintained that, in the celebration of the Lord's Supper, the elements of bread and wine are offered to God as a ſacrifice commemorative of Chriſt's one ſacrifice for the ſins of the whole world; that theſe elements, though they undergo no ſubſtantial change, yet receive ſuch a divine virtue by the deſcent of the Holy Ghoſt, as to convey to the worthy communicant all the benefits of Chriſt's paſſion; that they are therefore called his body and blood, becauſe being, after their oblation, eaten and drunk in remembrance of Him, they ſupply the place of his body and blood in the feaſt upon his ſacrifice; and that it is cuſtomary with our Saviour to give to any thing the name of another of which it completely ſupplies the place, as when he calls himſelf the *door* * of the ſheep, becauſe there is no entrance into the church or kingdom of God but by faith in him. They obſerve, that the Euchariſt's being commemorative, no more hinders it from being a proper ſacrifice, than the typical and figurative ſacrifices of the Old Law hindered them from being proper ſacrifices: for as to be a type doth not deſtroy the nature and notion of a legal ſacrifice, ſo to be repreſentative and commemorative doth not deſtroy the nature of an evangelical ſacrifice. To prove that, in the celebration of the Lord's Supper, there is a real ſacrifice offered to God as well as a ſacrament received by the communicants, they appeal to St Paul, who ſays expreſsly †, that "Chriſtians have an *altar*, whereof they have no right to eat who ſerve the tabernacle," and who by contraſting the cup of the Lord with the cup of devils, and the table of the Lord with the table of devils ¶, teaches plainly, that thoſe cups and thoſe tables had the ſame ſpecific nature. That the *table of devils* ſpoken of by the apoſtle was the Pagan altars, and the *cup of devils* the wine poured out in libations to the Pagan divinities, will admit of no diſpute; and therefore, ſay the advocates for the euchariſtical ſacrifice, the table of the Lord muſt be the Chriſtian altar, and the cup of the Lord the wine offered to God as the repreſentative of the blood of Chriſt; otherwiſe there would not be that *abſurdity* which the apoſtle ſuppoſes, in the ſame perſon drinking the cup of the Lord and the cup of devils, and partaking of the Lord's table and the table of devils. They obſerve farther, that in all the ancient liturgies extant there is a ſolemn form of oblation of the ſacramental elements, and that all the Chriſtian writers from the ſecond century downwards treat of the Lord's Supper as a ſacrifice as well as ſacrificial feaſt, having indeed no value in itſelf, but acceptable to God as repreſenting Chriſt's one ſacrifice for the ſins of the world. Our limits will not permit us to give even an abſtract of their arguments; but the reader who ſhall attentively peruſe *Johnſon's unbloody Sacrifice and Altar unveiled and ſupported*, will diſcover that their notions are better founded than probably he ſuppoſes, and that they are totally irreconcileable with the doctrine of tranſubſtantiation and the Popiſh ſacrifice of the *maſs*.

* St John x. 7.

† Heb. xiii. 10.

¶ 1 Cor. x. 16, &c.

14
Others, a mere memorial;

Other Engliſh divines of great learning, with the celebrated Hoadley biſhop of Winchester at the head of them, contend ſtrenuouſly that the Lord's Supper, ſo far from being

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(E) The archbiſhops Laud and Wake; the biſhops Poynet, Andrews, Bull, and Patrick; the Doctors Hickes, Grabe, and Brett; Meſſrs Bingham, Johnſon, Mede, Wheatly, Scandaret, Bowyer, &c.

being a ſacrifice of any kind, is nothing more than bread and wine reverently eaten and drunk, in remembrance that Chriſt's body was broken and his blood ſhed in proof of his Father's and his own love to mankind; that nothing is eſſential to the ſacrament but this remembrance, and a ſerious deſire to honour and obey our Saviour as our head; that the ſacrament might be celebrated without uttering one prayer or thankſgiving, merely by a ſociety of Chriſtians, whether ſmall or great, jointly eating bread and drinking wine with a ſerious remembrance of Chriſt's death; that St Paul enjoins a man to examine himſelf before he eat of that bread and drink of that cup, not to diſcover what have been the ſins of his paſt life in order to repent of them, but only that he may be ſure of his remembering Chriſt's body broken and his blood ſhed; that, however, it is his duty in that as in every other inſtance of religious worſhip to reſolve to obey from the heart every precept of the Goſpel, whether moral or poſitive; and that to partake worthily of the Lord's Supper is acceptable to God, becauſe it is paying obedience to one of theſe precepts; but that no particular benefits or privileges are annexed to it more than to any other inſtance of duty. Biſhop Hoadley acknowledges, that when St Paul ſays,* "The cup of bleſſing which we bleſs, is it not the communion of the blood of Chriſt? The bread which we break, is it not the communion of the body of Chriſt?" he has been ſuppoſed by many learned men to affirm, that all the benefits of Chriſt's paſſion are in the Lord's Supper conveyed to the worthy communicant; but this (ſays he) is an idea which the apoſtle could not have in his thoughts as at all proper for his argument. The Greek word κοινωνια and the Engliſh *communion* ſignify only a partaking of ſomething in common with others of the ſame ſociety; and the apoſtle's meaning (he ſays) can be nothing more, than that in the Lord's Supper we do not eat bread and drink wine as at an ordinary meal, but as memorials of the body and blood of Chriſt, in honour to *him* as the *head* of that body of which we are all *members*. That the word κοινωνια is not meant to denote any inward or ſpiritual part of the Lord's Supper, he thinks evident, becauſe the ſame word is uſed with regard to the cup and the table of idols, where no ſpiritual part could be thought of, and in an argument which ſuppoſes an idol to to be nothing.§

To this view of the nature and end of the Lord's Supper, it muſt appear no ſmall objection, that "he who eateth and drinketh unworthily is ſaid to be *guilty of the body and blood of the Lord, and to eat and drink a judgement to himſelf, not diſcerning the Lord's body.*" No doubt it would be ſinful to eat and drink a mere memorial of Chriſt's death without ſerious diſpoſitions; but we cannot conceive how a little wandering of the thoughts, which is all the unworthineſs which the author thinks there can be on ſuch an occaſion, ſhould be a ſin of ſo deep a dye as to be properly compared with the guilt of thoſe who murdered the Lord of life. Other divines therefore, feeling the force of this and ſimilar objections, ſteer a middle courſe between the mere memorialiſt and the advocate for a real ſacrifice in the holy Euchariſt, and inſiſt that this rite, though no ſacrifice itſelf, is yet a feaſt upon the one ſacrifice offered by Chriſt and ſlain upon the croſs. The moſt eminent patrons of this opinion have been Dr Cudworth, biſhop Warburton, and the preſent biſhop of Cheſter; and they ſupport it by ſuch arguments as the following: "In thoſe ages of the world when victims made ſo great a part of the religion both of Jews and Gentiles, the ſacrifice was always followed by a religious feaſting on the thing offered; which was called the *feaſt upon, or after the ſacrifice*, and was ſuppoſed to convey to the partakers of it the benefits of the ſacrifice. Now Jeſus (ſay they), about to offer himſelf a ſacrifice on the croſs for our redemption, did, in conformity to general practice, inſtitute the *laſt ſupper*, under the idea of *a feaſt after the ſacrifice;* and the circumſtances attending its inſtitution were ſuch, they think, that the apoſtles could not poſſibly miſtake his meaning. It was juſt before his paſſion, and while he was eating the paſchal ſupper, which was a Jewiſh *feaſt upon the ſacrifice*, that our bleſſed Lord inſtituted this rite; and as it was his general cuſtom to allude, in his actions and expreſſions, to what paſſed before his eyes, or preſented itſelf to his obſervation, who can doubt, when, in the very form of celebration, we ſee all the marks of a *ſacrificial ſupper*, but that the divine inſtitutor intended it ſhould bear the ſame relation to his *ſacrifice on the croſs* which the *paſchal ſupper* then celebrating bore to the oblation of the *paſchal lamb?* If this was not his purpoſe, and if nothing more was intended than a general memorial of a dead benefactor, why was this inſtant of time preferred for the inſtitution to all others throughout the courſe of his miniſtry, any one of which would have been equally commodious? Indeed any other time would have been more commodious for the inſtitution of a mere memorial; for the paſchal lamb and unleavened bread were certainly a ſacrifice; and the words uſed by our Saviour, when he gave the bread and wine to the apoſtles, were ſuch as muſt neceſſarily have led them to conſider that bread and wine as bearing the ſame relation to his ſacrifice that the paſchal ſupper bore to the paſchal ſacrifice. At that Jewiſh feaſt, it was the cuſtom of every father of a family to break the unleavened bread, and to give to every gueſt a portion, ſaying, "This is the bread of affliction, which our fathers did eat in the land of Egypt:" a cuſtom which, we may be ſure, that Chriſt, as father of his family, would religiouſly obſerve. The apoſtles knew well that they were not eating the identical bread which their fathers did eat in Egypt, but the feaſt upon the ſacrifice then offered in commemoration of their redemption from Egyptian bondage; and therefore when they ſaw their Maſter after ſupper break the bread again and give it to each of them, with theſe remarkable words, "This is my body which is given for you, do this in remembrance of me," they muſt have concluded, that his meaning was to inſtitute a rite which ſhould to the end of the world bear the ſame relation to his ſacrifice that the paſchal ſupper bore to the ſacrifice of the paſſover.

15
And others, a feaſt upon our Saviour's ſacrifice.

This inference, from the circumſtances attending the inſtitution, biſhop Warburton thinks confirmed by St Paul's mode of arguing with the Corinthians, on their impiety and abſurdity in partaking both of the Lord's table and the table of devils; for "what (ſays he) had the eaters of the ſacrifices to do with the partakers of the bread and wine in the Lord's Supper, if the Lord's Supper was not a feaſt of the ſame kind with their feaſts? If the three feaſts, Jewiſh, Pagan, and Chriſtian, had not one common nature, how could the apoſtle have inferred that this intercommunity was inconſiſtent? *Ye* CANNOT (ſays he) *drink the cup of the Lord and the cup of devils; ye* CANNOT *be partakers of the Lord's table and the table of devils.* For though there might be *impiety* in the promiſcuous uſe of Pagan and Chriſtian rites of any kind, yet the *inconſiſtency* ariſes from their having a common nature, and conſequently, as they had oppoſite originals, from their deſtroying one another's effects in the very celebration. Sacrifices, and feaſts upon ſacrifices, were univerſally conſidered as *federal* rites; and therefore the Lord's table and the table of devils being both *federal* rites, the ſame man could no more

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* 1 Cor. x. 16.

§ A plain Account of the Nature and End of the Lord's Supper.

Supper, Supplement.

be partaker of both, than he could at once engage to ſerve both God and the devil. This is the apoſtle's argument to the wiſe men, to whom he appeals; and we ſee that it turns altogether upon this poſtulatum, that the Chriſtian and Pagan feaſts had the ſame ſpecific nature, or were both feaſts upon ſacrifices. If this be admitted, it is eaſy to ſee why St Paul deemed thoſe who ate and drank unworthily guilty of the body and blood of the Lord; for if the Lord's Supper be a feaſt upon his ſacrifice, it muſt have been conſidered as the means of conveying to the communicants all the benefits of his death and paſſion; and the profanation of ſuch a rite, by rendering his death ineffectual, might be fitly compared and juſtly equalled to the enormous guilt of thoſe by whom his blood was ſhed." In reply to biſhop Hoadley's remarks upon the word κοινωνια, his brother biſhop obſerves, that "had the apoſtle meant what the learned writer makes him to mean, he would doubtleſs have ſaid κοινωνια ὑμων εις το σωμα, 'your communion in the body—your eating it jointly.' St Paul (continues he) knew how to expreſs himſelf properly, as appears from a paſſage in his epiſtle to the Philippians, where, profeſſedly ſpeaking of the joint participation of a bleſſing, he uſes theſe words, κοινωνια ὑμων εις το ευαγγελιον, 'your communion in the Goſpel.' To the other remark, that no ſpiritual part could be thought of in the table of idols, becauſe an idol is ſaid by the apoſtle to be *nothing*, biſhop Warburton replies, "that by St Paul the Gentiles are ſaid to have ſacrificed to devils, and thoſe who ate of ſuch ſacrifices to have had communion with devils: now the *devil* (continues his Lordſhip) was in St Paul's opinion *ſomething*." But the inference which the apoſtle draws from the acknowledged truth, that the cup of bleſſing which we bleſs is the communion of the blood of Chriſt, and the bread which we break the communion of the body of Chriſt, puts his meaning, our author thinks, beyond all doubt. He ſays †, that the partaking of one bread makes the receivers of *many* to become *one body*. A juſt inference, if this rite be of the nature of a *feaſt upon the ſacrifice*; for then *the communion of the body and blood of Chriſt* unites the receivers into one body by an equal diſtribution of one common benefit. But if it be only a general commemoration of a deceaſed benefactor, it leaves the receivers as it found them, not *one body*, but *many ſeparate profeſſors* of one common faith.

† 1 Cor. x. 17.

16
The ordinance not generally underſtood.

Thus have we given ſuch a view as our limits would permit us to give, of the principal opinions that have been held reſpecting the nature and end of the Lord's Supper. It is an ordinance which ſeems not to be generally underſtood; though, being intended to ſhow forth the Lord's death till he come, it is ſurely of ſufficient importance to engage the attention of every ſerious Chriſtian. The moſt conſiderable Proteſtant divines who have expreſsly written upon it are, Johnſon in his *Unbloody Sacrifice;* Cudworth in his *Diſcourſe concerning the true Nature of the Lord's Supper;* Hoadley in his *Plain Account;* and Warburton in his *Rational Account.* The notions of Cudworth and Warburton are the ſame, and perhaps they differ not ſo much from thoſe of Johnſon as many readers ſeem to imagine. At any rate, the arguments by which Warburton ſupports his doctrine muſt have ſome force, ſince it is ſaid that Hoadley himſelf acknowledged they would be unanſwerable, if it could be proved that the death of Chriſt was a real ſacrifice.

SUPPLEMENT, in literature, an appendage to ſupply what is wanting in a book. Books of various kinds require ſuch an appendage; but none ſo much as a dictionary of arts and ſciences, which, from the progreſſive courſe of phyſical ſcience, cannot be completed without it.

Supported || Supralapſarians.

SUPPORTED, in heraldry, a term applied to the uppermoſt quarters of a ſhield when divided into ſeveral quarters, theſe ſeeming as it were ſupported or ſuſtained by thoſe below. The chief is ſaid to be ſupported when it is of two colours, and the upper colour takes up two-thirds of it. In this caſe it is ſupported by the colour underneath.

SUPPORTERS, in heraldry, figures in an atchievement placed by the ſide of the ſhield, and ſeeming to ſupport or hold up the ſame. Supporters are chiefly figures of beaſts: figures of human creatures for the like purpoſe are called *tenants*.

SUPPOSITION, in muſic, is when one of the parts dwells on a note, while another part makes two or more leſſer notes equivalent to it, by conjoint degrees.

Suppoſition is defined by a late author the uſing of two ſucceſſive notes, of the ſame value as to time; the one whereof, being a diſcord, ſuppoſes the other a concord.

The harmony, Mr Malcolm obſerves, is always to be full on the accented parts of the bar or meaſure; but, on the unaccented, diſcords, may tranſiently paſs, without any offence to the ear. This tranſient uſe of diſcords, followed by concords, make what we, after the French, call *ſuppoſition*.

Concords by ſuppoſition are thoſe where the continued baſs adds or ſuppoſes a new ſound below the fundamental baſs; whence ſuch concords always exceed the extent of the octave. Of theſe concords there are three ſorts, all which are concords of the ſeventh: the firſt, when the added ſound is a third below the fundamental ſound; ſuch is the concord of the ninth: and if the concord of the ninth is formed by the mediant, added below the ſenſible concord in the minor mode, then the concord is called the *ſuperfluous fifth*. The ſecond kind is, when the ſuppoſed ſound is a fifth below the fundamental ſound, as in the concord of the fourth or eleventh; and if the concord is ſenſible, and the tonic be ſuppoſed, this concord is called the *ſuperfluous ſeventh*. The third kind is that where the ſuppoſed ſound is below a concord of the diminiſhed ſeventh: if it is a fifth below, *i. e.* if the ſuppoſed ſound be the mediant, the concord is called the concord of the *fourth* and *ſuperfluous fifth*: if it is a ſeventh below, *i. e.* if the ſuppoſed ſound be the tonic, the concord is called the *leſſer ſixth* and *ſuperfluous ſeventh*.

SUPPOSITORY, a kind of medicated cone or ball, which is introduced into the anus for opening the belly.

It is uſually compoſed of common honey, mixed up with either ſoap or oil, and formed into pieces of the length and thickneſs of the little finger, only pyramidal. To the compoſition is ſometimes alſo added powder of ſcammony, euphorbium, colocynthis, ſalt, aloes, &c. according to the caſe of the patient.

The ſuppoſitory was invented for the convenience of ſuch as have an averſion to the taking of clyſters; or to be uſed when the diſeaſe does not allow thereof.

SUPPRESSION, in medicine, is generally uſed to ſignify a retention of urine or of the menſes.

SUPPURATION, the ſecond way wherein an inflammation terminates; being a converſion of the inſpiſſated blood and the firſt adjacent parts, as the veſſels and fat into pus or matter; which diſorder, when it has not yet found an opening, is generally called an *abſceſs*.

SUPRACOSTALES, in anatomy. See *Table of the Muſcles* in ANATOMY.

SUPRALAPSARIANS, in theology, perſons who hold that God, without any regard to the good or evil works of men, has reſolved, by an eternal decree, *ſupra lapſum*, antecedently to any knowledge of the fall of Adam, and independently of it to ſave ſome and to damn others; or in, other words, that God intended to glorify his juſtice

Supraſpinatus
‖
Surat.

in the condemnation of ſome, as well as his mercy in the ſalvation of others; and for that purpoſe decreed that Adam ſhould neceſſarily fall, and by that fall bring himſelf and all his offspring into a ſtate of everlaſting condemnation.

Theſe are alſo called *antelapſaries*, and are oppoſed to ſublapſaries and infralapſaries.

According to the ſupralapſarians, the object of predeſtination is, *homo creabilis et labilis*; and, according to the ſublapſarians and infralapſarians, *homo creatus et lapſus*.

SUPRASPINATUS, in anatomy. See *Table of the Muſcles* in ANATOMY.

SUPREMACY, the ſuperiority or ſovereignty of the king. See SOVEREIGNTY.

SUR, or SHUR (anc. geog.), a deſert of Arabia Petræa, extending between Paleſtine and the Arabian Gulph; into which the Iſraelites, after marching through the Red Sea, firſt came (Exod. xv. 22.) Again (Numb. xxxiii. 8.), it is ſaid, that from the ſea they went three days journey into the Wilderneſs of Etham; whence ſome conclude that Etham and Shur are the ſame wilderneſs; or only differ as a part from the whole, Shur being the general name, and Etham that part of it lying neareſt to the place of encampment of the ſame name. We know ſo little of the geography of theſe places that there is more room for diſputation than for deciſion. As to the route which the Iſraelites followed in their paſſage through the Red Sea, Mr Bryant, we think, has given the moſt ſatisfactory account in his late work on the Plagues of Egypt.—Shur is now called *Corondel*.

SURAT, a city of Indoſtan, belonging to Britain, on the weſtern coaſt of the peninſula, a little to the northward of Bombay, and about 16 miles up the river Tappee. It is but of modern date, and is a moſt remarkable inſtance of the power of trade to bring wealth and population to any ſpot where it can be brought to ſettle. Towards the middle of the laſt century this place was only the reſort of a few merchants, who, under the ſhelter of an old inſignificant caſtle, laid the firſt foundations of a city now almoſt as large and fully as populous as London within the walls, and containing many fine buildings of Indian architecture, which is partly Gentoo and partly Moriſque. Thoſe of the greateſt note are ſo contrived, that the gateway is defenſible againſt any ſudden irruption of a few armed men. The private apartments lie backwards for the conveniency of the women, of whom the Moors are remarkably jealous. They are fond of having one room, in the midſt of which a fountain keeps playing, and which, by its noiſe, lulls them to ſleep, and refreſhes the room by its coolneſs; but thus a damp is produced, which would be very dangerous to Europeans. They have alſo generally a ſaloon with fountains playing in it, which with the variegated flower-beds, in which they are very curious, makes a beautiful proſpect. During the intenſe heats of ſummer they have country retirements a little way out of town, where they reſide, or go in parties to amuſe themſelves. The ſtreets are irregularly laid out; but have one property which renders it agreeable to walk in them, viz. that a competent width being left at bottom, the upper ſtories of the houſes project over one another in ſuch a manner, that people may with eaſe converſe from them; by which means the ſtreet is agreeably ſhaded, at the ſame time that a proper ventilation is not impeded, but rather promoted. The ſhops, notwithſtanding the vaſt trade carried on in this great and populous city, have a very mean appearance, owing to the dealers keeping their goods in warehouſes, and ſelling by ſamples.

No place is better ſupplied with proviſions than the city of Surat while its communication with the country remains open. Beſides the unbounded importation, by which every article is brought here in great abundance, the natural productions of the ſoil are excellent, though leſs cheap than in other parts of India, as at Bengal eſpecially; yet in that place, though the cattle and poultry are bought originally at a very low rate, they turn out very dear by the time they are fed for the table. Here, however, all kinds of eatables may be had at a reaſonable price, ready, for immediate uſe, and as good as can be found anywhere. The wheat of Surat is famous all over India for its ſingular ſubſtance, whiteneſs, and taſte; and its ſallads and roots are likewiſe of an excellent quality. There are alſo many kinds of wild-fowl and other game to be had at an eaſy rate; but for wines and ſpirituous liquors they depend moſtly on importation.

Surat.

Surat was ſurrounded with a wall in ſhort time after it had aſſumed the form of a town. The fortification, however, was meant only to prevent the incurſions of the Mahrattas, who had twice pillaged it; ſo that the place was by no means capable of ſtanding any regular ſiege. Even the caſtle appears but a poor defence, being mounted with cannon here and there, without any order, or without any thing like an attempt towards military architecture.

In this city, before the Eaſt India company became inveſted with the poſſeſſion of Bombay, was the preſidency of their affairs on the weſtern coaſt. For this purpoſe they had a factory eſtabliſhed there with great privileges by the Mogul government; and even after the preſidency was eſtabliſhed at Bombay, they continued a factory here at one of the beſt houſes in the city; which yet not being ſpacious enough to contain their effects, they hired another at ſome diſtance from it, and nearer the water-ſide, which was called the new factory. In the mean time, the city flouriſhed, and became the centre of all the Indian trade, being much more frequented for the ſake of foreign merchandize than for either the natural productions or manufactures of the country, though they alſo made a conſiderable part of its commerce. In ſhort, there was ſcarce any article of merchandize but what was to be found at all times in Surat, almoſt as readily as in London itſelf. While the Mogul government was in its vigour, there was ſuch a ſhow of juſtice kept up, as induced merchants of all religions and denominations to take up their reſidence in the city. The Gentoos eſpecially reſorted thither, in order to avoid the oppreſſions of their own government. Great care indeed was taken that no very flagrant acts of oppreſſion ſhould be committed; ſo that, in what ſometimes happened, appearances were at leaſt kept up; and the oppreſſions of government were chiefly owing to the animoſities and rivalſhip of the merchants themſelves. As an inſtance of the great extent to which commerce was puſhed in Surat, we ſhall here quote from Mr Groſe, what is ſaid by Captain Hamilton of a merchant named *Abdulgafour*, viz. "That he drove a trade equal to the Eaſt India company: for he had known him fit out in a year above 20 ſail of ſhips between 300 and 800 tons, none of which had leſs of his own ſtock than L. 20,000, and ſome of them L. 25,000. After that foreign ſtock was ſent away, it behoved him to have as much more of an inland ſtock for the following year's market." On the deceaſe of this merchant, the government ſeized on a million of his money; and his grandſon was not only deprived of all that he poſſeſſed, but barbarouſly murdered through the envy and treachery of his brother-merchants, and the rapacity of the governor.

The city of Surat was taken and ruined by the Portugueſe in 1520; and it was not till after this misfortune that it became ſuch a celebrated emporium. All the Indian merchants who had been accuſtomed to trade thither contributed to re-eſtabliſh it; but it was not till near a century after that it became the general ſtaple of Indian and

European merchandize; when the Dutch appearing in the Indian ocean, had deprived the Portugueſe of all their conqueſts on that coaſt, and almoſt entirely ruined their trade. The Engliſh eſtabliſhed a factory here in 1609, the Dutch in 1616, and the French in 1665. In proceſs of time, the Indian ſeas being greatly infeſted by pirates, a naval officer was appointed by the Mogul to keep them in awe. This officer was named *Siddee* (A) *Muſſoot*, who had been chief of an Ethiopian colony ſettled at Rajapore. Here he had collected ſome veſſels of conſiderable force, and carried on ſome trade, till he was diſpoſſeſſed by the Mahrattas; upon which he repaired to Bombay, and afterwards to Surat, where he was appointed admiral on that ſtation to the Mogul, with a yearly revenue of about L. 36,000 Sterling. Though he had no power, independent of the marine, he ſeized on the Caſtle, encroached on the town, and appropriated to himſelf a third part of its revenues, under pretence of arrears due in his appointed revenue. Another third was paid to the Mahrattas, to prevent their depredations upon trade in the open country; but they, not ſatisfied with this ſtipulation, watched an opportunity to plunder the town, which was kept in ſubjection by Siddee Muſſoot till his death, which happened in 1756.

Siddee Muſſoot was ſucceeded by his ſon, who ſoon rendered himſelf very diſagreeable to the inhabtants. In 1758 the Engliſh factory was greatly oppreſſed by him, and the black merchants treated ſtill worſe; on which the latter applied to Mr Ellis the Engliſh chief at that time, deſiring him to recommend it to the preſidency of Bombay to take the caſtle by force out of the hands of the uſurper. This propoſal proving agreeable, Admiral Pococke, who was then with his ſquadron at Bombay, readily concurred in ſupporting the expedition. The enterprize was conducted with ſucceſs; and Captain Maitland the conductor took poſſeſſion of the caſtle with its revenue in name of the Eaſt India company, who were confirmed in the government by grants from the Mogul.

SURCHARGE OF THE FOREST, is when a commoner puts more beaſts in the foreſt than he has a right to. See Forest.

Surcharge of Common, is a diſturbance of common of paſture, by putting more cattle therein than the paſture and herbage will ſuſtain, or the party hath a right to do. This injury can only happen where the common is appendant or appurtenant and of courſe limitable by law; or where, when in groſs, it is expreſsly limited and certain; for where a man hath common in groſs, *ſans nombre*, or without ſtint he cannot be a ſurcharge. In this caſe indeed there muſt be left ſufficient for the lord's own beaſts.

The uſual remedies for ſurcharging the common are by the lord's diſtraining the ſurplus number, or by his bringing an action of treſpaſs, or by a ſpecial action on the caſe, in which any commoner may be plaintiff. The ancient and moſt effectual method of proceeding is by writ of admeaſurement of paſture.

Writ of Second Surcharge, de ſecunda ſuperoneratione, is given by the ſtatute of Weſtm. 2. 13 Edw. I. cap. 8. when, after the admeaſurement of paſture hath aſcertained the right, the ſame defendant ſurcharges the common again; and thereby the ſheriff is directed to inquire by a jury whether the defendant has in fact again ſurcharged the common; and if he has, he ſhall then forfeit to the king the ſupernumerary cattle put in, and alſo ſhall pay damages to the plaintiff.

SURCINGLE, a girdle wherewith the clergy of the church of England uſually tie their caſſocks. See Girdle.

SURCOAT, a coat of arms, to be worn over body armour.

The ſurcoat is properly a looſe thin taffety coat, with arms embroidered or painted on it. Such as is worn by heralds, anciently alſo uſed by military men over their armour to diſtinguiſh themſelves by.

SURD, in arithmetic and algebra, denotes any number or quantity that is incommenſurable to unity: otherwiſe called an *irrational number* or *quantity*. See Algebra, Part I. Chap. IV.

SURETY, in law, generally ſignifies the ſame with Bail.

SURF, is a term uſed by ſeamen to expreſs a peculiar ſwell and breaking of the ſea upon the ſhore. It ſometimes forms but a ſingle range along the ſhore, and at others three or four behind one another extending perhaps half a mile out to ſea. The ſurf begins to aſſume its form at ſome diſtance from the place where it breaks, gradually accumulating as it moves forward till it gain, not uncommonly, in places within the limits of the trade-winds, a height of 15 or 20 feet, when it overhangs at top, and falls like a caſcade with great force and a prodigious noiſe. Countries where ſurfs prevail require boats of a particular conſtruction very different from the greater part of thoſe which are built in Europe. In ſome places ſurfs are great at high, and in others at low water; but we believe they are uniformly moſt violent during the ſpring-tides.

It is not eaſy to aſſign the cauſe of ſurfs. That they are affected by the winds can hardly be queſtioned; but that they do not proceed from the *immediate* operation of the wind in the places where they happen, is evident from this circumſtance, that the ſurf is often higheſt and moſt violent where there is leaſt wind, and *vice verſa*. On the coaſt of Sumatra the higheſt are experienced during the ſouth-eaſt monſoon, which is never attended with ſuch gales as the north-weſt. As they are moſt general in the tropical latitudes, Mr Marſden, who ſeems to have paid much attention to the ſubject, attributes them to the trade-winds which prevail at a diſtance from ſhore between the parallels of 30 degrees north, and ſouth whoſe uniform and invariable action cauſes a long and conſtant ſwell, that exiſts even in the calmeſt weather, about the line, towards which its direction tends from either ſide. This ſwell, when a ſquall happens or the wind freſhens up, will for the time have other ſubſidiary waves on the extent of its ſurface, breaking often in a direction contrary to it, and which will again ſubſide as a calm returns, without having produced on it any perceptible effect. Sumatra, though not continually expoſed to the ſouth eaſt trade-wind, is not ſo diſtant but that its influence may be preſumed to extend to it; and accordingly at Poolo Peſang, near the ſouthern extremity of the iſland, a conſtant ſoutherly ſea is obſerved, even after a ſtrong north-weſt wind. This inceſſant and powerful ſwell rolling in from an ocean, open even to the pole, ſeems an agent adequate to the prodigious effects produced on the coaſt; whilſt its very ſize contributes to its being overlooked. It reconciles almoſt all the difficulties which the phenomena ſeem to preſent, and in particular it accounts for the decreaſe of the ſurf during the north-weſt monſoon, the local wind then counteracting the operation of the general one; and it is corroborated by an obſervation, that the ſurfs on the Sumatran coaſt ever begin to

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(A) When the Abyſſinian ſlaves are promoted to any office under the Mogul government, they are called *Siddees*.

to break at their ſouthern extreme, the motion of the ſwell not being perpendicular to the direction of the ſhore. This explanation of the phenomena is certainly plauſible; but, as the author candidly acknowledges, objections may be urged to it. The trade-winds and the ſwell occaſioned by them are remarkably ſteady and uniform; but the ſurfs are much the reverſe. How then comes an uniform cauſe to produce unſteady effects?

In the opinion of our author it produces no unſteady effects. The irregularity of the ſurfs, he ſays, is perceived only within the remote limits of the trade-winds. But the equatorial parts of the earth performing their diurnal revolution with greater velocity than the reſt, a large circle being deſcribed in the ſame time, the waters thereabout, from the ſtronger centrifugal force, may be ſuppoſed more buoyant; to feel leſs reſtraint from the ſluggiſh principle of matter; to have leſs gravity; and therefore to be more obedient to external impulſes of every kind, whether from the winds or any other cauſe.

SURFACE. See Superficies.

SURFEIT, in medicine, a ſickneſs with a ſenſation of a load at the ſtomach, uſually proceeding from ſome error in diet, either with regard to the quantity or quality of the food taken. Sometimes, however, a ſurfeit is only a plethora from indolence and full but improper feeding; in which caſe perſpiration is defective; and eruptions form themſelves on the ſkin.

A ſurfeit from animal food, as muſcles, putrid fleſh, &c. is beſt remedied by the uſe of vegetable acids, which may be taken diluted with water, a vomit being premiſed, and this even though a vomiting and purging both attend.

When an exceſs of feeding is the cauſe, the primæ viæ being evacuated, and the nature of the plethora attended to, that the load may be properly evacuated, the indication of cure will be, to recover the perſpiratory diſcharge, conſiſtent with which diuretics may be uſed in preference to medicines which produce any other evacuation.

Surfeit, in farriery. See Farriery, § xix.

SURGE, in the ſea language, the ſame with a wave. See Wave.

SURGEON, or Chirurgeon, one that profeſſes the art of Surgery.

In England there are two diſtinct companies of ſurgeons now occupying the ſcience or faculty of ſurgery; the one company called *barbers*, the other *ſurgeons*, which latter are not incorporated.—The two are united to ſue, and be ſued, by the names of maſters or governors and commonalty of the myſtery of barbers and ſurgeons of London. 32 H. VIII. c. 42.

No perſon uſing any barbery or ſhaving in London, ſhall occupy any ſurgery, letting of blood, or other matter; drawing of teeth only excepted. And no perſon uſing the myſtery or craft of ſurgery ſhall occupy or exerciſe the feat or craft of barbery, or ſhaving, neither by himſelf, nor any other for his uſe. 32 H. VIII. c. 42.

By the ſame ſtatute, ſurgeons are obliged to have ſigns at their doors.

The French chirurgeons being refuſed to be admitted into the univerſities (notwithſtanding that their art makes a branch of medicine), on pretence of its bordering a little on butchery or cruelty, aſſociated themſelves into a brotherhood, under the protection of S. Coſmus and S. Damian: on which account, according to the laws of their inſtitution, they are obliged to dreſs and look to wounds *gratis* the firſt Monday of each month.

They diſtinguiſh between a chirurgeon of the long robe and a barber-chirurgeon. The firſt has ſtudied phyſic, and is allowed to wear a gown. The ſkill of the other, beſides what relates to the management of the beard, is ſuppoſed to be confined to the more ſimple and eaſy operations in chirurgy; as bleeding, tooth-drawing, &c.

They were formerly diſtinguiſhed by badges: thoſe of the long gown bore a caſe of inſtruments; the barber, a baſon.

SURGERY,

THAT part of medicine which treats of diſeaſes to be cured or alleviated by the hand, by inſtruments, or by external applications.

Chap. I. *Hiſtory of Surgery.*

1 Surgery early practiſed.

That ſurgery was coeval with the other branches of medicine, or perhaps antecedent to any of them, will not admit of doubt. The wars and contentions which have taken place among mankind almoſt ever ſince their creation, neceſſarily imply that there would be occaſion for ſurgeons at a very early period; and probably theſe external injuries would for ſome time be the only diſeaſes for which a cure would be attempted, or perhaps thought practicable.—In the ſacred writings we find much mention of balſams, particularly the balm of Gilead, as excellent in the cure of wounds; though at the ſame time we are informed that there were ſome wounds which this balſam could not heal.

2 Hiſtory of it among the Greeks,

Hiſtory.

Concerning the ſurgery practiſed among the Egyptians, Jews, and Aſiatic nations, we know little or nothing. The Greeks were thoſe from whom the art deſcended to us, though they confeſſedly received it from the eaſtern nations. The firſt Greek ſurgeons on record are Æſculapius and his ſons Podalirius and Machaon. Æſculapius flouriſhed about 50 years before the Trojan war; and his two ſons diſtinguiſhed themſelves in that war both by their valour and ſkill in curing wounds. This indeed is the whole of the medical ſkill attributed to them by Homer; for in the plague which broke out in the Grecian camp, he does not mention their being at all conſulted. Nay, what is ſtill more ſtrange, tho' he ſometimes mentions his heroes having their bones broke, he never takes notice of their being reduced or cured by any other than ſupernatural means; as in the caſe of Æneas, whoſe thigh-bone was broken by a ſtone caſt at him by Diomed. The methods which theſe two famous ſurgeons uſed in curing the wounds of their fellow-ſoldiers ſeems to have been the extracting or cutting out the darts which inflicted them, and applying emollient fomentations or ſtyptics to them when neceſſary: and to theſe they undoubtedly attributed much more virtue than they could poſſibly poſſeſs; as appears from the following lines, where Homer deſcribes Eurypylus as wounded and under the hands of Patroclus, who would certainly practiſe according to the directions of the ſurgeons.

> Patroclus cut the forky ſteel away;
> Then in his hand a bitter root he bruis'd
> The wound he waſh'd, the ſtyptic juice infus'd.
> The *cloſing fleſh* that inſtant ceas'd to glow;
> The wound to torture, and the blood to flow.

Till the days of Hippocrates we know very little of what was the practice of the Greek ſurgeons. From him, however, we learn, that the practice of blood-letting, cupping, and ſacrification, was known to them; alſo the uſe of warm and emollient fomentations, iſſues made with hot irons, peſſaries, injections, fumigations, &c. Hippocrates alſo gives directions with regard to fractures, luxations, ulcers, fiſtulas. He directs the extenſion, reduction, bandages, and ſplints, proper to be uſed in fractures and luxations of different bones, with ſeveral machines to increaſe the extenſion when neceſſary. He directs the laxity and tightneſs of the bandages; the intervals for unlooſing and binding them on again; the poſition and repoſe of the fractured member, and the proper regimen; and he mentions the time when a callus is uſually formed. He treats alſo of fractures of the ſkull, and the method of applying the trepan. In his treatment of ulcers, he ſpeaks of reducing fungous fleſh by means of eſcharotics, ſome of which are alum, nitre, verdigriſe, quicklime, &c.

In the time of Ptolemy Philopater of Egypt, medicine, all the branches of which had hitherto been practiſed by the ſame perſon, was now divided into three, viz. the dietetic, pharmaceutic, and ſurgical; from which time to the preſent, ſurgery has continued to be reckoned a diſtinct profeſſion from medicine, though very improperly, in the opinion of the beſt authors.

3
Among the Romans,

Surgery appears not to have exiſted in Rome, notwithſtanding the warlike genius of the people, for more than 500 years. Archagathus, a Greek, was the firſt profeſſor of that art in the city; and ſo frequently employed the knife, hot irons, and other cruel methods of cure, that he was branded with the opprobrious title of *carnifex*, and expelled the city, where no phyſician or ſurgeon of eminence again made his appearance for 180 years. At this time Aſclepiades undertook the profeſſion of medicine; but ſeems to have dealt little in ſurgery. Neither have we any thing of importance on that ſubject till the time of Celſus, who flouriſhed during the reigns of Auguſtus and Tiberius.—In his ſurgery, all the improvements from Hippocrates to his own days are collected; the moſt minute and trifling diſeaſes are not omitted. An eminent ſurgeon, of the moderns, emphatically exhorts every perſon in that profeſſion "to keep Celſus in his hands by day and by night."—He deſcribes the ſigns of a fractured ſkull, the method of examining for the fracture, of laying the ſkull bare by an inciſion in the form of the letter X, and afterwards of cutting away the angles, and of applying the trepan, with the ſigns of danger and of recovery. He obſerved, that ſometimes, though very rarely, a fatal concuſſion of the brain might happen, the blood-veſſels within the ſkull being burſt, yet the bone remaining entire. After the operation of the trepan, ſponges and cloths wetted with vinegar, and ſeveral other applications, were made to the head; and, throughout, ſevere abſtinence was enjoined. In violent fractures of the ribs, he ordered veneſection; low diet; to guard againſt all agitation of the mind, loud ſpeaking, motion, and every thing that might excite coughing or ſneezing. Cloths wetted with wine, roſes and oil, and other applications, were laid over the fracture. The cure of fractures, in the upper and lower extremities, he ſaid were nearly alike; that fractures differ in degree of violence and danger, in being ſimple or compound, that is, with or without a wound of the fleſh, and in being near to the joint. He directs the extenſion of the member by aſſiſtants; the reduction, by the ſurgeon's hands, of the fractured bones into their natural ſituation; and to bind the fractured part with bandages of different lengths, previouſly dipped in wine and oil: on the third day freſh bandages are to be applied, and the fractured member fomented with warm vapour, eſpecially during the inflammation. Splints, if neceſſary, are to be applied, to retain the bones in a fixed poſition. The fractured arm is to be ſuſpended in a broad ſling hung round the neck: the fractured leg is to be incloſed in a kind of caſe, reaching above the ham, and accommodated likewiſe with a ſupport to the foot, and with ſtraps at the ſide, to keep the leg ſteady: in the fractured thigh-bone, the caſe is to extend from the top of the hip to the foot. He deſcribes the method of treating compound fractures, and of removing ſmall fragments of ſplinters of bones; and the manner of extracting darts. In luxations of the ſhoulder, he mentions ſeveral methods of giving force to the extenſion, and of replacing the diſlocated bone. One method ſimilar to that of Hippocrates was, to ſuſpend the patient by the arm; the fore-part of the ſhoulder, at the ſame time, reſting upon the top of a door, or any other ſuch firm fulcrum. Another method was to lay the patient ſupine, ſome aſſiſtants retaining the body in a fixed poſition, and others extending the arm in the contrary direction; the ſurgeon, in the mean time, attempting, by his hands, forcibly to reduce the bone into its former place.

If a large inflammation was expected to enſue after a wound, it was ſuffered to bleed for ſome time, and blood was drawn from the arm. To wounds accompanied with conſiderable hæmorrhagy, he applied a ſponge wet in vinegar, and conſtant preſſure: If neceſſary, on account of the violence of the hæmorrhagy, ligatures were made round the veſſels, and ſometimes the bleeding orifice was ſeared up with the point of a hot iron. On the third day freſh dreſſings were applied. In conſiderable contuſions, with a ſmall wound of the fleſh, if neither blood-veſſels nor nerves prevented, the wound was to be enlarged. Abſtinence and low diet, upon all ſuch accidents, were preſcribed; cloths wet with vinegar, and ſeveral other applications, were to be applied to the inflamed part. He obſerves, that freſh wounds may be healed without compound applications. In external gangrene, he cut into the ſound fleſh; and when the diſeaſe, in ſpite of every effort, ſpread, he adviſed amputation of the member. After cutting to the bone, the fleſh was then ſeparated from it, and drawn back, in order to ſave as much fleſh as poſſible to cover the extremity of the bone. Celſus, though extremely diffuſe in the deſcription of ſurgical diſeaſes, and of various remedies and external applications, treats ſlightly of the method of amputating; from which, comparing his treatiſe with the modern ſyſtems, we might infer that the operation was then ſeldomer practiſed than at preſent. He deſcribes the ſymptoms of that dangerous inflammation the carbuncle, and directs, immediately to burn, or to corrode the gangrened part. To promote the ſuppuration of abſceſſes, he orders poultices of barley-meal, or of marſhmallows, or the ſeeds of linſeed and fenugreek. He alſo mentions the compoſitions of ſeveral repellent cataplaſms. In the *eryſipelas*, he applies ceruſe, mixed with the juice of ſolanum or nightſhade. Sal ammoniac was ſometimes mixed with his plaſters.

He is very minute in deſcribing diſeaſes of the eyes, ears, and teeth, and in preſcribing a multitude of remedies and applications. In inflammation of the eyes, he enjoined abſtinence and low diet, reſt, and a dark room: if the inflammation was violent, with great pain, he ordered veneſection, and a purgative; a ſmall poultice of fine flower, ſaffron, and the white of an egg, to be laid to the forehead to ſuppreſs the flow of pituita; the ſoft inſide of warm wheat bread dipped in wine, to be laid to the eye; poppy and roſes were alſo added to his collyriums, and various ingredients too tedious to enumerate. In chronic watery de-

fluxions,

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fluxions of the eyes, he applied aſtringents, cupped the temples, and burnt the veins over the temple and forehead. He couched cataracts by depreſſing the cryſtalline lens to the bottom of the orbit. Teeth, looſened by any accident, he directs, after the example of Hippocrates, to be faſtened with a gold thread to thoſe adjoining on each ſide. Previous to drawing a tooth, he ordered the gum to be cut round its neck; and if the tooth was hollow, it was to be filled with lead before extraction, to prevent its breaking by the forceps. He deſcribes not only the inflammation, but likewiſe the elongation, of the uvula: he alſo deſcribes the polypus, and ſome other diſeaſes affecting the noſe.

He deſcribes ſeveral ſpecies of herniæ or rupture, and the manual aſſiſtance required in thoſe complaints. After the return of the inteſtines into the abdomen, a firm compreſs was applied to that part of the groin through which they protruded, and was ſecured by a bandage round the loins. In ſome caſes, after the return of inteſtinal ruptures, he diminiſhed the quantity of looſe ſkin, and formed a cicatrix, ſo as to contract over the part, to render it more rigid and capable of reſiſting. He deſcribes various diſeaſes of the genital parts, the hydrocele or dropſy of the ſcrotum, a difficulty of urine, and the manner of drawing off the water by a catheter; the ſigns of ſtone in the bladder, and the method of ſounding or feeling for that ſtone. Lithotomy was at that time performed by introducing two fingers into the anus; the ſtone was then preſſed forward to the perinæum, and a cut made into the bladder; and by the finger or by a ſcoop the ſtone was extracted. He deſcribes the manner of performing this operation on both the ſexes, of treating the patient, and the ſigns of recovery and of danger.

Celſus directed various corroſive applications and injections to fiſtulas; and, in the laſt extremity, opened them to the bottom with a knife, cutting upon a grooved inſtrument or conductor. In old callous ulcers, he made a new wound, by either cutting away the hard edges, or corroding them with verdigriſe, quicklime, alum, nitre, and with ſome vegetable eſcharotics. He mentions the ſymptoms of caries in the bone; directs the bone to be laid bare, and to be pierced with ſeveral holes, or to be burnt or raſped, in order to promote an exfoliation of the corrupted part; afterwards to apply nitre and ſeveral other ingredients. One of his applications to a cancer was auripigmentum or arſenic. He directs the manner of tapping the abdomen in aſcites, and of drawing blood by the lancet and cupping-glaſſes. His cupping-glaſſes ſeem not to have been ſo convenient as the modern: they were made either of braſs or horn, and were unprovided with a pump. He cured varicoſe veins by uſtion or by inciſion. He gives directions for extracting the dead fœtus from the womb, in whatever poſition it ſhould preſent; and, after delivery, to apply to the private parts ſoft cloths wet in an infuſion of vinegar and roſes. In Celſus's works there is a great redundance and ſuperfluity of plaſters, ointments, eſcharotics, collyriums, of ſuppurating and diſcutient cataplaſms, and external applications of every kind, both ſimple and compound: Perhaps, amongſt the multitude, there are a few uſeful remedies now laid aſide and neglected.

The laſt writer of conſequence who flouriſhed at Rome was Galen, phyſician to the emperor Marcus Aurelius. His works are for the moſt part purely medicinal; although he wrote alſo on ſurgery, and made Commentaries on the Surgery of Hippocrates. He opened the jugular veins, and performed arteriotomy at the temples; directed leeches, ſcarification, and cupping-glaſſes, to draw blood. He alſo deſcribed with accuracy the different ſpecies of herniæ or ruptures.

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In the year 500 flouriſhed Aëtius, in whoſe works we meet with many obſervations omitted by Celſus and Galen, particularly on the ſurgical operations, the diſeaſes of women, the cauſe of difficult labours, and modes of delivery. He alſo takes notice of the dracunculus, or Guinea worm. Aëtius, however, is greatly excelled by Paulus Egineta, who flouriſhed in 640; whoſe treatiſe on ſurgery is ſuperior to that of all the other ancients. He directs how to extract darts; to perform the operation ſometimes required in dangerous caſes of rupture or hernia. He treats alſo of aneuriſm. Galen, Paulus, and all the ancients, ſpeak only of one ſpecies of aneuriſm, and define it to be "a tumor ariſing from arterial blood extravaſated from a ruptured artery." The aneuriſm from a dilatation of the artery is a diſcovery of the moderns. In violent inflammations of the throat, where immediate danger of ſuffocation was threatened, Paulus performed the operation of bronchotomy. In obſtinate defluxions upon the eyes, he opened the jugular veins. He deſcribes the manner of opening the arteries behind the ears in chronic pains of the head. He wrote alſo upon midwifery. Fabricius ab Aquapendente, a celebrated ſurgeon of the 16th century, has followed Celſus and Paulus as text-books.

4
Among the Arabians.

From the time of Paulus Egineta to the year 900, no writer of any conſequence, either on medicine or ſurgery, appeared. At this time the Arabian phyſicians Rhazes and Avicenna revived in the eaſt the medical art, which, as well as others, was almoſt entirely extinguiſhed in the weſt. Avicenna's *Canon Medicinæ*, or General Syſtem of Medicine and Surgery, was for many ages celebrated through all the ſchools of phyſic. It was principally compiled from the writings of Galen and Rhazes. The latter had correctly deſcribed the ſpina ventoſa, accompanied with an enlargement of the bone, caries, and acute pain. In difficult labours, he recommends the fillet to aſſiſt in the extraction of the fœtus; and for the ſame purpoſe, Avicenna recommends the forceps. He deſcribes the compoſition of ſeveral coſmetics to poliſh the ſkin, and make the hair grow, or fall off.

Notwithſtanding this, however, it was not till the time of Albucaſis that ſurgery came into repute among the Arabians. Rhazes complains of their groſs ignorance, and that the manual operations were performed by the phyſicians' ſervants. Albucaſis enumerates a tremendous liſt of operations, ſufficient to fill us with horror. The hot iron and cauteries were favourite remedies of the Arabians; and, in inveterate pains, they repoſed, like the Egyptians and eaſtern Aſiatics, great confidence in burning the part. He deſcribes accurately the manner of tapping in aſcites; mentions ſeveral kinds of inſtruments for drawing blood; and has left a more ample and correct delineation of ſurgical inſtruments than any of the ancients. He gives various obſtetrical directions for extracting the fœtus in caſes of difficult labour. He mentions the bronchocele, or prominent tumor on the neck, which he tells us, was moſt frequent among the female ſex. We are alſo informed by this writer, that the delicacy of the Arabian women did not permit male ſurgeons to perform lithotomy on females; but when neceſſary, it was executed by one of their own ſex.

From the 11th century to the middle of the 14th, the hiſtory of ſurgery affords nothing remarkable except the importation of that nauſeous diſeaſe the leproſy into Europe. Towards the end of the 15th century the venereal diſeaſe is ſaid to have been imported from America by the firſt diſcoverers of that continent.

At the beginning of the 16th century, ſurgery was held in contempt in Britain, and was practiſed indiſcriminately by barbers, farriers, and ſow-gelders. Barbers and ſurgeons continued, for 200 years after, to be incorporated in one company both in London and Paris. In Holland and ſome parts of Germany, even at this day, barbers exerciſe the razor and lancet alternately.

It is within the laſt three centuries that we have any conſiderable improvement in ſurgery; nor do we know of any eminent Britiſh ſurgical writers until within the laſt 130 years. "In Germany (ſays Heiſter) all the different ſurgical operations, at the beginning even of the 18th century, were left to empirics; while regular practitioners were contented to cure a wound, open a vein or an abſceſs, return a fractured of luxated bone; but they ſeldom or never ventured to perform any of the difficult operations." He alſo ſpeaks of their groſs ignorance of the Latin language.

5 Writers on ſurgery in the 16th century.

The firſt ſurgical work of the 16th century worthy of notice is that of J. Carpus. F. ab Aquapendente, an Italian, publiſhed a Syſtem of Surgery, containing a deſcription of the various diſeaſes, accidents, and operations. Boerhaave pays this author the following compliment: *Ille ſuperavit omnes et nemo illi hanc diſputat gloriam; omnibus potius quam hocce carere poſſumus.* About the ſame period, A. Parey, a Frenchman, made ſeveral important additions to ſurgery, particularly in his collection of caſes of wounds, fractures, and other accidents which occur during war. The ancients, who were ignorant of powder and fire-arms, are defective in this part of military ſurgery. Parey pretends to have firſt invented the method of tying with a needle and ſtrong ſilk-thread waxed the extremities of large arteries, after the amputation of a member. The ligature of the blood-veſſels is, however, merely a revival of the ancient practice, which had fallen into diſuſe: Throughout the dark ages, the hot iron, cauteries, and ſtrong aſtringents, were ſubſtituted in its place. B. Maggius and. L. Botallus wrote on the cure of gunſhot wounds. J. A. Cruce wrote a ſyſtem of ſurgery.

6 In the 17th century.

In the 17th century, ſurgery was enriched with ſeveral ſyſtems, and with detached or miſcellaneous obſervations. The principal authors are, M. A. Severinus, V. Vidius, R. Wiſeman, Le Clerc, J. Scultetus, J. Mangetus, C. Magatus, Spigellius, F. Hildanus, T. Bartholin, P. de Marchett.

Since the commencement of the preſent century, ſurgery has been enriched with many valuable and important improvements, of the greateſt part of which we have availed ourſelves in the courſe of the following treatiſe. But as it would far exceed the limits of a work of this nature to enumerate the names and writings of ſuch authors as have lived within the above period, and beſides, as it appears very unimportant to do ſo, we ſhall at once proceed to the next part of our ſubject.

CHAP. II. *Of Wounds.*

SECT. I. *Of Simple Wounds.*

THE firſt thing to be conſidered in the inſpection of a wound is, whether it is likely to prove mortal or not. This knowledge can only be had from anatomy, by which the ſurgeon will be able to determine what parts are injured; and, from the offices which theſe parts are calculated to perform, whether the human frame can ſubſiſt under ſuch injuries. It is not, however, eaſy for the moſt expert anatomiſt always to prognoſticate the event with certainty; but this rule he ought always to lay down to himſelf, to draw the moſt favourable prognoſis the caſe will bear, or even more than the rules of his art will allow. This is particularly incumbent on him in ſea-engagements, where the ſentence of death is executed as ſoon as pronounced, and the miſerable patient is thrown alive into the ſea, upon the ſurgeon's declaring his wound to be mortal. There are beſides, many inſtances on record, where wounds have healed, which the moſt ſkilful ſurgeons have deemed mortal. The following wounds may be reckoned mortal.

7 Wounds which are neceſſarily mortal.

1. Thoſe which penetrate the cavities of the heart, and all thoſe wounds of the viſcera where the large blood-veſſels are opened; becauſe their ſituation will not admit of proper applications to reſtrain the flux of blood.
2. Thoſe which obſtruct or entirely cut off the paſſage of the nervous influence through the body. Such are wounds of the brain, cerebellum, medulla oblongata, and ſpinal marrow; though the brain is ſometimes injured, and yet the patient recovers. Wounds likewiſe of the ſmall blood-veſſels within the brain are attended with great danger, from the effuſed fluids preſſing upon the brain. Nor is there leſs danger where the nerves which tend to the heart are wounded, or entirely divided; for, after this, it is impoſſible for the heart to continue its motion.
3. All wounds which entirely deprive the animal of the faculty of breathing.
4. Thoſe wounds which interrupt the courſe of the chyle to the heart; ſuch are wounds of the receptacle of the chyle, thoracic duct, and larger lacteals, &c.
5. There are other wounds which prove fatal if neglected and left to nature: ſuch are wounds of the larger external blood-veſſels, which might be remedied by ligature.

8 Symptoms of wounds in different parts of the body.

In examining wounds, the next conſideration is, whether the parts injured are ſuch as may be ſuppoſed to induce dangerous ſymptoms, either immediately or in ſome time during the courſe of the cure. In order to proceed with any degree of certainty, it is neceſſary to be well acquainted with theſe ſymptoms which attend injuries of the different parts of the body. If the ſkin only and part of the cellular ſubſtance is divided, the firſt conſequence is an effuſion of blood; the lips of the wound retract, become tumefied, red, and inflamed, leaving a gap of conſiderable wideneſs according to the length and deepneſs of the wound.

9 Of wounds of the ſkin and cellular ſubſtance.

Beſides, if a very conſiderable portion of ſkin and cellular ſubſtance is divided, a ſlight fever ſeizes the patient; the effuſion of blood in the mean time ſtops, and the wound is partly filled up with a cake of coagulated blood. Below this cake, the ſmall veſſels pour forth a clear liquor, which in a ſhort time is converted into pus (ſee the articles PUS and MUCUS). Below this pus granulations of new fleſh ariſe, the cake of coagulated blood looſens, a new ſkin covers the place where the wound was, and the whole is healed up; only there remains a mark, called a *cicatrix* or *ſcar*, ſhowing where the injury had been received.

10 Of the muſcles.

All wounds are accompanied with a conſiderable degree of pain, eſpecially when the inflammation comes on, though the diviſion reaches no farther than the ſkin and cellular ſubſtance. If the muſcular fibres are divided, the pain is much greater, becauſe the ſound part of the muſcle is ſtretched by the contraction of the divided part and the action of the antagoniſt muſcle, which it is now leſs fitted to bear. The wound alſo gaps much more than where the cellular ſubſtance only is divided, inſomuch that, if left to itſelf, the ſkin will cover the muſcular fibres, without any intervention of cellular ſubſtance; and not only a very unſightly cicatrix remains, but the uſe of the muſcle is in ſome meaſure loſt.—If the muſcle happens to be totally divided, its parts retract to a very conſiderable diſtance; and unleſs proper methods be taken, the uſe of it is certainly loſt ever afterwards.

11 Of the arteries.

If by a wound any conſiderable artery happens to be divided, the blood flows out with great velocity, and by ſtarts; the patient ſoon becomes faint with loſs of blood; nor does the hæmorrhagy ſtop until he faints away altogether, when the ends of the divided veſſel cloſe by their natural contractility; and if as much *vis vitæ* ſtill remains as is ſufficient to renew the operations of life, he recovers after ſome time, and the wound heals up as uſual. The part of the artery which is below the wound in the mean time becomes uſeleſs, and its ſides collapſe, ſo that all the inferior part of the limb would be deprived of blood, were it not that the ſmall branches ſent off from the artery above the wounded place become enlarged, and capable of carrying on the circulation. Nature alſo, after a wonderful manner, often produces new veſſels from the ſuperior extremity of the divided artery, by which the circulation is carried on as formerly. However, the conſequences of ſuch a profuſe hæmorrhagy may be very dangerous to the patient, by inducing extreme debility, polypous concretions in the heart and large veſſels, or an univerſal dropſy. This happens eſpecially where the artery is partially divided; becauſe then the veſſel cannot contract in ſuch a manner as to cloſe the orifice: however, if the wound is but ſmall, the blood gets into the cellular ſubſtance, ſwelling up the member to an extreme degree, forming what is called a *diffuſed aneuriſm*. Thus the hæmorrhagy ſoon ſtops externally, but great miſchief is apt to flow from the confinement of the extravaſated blood, which is found to have the power of diſſolving not only the fleſhy parts, but alſo the bones themſelves; and thus not only the uſe of the limb is entirely loſt, but the patient is brought into great danger of his life, if proper aſſiſtance be not obtained in a ſhort time.

12 Of the ligaments, nerves, and tendons.

Wounds of the ligaments, nerves, and tendons, are likewiſe attended with bad conſequences. When a nerve is entirely divided, the pain is but trifling, though the conſequences are often dangerous. If the nerve is large, all the parts to which it is diſtributed below the wound immediately loſe the power of motion and ſenſation; nor is it uncommon, in ſuch caſes, for them to be ſeized with a gangrene. This, however, takes place only when all or the greateſt part of the nerves belonging to a particular part are divided. If the ſpinal marrow, for inſtance, be divided near the head, the parts below ſoon loſe their action irrecoverably; or if the bundle of nerves paſſing out of the axilla be divided or tied, ſenſation in the greateſt part of the arm below will probably be loſt. But though a nerve ſhould be divided, and a temporary palſy be produced, it may again reunite, and perform its former functions. If a nerve be wounded only, inſtead of being divided, the worſt ſymptoms frequently enſue.

13 Of the thorax, and the viſcera which it contains.

Wounds which penetrate the cavities of the thorax are always exceedingly dangerous, becauſe there is ſcarce a poſſibility of all the viſcera eſcaping unhurt. A wound is known to have penetrated the cavity of the thorax principally by the diſcharge of air from it at each inſpiration of the patient, by an extreme difficulty of breathing, coughing up blood, &c. Such wounds, however, are not always mortal; the lungs have frequently been wounded, and yet the patient has recovered.—Wounds of the diaphragm are almoſt always mortal, either by inducing fatal convulſions immediately, or by the aſcent of the ſtomach, which the preſſure of the abdominal muſcles forces up through the wound into the cavity of the thorax; of this Van Swieten gives ſeveral inſtances.—Even though the wound does not penetrate into the cavity of the thorax, the very worſt ſymptoms may follow. For if the wound deſcends deeply among the muſcles, and its orifice lies higher, the extravaſated humours will be therein collected, ſtagnate, and corrupt in ſuch a manner as to form various ſinuſes; and after having eroded the pleura, it may at length paſs into the cavity of the thorax. The matter having once found a vent into this cavity, will be continually augmenting from the diſcharge of the ſinuous ulcer, and the lungs will at laſt ſuffer by the ſurrounding matter. If, in caſes of wounds in the thorax, the ribs or ſternum happen to become carious, the cure will be extremely tedious and difficult. Galen relates the caſe of a lad who received a blow upon his ſternum in the field of exerciſe: it was firſt neglected, and afterwards badly healed; but, four months afterwards, matter appeared in the part which had received the blow. A phyſician made an inciſion into the part, and it was ſoon after cicatrized: but in a ſhort time a new collection of matter made its appearance, and upon a ſecond inciſion the wound refuſed to heal. Galen found the ſternum carious; and having cut off the diſeaſed part, the pericardium itſelf was obſerved to be corroded, ſo that the heart could be ſeen quite naked; notwithſtanding which, the wound was cured in no very long time.

There is ſometimes difficulty in determining whether the wound has really penetrated into the thorax or the abdomen; for the former deſcends much farther towards the ſides than at the middle. But as the lungs are almoſt always wounded when the cavity of the thorax is penetrated, the ſymptoms ariſing from thence can ſcarcely be miſtaken. —Another ſymptom which frequently, though not always, attends wounds of the thorax, is an emphyſema. This is occaſioned by the air eſcaping from the wounded lungs, and inſinuating itſelf into the cellular ſubſtance; which being pervious to it over the whole body, the tumour paſſes from one part to another, till at laſt every part is inflated to a ſurpriſing degree. An inſtance is given in the Memoirs of the Royal Academy, of a tumour of this kind, which on the thorax was eleven inches thick, on the abdomen nine, on the neck ſix, and on the reſt of the body four; the eyes were in a great meaſure thruſt out of their orbits by the inflation of the cellular ſubſtance; and the patient died the fifth day. This was occaſioned by a ſtab with a ſword.

14 Of the abdomen and its viſcera.

Wounds of the abdomen are not leſs dangerous than thoſe of the thorax, on account of the importance of the viſcera which are lodged there. When the wound does not penetrate the cavity, there is ſome danger of an hernia being formed by the protruſion of the peritonæum through the weakened integuments, and the danger is greater the larger the wound is. Thoſe wounds which run obliquely betwixt the interſtices of the muſcles often produce ſinuous ulcers of a bad kind. For as there is always a large quantity of fat interpoſed everywhere betwixt the muſcles of the abdomen, if a wound happens to run between them, the extravaſated humours, or matter there collected, not meeting with free egreſs through the mouth of the wound, often makes its way in a ſurpriſing manner through the cellular ſubſtance, and forms deep ſinuoſities between the muſcles; in which caſe the cure is always difficult, and ſometimes impoſſible.

If a large wound penetrates the cavity of the abdomen, ſome of the viſcera will certainly be protruded through it; or if the wound is but ſmall, and cloſed up with fat ſo that none of the inteſtines can be protruded, we may know that the cavity of the abdomen is pierced, and probably ſome of the viſcera wounded, by the acute pain and fever, paleneſs, anxiety, faintings, hiccough, cold ſweats, and weakened pulſe, all of which accompany injuries of the internal parts. The miſchiefs which attend wounds of this kind proceed not only from the injury done to the viſcera themſelves, but from the extravaſation of blood and the diſcharge of the contents of the inteſtines into the cavity of the abdomen; which, being of a very putreſcent nature, ſoon bring on the moſt violent diſorders. Hence wounds of the abdominal viſcera are very often mortal. This, however, is not always the caſe, for the ſmall inteſtines have been totally divided, and yet the patient has recovered. Wounds both of the ſmall and large inteſtines have healed ſpontaneouſly, even when they were of ſuch magnitude that the contents of the inteſtine was freely diſcharged through the wound in it, and after-part of the inteſtine itſelf has been protruded through the wound of the integuments.

When the meſentery is injured, the danger is extreme, on account of the numerous veſſels and nerves ſituated there. Wounds of the liver, ſpleen, and pancreas, are alſo exceedingly dangerous, although there are ſome inſtances of the ſpleen being cut out of living animals without any conſiderable injury.

From the preceding account of the ſymptoms attending wounds in the different parts of the body, the ſurgeon may be enabled to judge in ſome meaſure of the event; though it muſt always be remembered, that wounds, even thoſe which ſeemed to be of the ſlighteſt nature, have, contrary to all expectation, proved mortal, chiefly by inducing convulſions, or a locked jaw; ſo that no certain prognoſtic can be drawn on ſight of recent wounds. We ſhall now, however, proceed to conſider their treatment.

15
Treatment of wounds.

For the cure of wounds, it has been already obſerved, that the ancients imagined balſams, the juice of herbs, &c. to be a kind of ſpecifics. In after-ages, and in countries where balſams are not eaſily to be procured, ſalves have been ſubſtituted in their place; and even at this day there are many who reckon a ſalve or ointment eſſentially neceſſary for healing the ſlighteſt cut. It is certain, however, that the cure of wounds cannot be effected, nay, not even forwarded in the leaſt, by ointments, unleſs in particular caſes or by accident. That power which the human frame has of repairing the injuries done to itſelf, which by phyſicians is called *vis medicatrix naturæ*, is the ſole agent in curing external injuries; and without this the moſt celebrated balſams would prove ineffectual. When a wound has been made with a ſharp inſtrument, and is not extenſive, if it be immediately cleaned, and all the extravaſated blood ſucked (A) out, it will almoſt always heal by the firſt intention in a very ſhort time. Indeed the cures performed by this ſimple proceſs are ſo ſurpriſing, that they would be incredible were we not aſſured of their reality by eye-witneſſes. When this proceſs is either neglected or proves unſucceſsful, there are three ſtages to be obſerved in the cure of a wound: the firſt, called *digeſtion*, takes place when the ends of the wounded veſſels contract themſelves, and pour out the liquor which is converted into pus. As ſoon as this appears, the ſecond ſtage, in which the fleſh begins to *grow up*, takes place; and as this proceeds, the edges of the wound acquire a fine bluiſh or pearl colour, which is that of the new ſkin beginning to cover the wound as far as the fleſh has filled it up. This proceſs continues, and the ſkin advances from all ſides towards the centre, which is called the *cicatrizing* of the wound. For the promoting of each of theſe proceſſes, ſeveral ointments were formerly much in vogue. But it is now found, that no ointment whatever is capable of promoting them; and that it is only neceſſary to keep the wound clean, and to prevent the air from having acceſs to it. This, indeed, nature takes care to do, by covering the wound with a cake of coagulated blood; but if a wound of any conſiderable magnitude ſhould be left entirely to nature, the pus would form below the cruſt of coagulated blood in ſuch quantity, that it would moſt probably corrupt, and the wound degenerate into a corroding ulcer. It is neceſſary, therefore, to cleanſe the wound frequently; and for this purpoſe it will be proper to apply a little ointment ſpread on ſoft ſcraped lint. For the firſt dreſſing, dry lint is uſually applied, and ought to be allowed to remain for two or three days, till the pus is perfectly formed; after which the ointment may be applied as juſt now directed; and, in a healthy body, the wound will heal without further trouble. As to the ointment employed, it is almoſt indifferent what it be, provided it has no acrid or ſtimulating ingredient in its compoſition.

But though, in general, wounds thus eaſily admit of a cure, there are ſeveral circumſtances which require a different treatment, even in ſimple diviſions of the fleſhy parts, when neither the membranous nor tendinous parts are injured. Theſe are, 1. Where the wound is large, and gapes very much, ſo that, if allowed to heal in the natural way, the patient might be greatly disfigured by the ſcar. It is proper to bring the lips of the wound near to each other, and to join them either by adheſive plaſter or by ſuture, as the wound is more ſuperficial, or lies deeper. 2. When foreign bodies are lodged in the wound, as when a cut is given by glaſs, &c. it is neceſſary by all means to extract them, before the wound is dreſſed; for it will never heal until they are diſcharged. When theſe bodies are ſituated in ſuch a manner as not to be capable of being extracted without lacerating the adjacent parts, which would occaſion violent pain and other bad ſymptoms, it is neceſſary to enlarge the wound, ſo that theſe offending bodies may by eaſily removed. This treatment, however, is chiefly neceſſary in gunſhot wounds, of which we ſhall treat in the next ſection. 3. When the wound is made in ſuch a manner that it runs for ſome length below the ſkin, and the bottom is much lower than the orifice, the matter collected from all parts of the wound will be lodged in the bottom of it, where, corrupting by the heat, it will degenerate into a fiſtulous ulcer. To prevent this, we muſt uſe compreſſes, applied ſo that the bottom of the wound may ſuffer a more conſiderable preſſure than the upper part of it. Thus the matter formed at the bottom will be gradually forced upwards, and that formed at the upper part will be incapable of deſcending by its weight; the divided parts, in the mean time, eaſily uniting when brought cloſe together. Indeed, the power which nature has of uniting different parts of the human body is very ſurpriſing; for, according to authors of credit, even if a piece of fleſh be totally cut out, and applied in a ſhort time afterwards to the place from whence it was cut, the two will unite. That a part cut out of a living body does not entirely loſe its vital power for ſome time, is evident from the modern practice of tranſplanting teeth; and from an experiment of Mr Hunter's at London, he put the teſticle of a cock into the belly of a living hen, which adhered to the liver, and became connected to it by means of blood-veſſels*. We have therefore the greateſt reaſon to hope, that the divided parts of the human body, when cloſely applied to each other, will cohere without leaving any ſinus or cavity between them. However, if this method ſhould fail, and matter ſtill be collected in the depending part of the wound, it will be neceſſary to make an opening in that part in order to let it out; after which the wound may be cured in the common way. 4. During the courſe of the cure, it ſometimes happens that the wound, inſtead of filling up with fleſhy granulations of a florid colour, ſhoots up into a glaſſy-like ſubſtance which riſes above the level of the ſurrounding ſkin, while,

* See Blood, nº 19.

at

(A) See an account of the method of ſucking wounds in Mr John Bell's *Diſcourſes on Wounds*, Part I. Diſcourſe v. p. 215.

at the ſame time, inſtead of laudable pus, a thin ill-coloured and fetid ichor is diſcharged. In this caſe the lips of the wound loſe their beautiful pearl colour, and become callous and white, nor does the cicatrizing of the wound at all advance. When this happens in a healthy patient, it generally proceeds from ſome improper management, eſpecially the making uſe of too many emollient and relaxing medicines, an immoderate uſe of balſams and ointments. Frequently nothing more is requiſite for taking down this fungus than dreſſing with dry lint; at other times deſiccative powders, ſuch as calamine, tutty, calcined alum, &c. will be neceſſary; and ſometimes red precipitate mercury muſt be uſed. This laſt, however, is apt to give great pain, if ſprinkled in its dry ſtate upon the wound; it is therefore moſt proper to grind it with ſome yellow baſilicon ointment, which makes a much more gentle, though at the ſame time an efficacious eſcharotic. Touching the evergrown parts with blue vitriol is alſo found very effectual.

16 Of the regimen of patients in wounds.

Hitherto we have conſidered the wounded patient as otherwiſe in the ſtate of perfect health; but it muſt be obſerved, that a large wound is capable of diſordering the ſyſtem to a great degree, and inducing dangerous diſeaſes which did not before exiſt.—If the patient is ſtrong and vigorous, and the pain and inflammation of the wound great, a conſiderable degree of fever may ariſe, which it will be neceſſary to check by bleeding, low diet, and other parts of the antiphlogiſtic regimen, at the ſame that the inflamed lips of the wound and parts adjacent are to be treated with emollient fomentations or cataplaſms till the pain and ſwelling abate. On the other hand, it may happen, when the patient is of a weak and lax habit, that the vis vitæ may not be ſufficient to excite ſuch an inflammation in the wound as is abſolutely neceſſary for its cure. In this caſe, the edges of the wound look pale and ſoft; the wound itſelf ichorous and bloody, without any ſigns of fleſhy granulations; or if any new fleſh ſhoots up, it is of the fungous glaſſy kind abovementioned. To ſuch wounds all external applications are vain; it is neceſſary to ſtrengthen the patient by proper internal remedies, among which the bark has a principal place, until the wound begins to alter its appearance. In ſuch perſons, too, there is ſome danger of a hectic fever by the abſorption of matter into the body when the wound is large; and this will take place during the courſe of the cure, even when the appearances have been at firſt as favourable as could be wiſhed. This happens generally when the wound is large, and a great quantity of matter formed; for by this diſcharge the patient is weakened; ſo that the pus is no ſooner formed, than it is by the abſorbent veſſels re-conveyed into the body, and feveriſh heats immediately affect the patient. For this the beſt remedy is to exhibit the bark copiouſly, at the ſame time ſupporting the patient by proper cordials and nouriſhing diet. Indeed, in general, it will be found, that, in the caſe of wounds of any conſiderable magnitude, a more full and nouriſhing regimen is required than the patient, even in health, has been accuſtomed to; for the diſcharge of pus alone, where the quantity is conſiderable, proves very debilitating, if the patient is not ſtrengthened by proper diet. And it is conſtantly found, that the cure of ſuch ſores goes on much more eaſily when the patient is kept in his uſual habit of body, than when his ſyſtem is much emaciated by a very low allowance; and, for the ſame reaſon, purgatives, and whatever elſe tends to weaken the conſtitution, are improper in the cure of wounds.

17 Of hemorrhagies from wounds.

Hæmorrhagies very frequently happen in wounds, either from a diviſion of one large artery, or of a number of ſmall ones. In this caſe, the firſt ſtep to be taken by the ſurgeon is to effect a temporary ſtoppage of the blood by means of compreſſion. He is then to tie up all the veſſels in the manner to be afterwards deſcribed.

When the principal arteries of a wound have been tied, and a little blood continues to be diſcharged, but appears to come from ſundry ſmall veſſels only, an experienced ſurgeon is induced to think, that the neceſſary compreſſion of the bandages will in all probability effect a total ſtoppage of the hæmorrhagy. In a general oozing of a ſmall quantity of blood from the whole ſurface of a ſore, and when no particular veſſel can be diſtinguiſhed, there is a neceſſity for truſting to this remedy; but whenever an artery can be diſcovered, of whatever ſize it may be, it ought unqueſtionably to be ſecured by a ligature. But it frequently happens, that conſiderable quantities of blood are diſcharged, not from any particular veſſel, but from all the ſmall arteries over the ſurface on the ſore. In wounds of great extent, particularly after the extirpation of cancerous breaſts, and in other operations where extenſive ſores are left, this ſpecies of hæmorrhagy often proves very troubleſome by being exceedingly difficult to ſuppreſs.

Bleedings of this kind ſeem evidently to proceed from two very different and oppoſite cauſes. *Firſt*, Either from too great a quantity of blood contained in the veſſels, or from an over degree of tone in the veſſels themſelves; or, perhaps, from a combination of both theſe cauſes. But, *ſecondly*, Such evacuations undoubtedly happen moſt frequently in ſuch conſtitutions as are very relaxed and debilitated; either from a particular ſtate of the blood, or from a want of tone in the containing veſſels, or, in ſome inſtances, from a concurrence of both.

In conſtitutions perfectly healthy, on the occurrence of wounds even of the moſt extenſive nature, as ſoon as the larger arteries are ſecured, all the ſmall veſſels which have been divided are diminiſhed, not only in their diameters, but alſo in their length; in conſequence of which, they recede conſiderably within the ſurface of the ſurrounding parts. This cauſe of itſelf would probably, in the greateſt number of inſtances, prove ſufficient for reſtraining all loſs of blood from the ſmaller arteries. Another very powerful agent however is provided by nature for producing the ſame effect. From the extremities of the divided veſſels which at firſt diſcharged red blood only, there now, in their contracted ſtate, oozes out a more thin, though viſcid fluid, containing a great proportion of the coagulable parts of the blood; and this being equally diſtributed over the ſurface of the wound, by its balſamic agglutinating powers has a very conſiderable influence in reſtraining all ſuch hæmorrhagies.

When a tedious oozing occurs in a patient young and vigorous, and where the tone of the muſcular fibres is evidently great, the moſt effectual means of putting a ſtop to the diſcharge is to relax the vaſcular ſyſtem, either by opening a vein in ſome other part, or, what gives ſtill more immediate relief, by untying the ligature on one of the principal arteries of the part, ſo as to allow it to bleed freely: thoſe violent ſpaſmodic twitchings too, ſo frequent after operations on any of the extremities, when they do not depend on a nerve being included in the ligature with the artery, are in this manner more effectually relieved than by any other means.

By the ſame means the patient, from being in a febrile heat and much confuſed, ſoon becomes very tranquil: the violent pulſation of the heart and larger arteries abates, and the blood not being propelled with ſuch impetuoſity into the ſmaller veſſels of the part, they are thereby left at more liberty to retract. In the mean time the patient ought to be kept exceedingly cool; wine and other cordials ſhould be rigidly avoided; cold water, acidulated either with the mineral

ral or vegetable acids, ought to be the only drink; motion of every kind, particularly of the part affected, ſhould be guarded againſt; and the wound being gently covered with ſoft charpie, ought to be tied up with a bandage ſo applied as to produce a moderate degree of preſſure on the extremities of the divided parts.

As ſoon as a ſufficient quantity of blood has been diſcharged, the wound being dreſſed, and the patient laid to reſt, a doſe of opium proportioned to the violence of the ſymptoms ought to be immediately exhibited. It ought to be remarked, however, that in all ſuch circumſtances, much larger doſes of the remedy are neceſſary than in ordinary caſes requiring the uſe of opiates. Small doſes, inſtead of anſwering any good purpoſe, ſeem frequently rather to aggravate the various ſymptoms; ſo that whenever they are here had recourſe to, they ought always to be given in quantities ſufficient for the intended effect.

But hæmorrhagies of this nature happen much more frequently in relaxed enfeebled habits, where the ſolids have loſt part of their natural firmneſs, and the fluids have acquired a morbid tenuity. In this caſe a moderate uſe of generous wine ought to be immediately preſcribed; for nothing tends ſo much, in ſuch circumſtances, to reſtrain hæmorrhagies, as a well-directed uſe of proper cordials. By tending to invigorate and brace the ſolids, they enable the arterial ſyſtem to give a due reſiſtance to the contained fluids; and have alſo a conſiderable influence in reſtoring to the fluids that viſcidity of texture, of which in all ſuch inſtances we ſuppoſe them to be deprived.

A nouriſhing diet alſo becomes proper; the patient ought to be kept cool; and the mineral acids, from their known utility in every ſpecies of hæmorrhagy, ought alſo to be preſcribed. Reſt of body is here alſo proper; and opiates, when indicated either by pain or ſpaſmodic affections of the muſcles, ought never to be omitted.

Together with theſe remedies adapted to the general ſyſtem, particular dreſſings, appropriated to the ſtate of the parts to which they are to be applied, have been found very beneficial. In healthy conſtitutions, ſoon after the diſcharge of blood is over, the parts are covered with a viſcid coagulable effuſion from the mouths of the now-retracted arteries; but in conſtitutions of an oppoſite nature, where the ſolids are much relaxed, the blood in general is found in ſuch an attenuated ſtate as to afford no ſecretion of this nature.

To ſupply as much as poſſible the deficiency of this natural balſam, different artificial applications have been invented. Duſting the part with ſtarch or wheat-flour has ſometimes been found of uſe, and gum arabic in fine powder has been known to anſwer when theſe failed.

Applications of this kind, indeed, have been uſed with ſucceſs in all ſuch hæmorrhagies, with whatever habit of body they happen to be connected; but they have always proved more particularly ſerviceable in relaxed conſtitutions, attended with an attenuated ſtate of the blood and an enfeebled muſcular ſyſtem. Alcohol, or any other ardent ſpirits, impregnated with as great a quantity as they can diſſolve of myrrh, or any other of the heating viſcid gums, may be here uſed with freedom, though in conſtitutions of an oppoſite nature they ought never to be employed. The balſamum traumaticum of the ſhops, a remedy of this nature, has long been famous for its influence in ſuch caſes: but that indiſcriminate uſe of this and ſimilar applications which has long prevailed with ſome practitioners, has undoubtedly done much harm; for as they are all poſſeſſed of very ſtimulating powers, they of courſe tend to aggravate every ſymptom in wounds connected with a tenſe ſtate of fibres, when much pain, and eſpecially when ſpaſmodic muſcular affections prevail.

By a due perſeverance in one or other of the plans here pointed out, it will ſeldom happen that hæmorrhagies of this nature are not at laſt put a ſtop to: but when the contrary does occur, when, notwithſtanding the uſe of the remedies recommended, a diſcharge of blood ſtill continues; together with the means already adviſed, an equal moderate preſſure ought to be applied over the whole ſurface of the ſore, to be continued as long as the neceſſity of the caſe ſeems to indicate.

In finiſhing the dreſſings of ſuch wounds, after the charpie and compreſſes have been applied, a bandage properly adapted to the part ought to conclude the whole, and in ſuch a manner as to produce as equal a degree of preſſure over the ſurface of the ſore as poſſible. But it now and then happens that no bandage whatever can be ſo applied as to produce the deſired effect; and in ſuch caſes the hand of an aſſiſtant is the only reſource; which being firmly applied over the dreſſings, ſo as to produce a very equal degree of preſſure, will commonly ſucceed when no other remedy is found to have much influence.

18
Symptoms which ſometimes ſucceed blood-letting.

Wounds of the nerves, tendons, and ligaments, are attended with much more violent ſymptoms than thoſe where even conſiderable arteries are divided, and frequently reſiſt every method of cure propoſed by the moſt ſkilful practitioners. In the ſimple proceſs of blood-letting, it frequently happens that the tendinous expanſion called the *aponeuroſis* of the biceps muſcle is wounded, or even the tendon of that muſcle itſelf is punctured, by the point of the lancet; or ſometimes a nerve which happens to lie in the neighbourhood is partially divided. Any one of theſe wounds, though they are the ſmalleſt we can well ſuppoſe to be given, are frequently very dangerous and difficult of cure. It ſometimes immediately happens on the introduction of the lancet, that the patient complains of a moſt exquiſite degree of pain; and when this occurs, we may reſt aſſured that either a nerve or tendon has been wounded. On ſome occaſions, by proper management, ſuch as evacuating a conſiderable quantity of blood at the orifice newly made, by keeping the part at perfect reſt, and preſerving the patient in as cool a ſtate as poſſible, the pain at firſt complained of will gradually abate, and at laſt go off entirely, without any bad conſequence whatever. At other times, however, this pain which occurs inſtantaneouſly on the introduction of the lancet, inſtead of abating, begins ſoon to increaſe; a fullneſs, or ſmall degree of ſwelling, takes place in the parts contiguous to the wound; the lips of the ſore become ſomewhat hard and inflamed; and, in the courſe of 24 hours or ſo from the operation, a thin watery ſerum begins to be diſcharged at the orifice.

If, by the means employed, relief is not ſoon obtained, theſe ſymptoms generally continue in nearly the ſame ſtate for two or perhaps three days longer. At this time the violent pain which at firſt took place becomes ſtill more diſtreſſing; but inſtead of being ſharp and acute as before, it is now attended with the ſenſation of a burning heat, which ſtill goes on to increaſe, and proves, during the whole courſe of the ailment, a ſource of conſtant diſtreſs to the patient. The fullneſs and hardneſs in the lips of the wound begin to increaſe, and the ſwelling in the neighbouring parts gradually extends over the whole members. The parts at laſt become exceedingly tenſe and hard; an eryſipelatous inflammatory colour frequently appears over the whole member; the pulſe by this time has generally become very hard and quick; the pain is now intenſe, the patient exceedingly reſtleſs; twitchings of the tendons oc-

Simple Wounds.

cur to a greater or leſſer degree; on ſome occaſions, a locked jaw and other convulſive affections ſupervene; and all theſe ſymptoms continuing to increaſe, it moſt frequently happens that the torture under which the patient has been groaning is at laſt terminated by death.

19 Opinions about the cauſes of theſe ſymptoms.

Different opinions have prevailed reſpecting the cauſe of theſe ſymptoms. By ſome they have been imputed to wounds of the tendons. By others the tendons are ſuppoſed to be ſo entirely deſtitute of ſenſibility, as to be quite incapable of producing ſo much diſtreſs; ſo that wounds of the nerves they conſider, on all ſuch occaſions, as the true cauſe of the various ſymptoms we have mentioned.

20 Mr John Hunter's opinion.

One or other of theſe ideas continued to be the only ſource for explaining the various phenomena found to occur in this malady, till a different opinion was ſuggeſted by the late ingenious Mr John Hunter of London. Mr Hunter ſuppoſes, that all the dreadful ſymptoms found now and then to be induced by the operation of blood-letting, may be more readily accounted for from an inflamed ſtate of the internal ſurface of the vein, than from any other cauſe. Such a ſtate of the vein he has often traced in horſes that have died of ſuch ſymptoms from veneſection, and the ſame appearances have ſometimes occurred alſo in the human body. And on other occaſions, inflammation having in this manner been once excited, has been known to terminate in ſuppuration; and the matter thus produced being in the courſe of circulation carried to the heart, Mr Hunter ſuppoſes that in ſuch caſes death may have been induced by that cauſe alone.

There can be no reaſon to doubt the fact held forth by Mr Hunter, that in ſuch inſtances the vein in which the orifice has been made has frequently after death been found greatly inflamed: but however ingenious his arguments may be for concluding that the ſtate of the vein is the original cauſe of all the bad ſymptoms enumerated, and although we muſt allow that ſuch an inflammatory affection of a vein muſt have a conſiderable influence in aggravating the various ſymptoms previouſly induced by other cauſes; yet we may very fairly conclude, that it could not probably in any one inſtance be able to account with ſatisfaction for their firſt production.

21 Not juſt.

In many inſtances the patient, at the very inſtant of the operation, feels a very unuſual degree of pain. In ſome caſes, the violence of the pain is almoſt unſupportable. Now this we can never ſuppoſe to have been produced by the mere puncture of a vein; for although the coats of veins are not perhaps entirely deſtitute of feeling, yet we know well that they are not endowed with ſuch a degree of ſenſibility as to render it probable ſuch intenſe pain could ever be induced by their being punctured in any way whatever. This inflamed ſtate of the veins therefore, as detected by Mr Hunter after death, muſt be conſidered rather as being produced by, than as being productive of, ſuch affections; and that ſuch ailments ſhould frequently produce an inflammation of the contiguous veins, is a very probable conjecture. In the courſe of 48 hours or ſo from the operation, when the febrile ſymptoms are juſt commencing, ſuch a degree of hardneſs and evident inflammation is induced over all the parts contiguous to the orifice, that it would be ſurpriſing indeed if the vein, which is thus perhaps entirely ſurrounded with parts highly inflamed, ſhould eſcape altogether.

22 Really owing to the partial wounding of a nerve or tendon.

We ſhall therefore proceed upon the ſuppoſition of this inflamed ſtate of the veins being a conſequence rather than the cauſe of ſuch ailments; and of courſe we now revert to one or other of the opinions long ago adopted on this ſubject, that all the train of bad ſymptoms found on ſome occaſions to ſucceed veneſection, proceeds either from the wound of a nerve or of a tendon.

That a partial wound of a nerve will now and then produce very diſtreſſing ſymptoms, no practitioner will deny: but it has been attempted to be ſhown, that tendons are almoſt totally deſtitute of ſenſibility; and it has therefore been ſuppoſed, that their being wounded can never account for the various ſymptoms known to occur in ſuch caſes. There is great reaſon however to think, that in different inſtances the ſame train of ſymptoms have been induced by different cauſes; that in one inſtance a wounded nerve, and in others pricks of the tendons, have given riſe to them, as we have already ſuppoſed.

23 Method of obviating theſe ſymptoms, and curing the wound.

In order to prevent as much as poſſible the conſequent inflammation and other ſymptoms which uſually enſue, a conſiderable quantity of blood ſhould be immediately diſcharged at the orifice juſt made: the limb, for ſeveral days at leaſt, ought to be kept in a ſtate of perfect reſt, care being at the ſame time taken to keep the muſcles of the part in as relaxed a ſtate as poſſible: the patient ſhould be kept cool; on a low diet; and, if neceſſary, gentle laxatives ought to be adminiſtered.

When, notwithſtanding theſe means, the ſymptoms, inſtead of diminiſhing, rather become more violent; if the lips of the orifice turn hard and more inflamed, if the pain becomes more conſiderable, and eſpecially if the ſwelling begins to ſpread, other remedies come then to be indicated. In this ſtate of the complaint, topical blood-letting, by means of leeches applied as near as poſſible to the lips of the wound, frequently affords much relief; and when the pulſe is full and quick, it even becomes neceſſary to evacuate large quantities of blood by opening a vein in ſome other part.

The external applications uſually employed in this ſtate of the complaint are warm emollient fomentations and poultices. In ſimilar affections of other parts no remedies with which we are acquainted would probably be found more ſucceſsful; but in the complaint now under conſideration, all ſuch applications, inſtead of being productive of any advantage, rather do harm. The heat of the part is here one of the moſt diſtreſſing ſymptoms; and warm emollient applications rather tend to augment this ſource of uneaſineſs. The lips of the wound alſo are rendered ſtill more hard, ſwelled, and of courſe more painful; and the ſwelling of the contiguous parts is increaſed. The beſt external remedies are cooling aſtringents, eſpecially the ſaturnine applications. The parts chiefly affected being alternately covered over with cloths wet with a ſolution of ſaccharum ſaturni, and pledgits ſpread with Goulard's cerate, are kept more cool and eaſy than by any other remedy hitherto uſed. The febrile ſymptoms which occur muſt at the ſame time be attended to, by keeping the patient cool, on a low diet, preſerving a lax ſtate of the bowels; and, if neceſſary, farther quantities of blood ought to be evacuated.

On account of the violence of the pain, which is ſometimes ſo exceſſive as to deſtroy entirely the patient's reſt, opiates ought to be freely exhibited; and when twitchings of the tendons and other convulſive ſymptoms ſupervene, medicines of this kind become ſtill more neceſſary. In order, however, to have a proper influence in this ſtate of the complaint, opiates ought to be given in very full doſes; otherwiſe, inſtead of anſwering any good purpoſe, they conſtantly tend to aggravate the different ſymptoms, not only by increaſing the heat and reſtleſſneſs, but by having an evident influence in rendering the ſyſtem more ſuſceptible than it was before of the pain and other diſtreſſing effects produced upon it by the wound.

It often happens, however, either from neglecting the wound or from improper treatment, that all theſe remedies are had recourſe to without any advantage whatever: the fever, pain, and ſwelling of the parts continuing, convulſive affections of the muſcles at laſt occur, all tending to indicate the moſt imminent danger. In this ſituation of matters, if we have not immediate recourſe to ſome effectual means, the patient will ſoon fall a victim to the diſorder; and the only remedy from which much real advantage is to be expected, is a free and extenſive diviſion of the parts in which the orifice producing all the miſchief was at firſt made. We know well, from the repeated experience of ages, that much more pain and diſtreſs of every kind is commonly produced by the partial diviſion either of a nerve or of a tendon, than from any of theſe parts being at once cut entirely acroſs. Now the intention of the operation here recommended, is to produce a complete diviſion of the nerve or tendon we ſuppoſe to have been wounded by the point of the lancet, and which we conſider as the ſole cauſe of all the ſubſequent diſtreſs.

This operation being attended with a good deal of pain, and being put in practice for the removal of ſymptoms from which it is perhaps difficult to perſuade the patient that much danger can occur, all the remedies we have mentioned ſhould be firſt made trial of before it is propoſed: but at the ſame time, care ought to be taken that the diſorder is not allowed to proceed too far before we have recourſe to it; for if the patient ſhould be previouſly much weakened by the feveriſh ſymptoms having continued violent for any length of time, neither this remedy nor any other with which we are acquainted would probably have much influence. So ſoon therefore as the courſe already preſcribed has been fairly tried, and is found to be inadequate to the effects expected from it, we ought immediately to have recourſe to a free diviſion of the parts chiefly affected.

24
eatment wounded ruptur- tendons.

Wherever a wounded or ruptured tendon may be ſituated, the limb ſhould be placed in ſuch a manner as will moſt readily admit of the retracted ends of the tendon being brought nearly together; and when in this ſituation, the muſcles of the whole limb in which the injury has happened muſt be tied down with a roller, ſo as to prevent them from all kinds of exertion during the cure, endeavouring at the ſame time to keep the parts eaſy and relaxed. Thus in a wound or rupture of the tendon of the rectus muſcle of the thigh, the patient's *leg* ſhould be kept as much as poſſible ſtretched out during the cure, while the thigh ſhould be in ſome degree bent, to relax the muſcle itſelf as far as poſſible.

In ſimilar affections of the tendo Achilles, the *knee* ſhould be kept conſtantly bent to relax the muſcles of the leg, and the foot ſhould be ſtretched out to admit of the ends of the ruptured tendon being brought nearly into contact. A roller ſhould be applied with a firmneſs quite ſufficient for ſecuring the muſcles and tendons in this ſituation; but care muſt be taken to prevent it from impeding the circulation. With this view, fine ſoft flannel ſhould be preferred either to linen or cotton; for being more elaſtic, it more readily yields to any ſwelling with which the limb may be attacked.

The late Dr. Monro was the firſt who gave any accurate directions for the treatment of rupture in the large tendons; and it is perhaps given with more preciſion, from his having himſelf experienced the effects of this misfortune in the tendo Achillis.

He uſed a foot-ſock or ſlipper, made of double quilted ticking, and left open at the toe; from the heel of which a ſtrap went up above the calf of the leg. A ſtrong piece of the ſame materials went round the calf, and was faſtened with a lace. On the back part of this was a buckle, through which the ſtrap of the foot-ſock was paſſed, by which the calf could be brought down, and the foot extended at pleaſure. Beſides, there was a piece of tin applied to the fore part of the leg, to prevent the foot from getting into any improper poſture during ſleep. After propoſing to walk, he put on a ſhoe with a heel two inches deep; and it was not till the expiration of five months that he ventured to lay aſide the tin plate; and he continued the uſe of the high-heeled ſhoe for two years. The whole apparatus is repreſented Plate CCCCXCII. fig. 124.

From this treatment a knowledge may be formed of the treatment neceſſary to be followed in the laceration of tendons of other parts of the body.

25
Wounds of the thorax.

In wounds of the thorax, even though none of the viſcera ſhould be wounded, we may yet reaſonably expect that a conſiderable quantity of blood will be extravaſated; and this, if very large, muſt be evacuated if poſſible. However, it ought to be particularly obſerved, that this extravaſated blood ſhould not be diſcharged before we are aſſured that the wounded veſſels have done bleeding. When the pulſe appears ſufficiently ſtrong and equal, the extremities are warm, no hiccup or convulſion appears, and the patient's ſtrength continues, we may then know that the internal hæmorrhagy has ceaſed, and that the means for diſcharging the blood may now be ſafely uſed. Matter, water, blood, &c. have ſometimes vaniſhed from the cavities of the thorax, and been afterwards diſcharged by ſweat, urine, &c. Yet this but ſeldom happens; and if we were to truſt to nature only in theſe caſes, it is certain that many would periſh from a deſtruction of the vital viſcera by the extravaſated and putrid blood, who by an artificial extraction of the ſame blood might have been ſaved.

26
Wounds of the abdomen.

Wounds of the abdomen muſt be cloſed as ſoon as poſſible, and then treated as ſimple wounds; only they ought to be dreſſed as ſeldom and expeditiouſly as may be. A ſpare diet, with other parts of the antiphlogiſtic regimen, is here abſolutely neceſſary. It ſometimes happens, that, thro' a large wound of the abdominal integuments, the inteſtine comes out without being injured; yet, if it remains for any time expoſed to the air, the caſe is commonly very dangerous. The moſt certain method, in all ſuch caſes, is to return the protruded part as ſoon as poſſible; for although writers in general formerly recommended warm fomentations, &c. to be previouſly applied, the lateſt authors upon this ſubject conſider the moſt natural and proper fomentation to be that which is produced by the heat and moiſture of the patient's belly, and that therefore the inteſtines, if no mortification has taken place, are to be cleared from extraneous matter, and immediately returned.

When the wound of the abdomen is large, the inteſtines eaſily prolapſe, but are as eaſily returned. But when part of an inteſtine has been forced through a narrow wound, the diſorder is much more dangerous. For the prolapſed inteſtine being diſtended by flatus, or the ingeſted aliments driven thither by the periſtaltic motion, it will be inflamed, tumefied, and incapable of being returned through the ſtricture of the wound; whence a ſtoppage of the circulation and gangrene will ſoon follow. In this caſe the utmoſt care is to be taken to reduce the inteſtine to its natural ſize. When this cannot be accompliſhed by other means, ſome practitioners of great eminence have even adviſed the puncturing of the inteſtine in different places in order to diſcharge the flatus. This practice has alſo been recommended in an incarcerated hernia, but is exceedingly diſapproved of by Mr Pott and later writers; and it ſeems to be very dubious whether any good can poſſibly ariſe from it. To puncture any part that is already inflamed, muſt undoubtedly add to the inflammation; and it is very improbable that the diſcharge of flatus procured by the punctures would at all be a recompenſe for the bad conſequences produced by the increaſed inflammation. The method of Celſus is much more eligible: It is to dilate the wound ſo as to reduce the inteſtine with eaſe. Sometimes part of the inteſtine is loſt either by ſuppuration or gangrene. In this caſe, all that can be done is to ſtrike a ſingle ſtitch through the wounded bowel, and to fix it to the external wound by paſſing the ſuture alſo through the ſides of the wound. The ends of the inteſtine may perhaps adhere; or at any rate the wound will continue to perform the office of an anus, out of which the fæces will continue to be diſcharged during life. The directions given by ſome ſurgeons about inſerting the upper end of the gut into the lower, and ſtitching them together, are perfectly impracticable, as Mr John Bell has ſhown in his important Diſcourſes on Wounds*; and even if they were practicable, would certainly produce new mortification, which could not but be fatal.

When the omentum appears prolapſed, the ſame general treatment is to be obſerved; only that, when it is dry and mortified, the dead part may ſafely be extirpated.—We ſhall conclude the article of abdominal wounds with a caſe from the memoirs of the academy of ſciences for the year 1705, which ſhows that we ought not to deſpair, even though the moſt deſperate ſymptoms ſhould take place, as long as any vis vitæ remains. A madman wounded himſelf in 18 different places of the abdomen. Eight of theſe penetrated the cavity, and injured the contained viſcera; he had a diarrhœa, nauſea, and vomiting, tenſion of the abdomen, with difficult reſpiration and violent fever, ſo that his life was deſpaired of. During the firſt four days he was blooded ſeven times; and during the greateſt part of the cure his diet conſiſted almoſt entirely of fleſh-broths, with the addition of ſome mild vegetables. By theſe means he was not only cured of his wounds, but reſtored to his right ſenſes. Seventeen months after, he went mad again, and threw himſelf over a precipice, by which he was inſtantly killed: on opening the body, the wounds were found to have penetrated the middle lobe of the liver, the inteſtinum jejunum, and the colon.

Such extraordinary cures are to be imputed, according to the ſatisfactory explanation of Mr J. Bell, to the abdomen being perfectly full, and conſtantly ſubjected to ſtrong preſſure between the diaphragm and abdominal muſcles; which keeps the parts contiguous to a wound cloſely applied to it, prevents the diſcharge of fæces or even of blood in ſome meaſure, and gives an opportunity for a very ſpeedy adheſion between the parts.

27 Wounds of the head.

In wounds of the head, where the cellular membrane only is affected, and the aponeuroſis and pericranium untouched, phlebotomy, lenient purges, and the uſe of the common febrifuge medicines, particularly thoſe of the neutral kind, generally remove all the threatening ſymptoms. When the inflammation is gone off, it leaves on the ſkin a yellowiſh tint and a dry ſcurf, which continue until perſpiration takes them away; and upon the removal of the diſeaſe, the wound immediately recovers a healthy aſpect, and ſoon heals without further trouble. But in the worſt kind of theſe wounds, that is, where a ſmall wound paſſes through the tela celluloſa and aponeuroſis to the pericranium, the patient will admit of more free evacuations by phlebotomy than in the former. In both, the uſe of warm fomentations is required; but an emollient cataplaſm, which is generally forbid in the eryſipelatous ſwellings, may in this latter caſe be uſed to great advantage. Where the ſymptoms are not very preſſing, nor the habit very inflammable, this method will prove ſufficient; but it ſometimes happens that the ſcalp is ſo tenſe, the pain ſo great, and the ſymptomatic fever ſo high, that by waiting for the ſlow effect of ſuch means the patient runs a riſk from the continuance of the fever; or elſe the injured aponeuroſis and pericranium, becoming ſloughy, produce an abſceſs, and render the caſe both tedious and troubleſome. A diviſion of the wounded part, by a ſimple inciſion down to the bone, about half an inch or an inch in length, will moſt commonly remove all the bad ſymptoms; and if it be done in time, will render every thing elſe unneceſſary.

28 Wounds of the joints.

The wounds penetrating into the cavities of the joints do not ſeem at firſt alarming; yet, by expoſure to the air, the lining membrane of ſuch cavities acquire ſuch a degree of ſenſibility as to endanger life when they are large. As ſoon therefore as any extraneous body, puſhed into the joint, is removed, the admiſſion of the external air is to be guarded againſt as much as poſſible. If the wound be not too large, this may be done by pulling the ſkin over the wound of the joint; and, to prevent its retraction, rather adheſive plaſter, with proper bandaging, is to be uſed. But when inflammation is come on, repeated and copious blood-letting, together with fomentations, become neceſſary; and as the pain, in theſe caſes, is apt to be violent, opiates muſt be adminiſtered; but ſhould matter be formed in the cavity of the joint, free vent muſt be given to it.

Sect. II. *Of contuſed and lacerated Wounds.*

When the ſmall veſſels are broken by a blow with any hard inſtrument without penetrating the ſkin, at the ſame time that the ſolid fibres of the part are cruſhed, the injury is termed a *contuſion:* and when at the ſame time the ſkin is broken, it is termed a *contuſed and lacerated wound;* becauſe in this caſe the parts are not fairly divided as with a knife, but torn aſunder or violently ſtretched.

29 Symptoms and effects of contuſions.

Every contuſion therefore, whether the ſkin is broken or not, may properly be reckoned a wound; for where the injury is ſo ſlight that none of the contents of the ſmall veſſels are extravaſated, it ſcarce deſerves to be mentioned. The immediate conſequence of a contuſion, therefore, is a ſwelling, by reaſon of the extravaſation juſt mentioned; and the ſkin becomes diſcoloured by the blood ſtagnating under it: but as this fluid, even though covered by the ſkin, cannot long remain in its natural ſtate, it thence happens, that the contuſed part ſoon loſes its florid red colour, and becomes blue or black; the thinner parts being in the mean time gradually taken up by the abſorbent veſſels, which at laſt happens to the blood itſelf; the blue diſappears, and is ſucceeded by a yellowiſh colour, ſhowing that the blood is now diſſolved; after which the part recovers its former appearance, and the ruptured veſſels appear to have united as though nothing had happened.

Theſe are the ſymptoms which attend the ſlighteſt kind of contuſions; but it is evident, that where the blow is ſo violent as to rupture or cruſh ſome of the large nerves, or blood-veſſels, all the bad conſequences which attend ſimple wounds of thoſe parts will enſue, and they will not at all be alleviated by the circumſtance of the ſkin being whole. Hence it is eaſy to ſee how a contuſion may produce ulcers of the worſt kind, gangrene, ſphacelus, carious bones, &c.; and if it happens to be on a glandular part, a ſcirrhus or cancer is very frequently found to enſue. Even the viſcera themſelves, eſpecially of the abdomen, may be injured by contuſions to ſuch a degree as to produce an inflammation, gangrene, or ſcirrhus, nay inſtant death, without rupturing the ſkin.

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* Part II. Diſcourſes 4th and 5th.

Sect. III. *Of Gun-ſhot Wounds.*

Gun-shot wounds can be conſidered in no other light than contuſed wounds. In thoſe made by a muſket or piſtol ball, the moſt immediate conſiderations are, to extract the ball, or any other extraneous body which may have lodged in the wounded part; and to ſtop the hemorrhagy, if there is an effuſion of blood from the rupture of ſome conſiderable artery.

30 xtraction f the ball r other foeign boies.

It is frequently neceſſary to enlarge the wound in order to extract the ball; and if it has gone quite through, (provided the ſituation of the part wounded will admit of its being done with ſafety), the wound is to be laid freely open through its whole length; by which means any extraneous body will be more readily removed, and the cure facilitated.

In order to get at the ball, or any other foreign matter, probing is to be uſed as ſparingly as poſſible: and this muſt evidently appear to any one who will only conſider the nature of the ſymptoms attendant on penetrating wounds of the breaſt or belly, either from a bullet or ſharp inſtrument; the thruſting in a probe to parts under ſuch circumſtances being unavoidably a freſh ſtab on every repetition of ſuch practice. Wherever probing is neceſſary, the finger is to be preferred as the beſt and trueſt probe, where it can be uſed.

If a ball, or any other foreign body, happens to be lodged near the orifice, or can be perceived by the finger to lie under the ſkin, though at ſome diſtance from the mouth of the wound, we ſhould cut upon it and take it out: but when it is ſunk deep, and lies abſolutely beyond the reach of the finger, it muſt appear evident, upon the leaſt reflection, that thruſting, firſt a long probe in queſt of the bullet, and then, as has been practiſed likewiſe, a longer pair of forceps, either with or without teeth, into a wound of that kind, though with a ſort of certainty to extract it, muſt either contuſe, or irritate and inflame, the parts to a great degree; and conſequently do as much, or more miſchief, than the ball did at firſt by forcing its paſſage ſuch a length of way. And ſhould they at the ſame time lay hold of any conſiderable artery or nerve along with the ball (which can ſcarce ever fail of being the caſe), what ſhocking conſequences would attend ſuch a proceeding! Nor would attempts of this ſort be leſs injurious in caſe a bullet ſhould happen to be lodged in the cavity of the belly or breaſt. Such attempts are the leſs neceſſary, becauſe a great number of inſtances have occurred, where balls have been quietly lodged in ſeveral parts of the body, till after many years they have worked themſelves a paſſage towards the ſurface, and were very eaſily extracted; and many where balls have been entirely left behind.

31 Dilatation of the wound.

In caſe the wound be occaſioned by a muſket or piſtol ſhot, and of courſe but ſmall, it will be neceſſary to dilate it without delay, provided the nature of the part will admit of this with ſafety: for in wounds near a joint, or in very membranous or tendinous parts, the knife, as well as forceps, ſhould be put under ſome reſtraint; nor ſhould any more opening be made than what is abſolutely requiſite for the free diſcharge of the matter lodged within.

32 Advantages of bleeding.

Where the wounded perſon has not ſuffered any great loſs of blood, and this is generally the caſe, it will be adviſable to open a vein immediately, and take from the arm a large quantity; and to repeat bleeding as circumſtances may require, the ſecond, and even the third day. Repeated bleedings in the beginning draw after them many advantages. They prevent a good deal of pain and inflammation, leſſen any feveriſh aſſaults, forward the digeſtion, and ſeldom fail to obviate impoſthumations, and a long train of complicated ſymptoms which are wont otherwiſe to interrupt the cure, miſerably haraſs the poor patient, and too often endanger his life; and even where the feveriſh ſymptoms run high, and there is almoſt a certainty that matter is forming, bleeding, in that ſtate, is very frequently of great advantage.

33 Regimen.

For the firſt 12 days it will be proper to obſerve a cooling regimen, both in reſpect of the medicines that may be preſcribed, and the diet requiſite for the ſupport of nature. It is abſolutely neceſſary likewiſe that the body be conſtantly kept open. Unleſs, therefore, nature does this office of herſelf, a ſtool ſhould be every day procured, either by emollient clyſters, or ſome gentle laxative taken at the mouth; and whenever there is much pain in the wounded parts, immediate recourſe muſt be had to opium.

34 External applications.

As to external applications, whatever is of a hot ſpirituous nature is remarkably injurious on theſe occaſions, and what no wounded part can in any degree bear. The wound may be dreſſed with pledgits of any emollient ointment; the whole being covered with a common poultice, or, in ſome caſes, the preparations of lead may be uſed. An opiate ſhould now be adminiſtered; and the part affected being placed in the eaſieſt and moſt convenient poſture, the patient ſhould be laid to reſt. The formation of matter, in every contuſed wound, is an object of the firſt importance; for, till this takes place, there is often reaſon to ſuſpect that gangrene may happen. With a view to haſten ſuppuration, the warm poultices ſhould be frequently renewed, and they ſhould be continued till the tenſion and ſwelling, with which wounds of this kind are uſually attended, be removed, and till the ſore has acquired a red, healthy, granulating appearance, when it is to be treated like a common ulcer.

Gun-ſhot wounds are commonly covered from the beginning with deep ſloughs, and various remedies are recommended for removing them. Every appearance, however, of this kind with which they are attended proceeds entirely from contuſion; and, excepting the injury be extenſive, the ſlough is not often perceptible, or it is ſo thin as to come away along with the matter at the firſt or ſecond dreſſing. Although emollient poultices be extremely uſeful, they ought to be no longer continued than till the effects already mentioned are produced; otherwiſe they will not only relax the parts, but alſo produce too copious a diſcharge of matter, which is ſometimes attended with great danger. A too copious flow of matter may proceed from different cauſes; but in whatever way it may have been produced, the practice to be adopted muſt be nearly the ſame. Every collection which appears muſt have a free outlet, and the limb laid in that poſture which will moſt readily admit of its running off. In ſuch circumſtances, nouriſhing diet and Peruvian bark in conſiderable quantities are highly uſeful. When the diſcharge continues copious, in ſpite of every effort to check it, detached pieces of bone or ſome extraneous matter are probably the cauſe. In ſuch a ſituation nothing will leſſen the quantity of matter till ſuch ſubſtances be removed. The wound ought therefore again to be examined, and looſe bodies removed. Pieces of cloth have been known to be removed by ſetons, when that method was practicable, after every other method had failed. Opium likewiſe is frequently uſeful in checking an exceſſive diſcharge, when it happens to be kept up by irritation.

Although no conſiderable hemorrhagy may happen at firſt in gun-ſhot wounds; yet after the ſloughs commonly produced upon ſuch occaſions have come off, ſome conſiderable arteries may be expoſed, and then a dangerous hemorrhagy may enſue. The hemorrhagy is often preceded by a great heat in the injured parts, and with a throbbing pulſatory pain. At this period it may frequently be prevented

Poiſoned Wounds.

vented by plentiful blood-letting, particularly local. But if the hemorrhagy has fairly taken place, and from arteries of conſiderable ſize, nothing will do but the proper application of ligatures. As the diſcharge in theſe caſes would often prove dangerous before the ſurgeon could be procured, the attendants ſhould be furniſhed with a tourniquet, with directions to apply it, upon the firſt appearance of blood.

35 Scarifying improper.

Till of late years the ſcarifying of gun-ſhot wounds was a practice which prevailed very univerſally among ſurgeons; and it was expected by this, that the ſloughs with which wounds are ſometimes covered would ſooner ſeparate, and that the cure would thereby be more readily performed. It is now, however, known, that this practice, inſtead of being uſeful, very generally does harm by increaſing the inflammation. It ſhould therefore be laid entirely aſide. When a gun-ſhot wound cannot eaſily or ſafely be laid open from one end to the other, perhaps it may be proper to introduce a cord through the ſinus. This, however, ſhould not be attempted till the firſt or inflammatory ſtate of the wound is over: but when a cord cannot be properly introduced, on account of the ſituation or direction of the wound, compreſſion may prove equally uſeful here as in caſes of punctured wounds.

36 Mortification.

Mortification happening after gun-ſhot wounds, is to be treated in the ſame manner as if it had ariſen from any other cauſe, only bark is not to be promiſcuouſly uſed; as, in plethoric habits, it may prove hurtful, though in debilitated relaxed habits it will be extremely uſeful; but even in ſuch it ſhould never be given while much pain and tenſion continue.

Sect. IV. *Of Poiſoned Wounds.*

37 Treatment of wounds poiſoned by by the bite of animals.

Poison may be introduced into the ſyſtem various ways. The effects of the poiſon introduced by the ſtings of inſects may frequently be prevented by applying immediately vinegar or ardent ſpirits. After inflammation has come on, the moſt effectual remedy is the waſhing the parts with cold water. The bite of a viper is not always dangerous; but as we can never judge with certainty whether the wound be poiſoned or not, and as the poiſon of this animal acts very ſpeedily upon the ſyſtem, its bad effects ought to be prevented by every poſſible means. The injured part ought either to be cut out immediately, or deſtroyed with the actual or potential cautery.

Formerly ſuction was much employed, and frequently with ſucceſs: it ſhould not, however, prevent the removal of the part. After the part has been removed, we ſhould endeavour to produce a plentiful ſuppuration. When the poiſon appears to have entered the ſyſtem, the application of warm oil over the whole body has been extolled; and it has been ſaid that advantage has been derived from the internal uſe of it. From ſome late obſervations, however, the efficacy of this remedy is much to be doubted. Perhaps a plentiful ſweat, kept up for a conſiderable time, is the moſt certain method yet diſcovered. Small doſes of volatile alkali frequently repeated is more to be depended on for producing this effect than any other remedy.

38 Wounds from the bite of mad animals.

The bite of a mad animal occaſions the moſt formidable poiſoned wound known in this country. In theſe wounds hydrophobia indeed does not always enſue; but when it does, death is almoſt certainly the conſequence. A variety of noſtrums for preventing and curing this diſeaſe have been held forth to the public; but there is ſcarcely any well atteſted fact of any one of them proving uſeful. Nothing yet known can be depended upon but the immediate removal of the injured part, either with the ſcalpel or the actual or potential cautery; which, together with a plentiful ſuppuration, has, in different inſtances, appeared to anſwer the purpoſe effectually; at leaſt, patients treated in this manner have eſcaped, while others bit at the ſame time by the ſame animal have ſuffered. The ſooner the operation is performed, the more effectual it is likely to prove; but it ought not to be omitted, even though ſome time has elapſed from the time that the wound was inflicted; for there is reaſon to ſuppoſe that this poiſon does not enter the ſyſtem ſo quickly as ſeveral others are obſerved to do. Sea-bathing has been much recommended in all ages as a preventive; but there are few well atteſted caſes of its being attended with advantage. Many practitioners depend much on mercury; and as it can be uſed along with any other plan of treatment, it ought not to be neglected.

When wounds are poiſoned by the application of matter from certain ſores, as thoſe of the venereal or cancerous kinds, or from any of the vegetable poiſons, it is better to remove the part affected immediately, than to undergo a courſe of medicines generally ſlow and often doubtful in their operation.

The metallic poiſons do not fall to be conſidered in this place; for however deleterious they may be when taken into the ſtomach, they ſeldom appear to be otherwiſe hurtful, when applied to wounds, than by irritating or corroding the parts with which they come in contact.

Inflammation and Suppuration.

CHAP. III. *Inflammation and its Conſequences.*

Sect. I. *Of Inflammation and Suppuration.*

39 Symptoms of inflammation.

Inflammation of any part is accompanied with increaſed heat, redneſs, and painful tenſion. For the remote and proximate cauſes of inflammation, together with the treatment of inflammatory diſeaſes, ſee *Phlegmaſiæ*, article Medicine. Inflammation is commonly divided into two ſpecies, the *phlegmonic* and *erythematic*. The firſt is diſtinguiſhed by conſiderable ſwelling, throbbing pain, and circumſcribed bright red colour. The ſecond by ſuperficial ſwelling, burning pain, dull red colour, apt to ſpread, diſappearing when preſſed, and quickly returning; the part affected is frequently covered with ſmall veſicles.

40 Its conſequences, ſuppuration and gangrene.

The conſequences of inflammation are ſuppuration and gangrene, unleſs the inflammation be checked and terminated by reſolution.—That an inflammation will terminate in ſuppuration may be known from the length of time it has continued, from the remiſſion of the pain and hardneſs, the greater elevation of the ſkin in the middle part, a change of colour from red to bluiſh or livid, a ſlight fever with ſhivering, and from a fluctuation of matter perceived on handling the part.

41 When reſolution ſhould be attempted.

During the firſt ſtage of the inflammation, however, we ought, for the moſt part, to endeavour to reſolve it, or prevent the ſuppuration. Yet ſome caſes muſt be excepted. For inſtance, thoſe inflammatory ſwellings which ſometimes occur in fevers, or ſucceed to them, ought always to be brought to ſuppuration; and it might be very dangerous to attempt a reſolution of them. In ſwellings of a ſcrophulous nature, it is perhaps beſt to do nothing at all, either with a view to reſolve or ſuppurate. Thus it might be dangerous to make uſe of repellent application, at the ſame time that it is by no means adviſable to promote their ſuppuration; the cure of ſuch ſwellings, when opened, proving always very troubleſome; while at the ſame time it is known, that ſuch ſwellings may remain for a very long time without any riſk to the patient. In the lues venerea, too, as we are poſſeſſed of a certain antidote for the diſorder, it is beſt not to attempt the ſuppuration of any buboes which may appear;

pear; as the cure of them, when opened, very often proves extremely troubleſome; and as their being opened cannot contribute any thing towards their cure.

Where the inflammation is but beginning, and the ſymptoms are not ſo violent as to affect the general ſyſtem, topical remedies, with a due attention to regimen, often anſwer in reſolving them. The firſt thing to be attended to in the caſe of every inflammation, is the removal of the exciting cauſes, which either have brought on the inflammation originally, or which may continue it after it is begun. Such are extraneous bodies in wounds, pieces of fractured bones, luxations, &c. Of all the various applications for an inflamed part, thoſe of a ſedative nature are chiefly to be depended upon; and, next to theſe, emollients. Of the former kind we may conſider all the different preparations of lead diſſolved in vinegar; together with vinegar itſelf, which generally acts alſo as a ſedative. Among the latter we may place the mild expreſſed oils, as alſo the ſoft ointments made with theſe oils and pure wax.

When we ſpeak of ſedative medicines, however, it muſt not be underſtood that all of that claſs are to be uſed indiſcriminately. Thus opium, though one of the moſt powerful of all ſedatives, yet as its application, externally to the human body, is always attended with ſome degree of irritation, however uſeful it may at times be found in ſome particular ſpecies of inflammatory diſorders, will never, probably, as an external application, become of general uſe in theſe caſes. Warm emollient fomentations alſo, though powerful ſedatives, as tending more effectually to remove tenſion and pain than perhaps any other remedy, are conſtantly found to be improper where a reſolution is to be wiſhed for. Their conſtant effect is, either to bring the ſwelling to a ſuppuration, or to relax the parts in ſuch a manner as to render the removal of the diſorder always exceedingly tedious.

Mr Bell recommends the preparations of lead as proper applications, in caſes of external inflammation, where we wiſh for a reſolution. The beſt method of applying it, he ſays, is in the form of a watery ſolution; and he gives the following formula: "℞. Sacchar. ſaturn. ʒſs.; ſolve in acet. pur. ℥iv.; et adde aq. fontan. diſtillat. ℔ij. The addition of vinegar renders the ſolution much more complete than it otherwiſe would be; and without it indeed a very conſiderable proportion of the lead generally ſeparates and falls to the bottom.

In making uſe of this ſolution in caſes of inflammation, as it is of conſequence to have the parts affected kept conſtantly moiſt with it, cataplaſms prepared with it and crumb of bread in general anſwer that intention exceedingly well. But when the inflamed parts are ſo tender and painful as not eaſily to bear the weight of a poultice, which is frequently the caſe, pieces of ſoft linen moiſtened with the ſolution anſwer the purpoſe tolerably well. Both ſhould be applied cold, or at leaſt with no greater warmth than is merely neceſſary for preventing pain or uneaſineſs to the patient: they ſhould be kept almoſt conſtantly at the part, and renewed always before turning ſtiff or hard.

When the tenſion and irritation on the ſkin are conſiderable, emollients are often attended with very great advantage: the parts affected being, in ſuch a ſtate of the diſorder, gently rubbed over with any of the mild expreſſed oils two or three times a-day, the tenſion, irritation, and pain, are often very much relieved, and the diſcuſſion of the tumor thereby greatly promoted.

In every caſe of inflammation, indeed, emollient applications would afford ſome relief. But as the preparations of lead, already recommended, prove in all ſuch diſorders ſtill more advantageous; and as unguents of every kind tend conſiderably to blunt the action of lead; theſe two ſets of remedies ſhould as ſeldom as poſſible be allowed to interfere with one another; and emollients ſhould accordingly never be preſcribed, but when the circumſtances already mentioned of irritation, tenſion, and pain, are ſo conſiderable as to render their application altogether neceſſary.

Inflammation and Suppuration.

When the part affected with inflammation is not very tender, or lies deep, applications of vinegar are often had recourſe to with conſiderable advantage: the moſt effectual form of uſing it ſeems to be by way of cataplaſm, made with the ſtrongeſt vinegar and crumb of bread. In ſuch caſes, an alternate uſe of this remedy, with the ſaturnine ſolution, has produced more beneficial effects than are commonly obſerved from a continued courſe of any one of them.

At the ſame time that theſe applications are continued, blooding with leeches, or cupping and ſcarifying, as near as poſſible to the part affected, is generally of very great ſervice; and in no caſe of local inflammation ſhould ever be omitted. In all ſuch caſes, the whole body, but more eſpecially the diſeaſed part, ſhould be preſerved as free as poſſible from every kind of motion; and, for the ſame reaſon, the neceſſity of a low cooling diet, in every inflammatory diſorder, appears obvious, as does alſo a total abſtinence from ſpirituous and fermented liquors.

43 Blood-letting, when proper for this purpoſe.

In ſlight caſes of inflammation, a due perſeverance of the ſeveral articles taken notice of will, in general, be found ſufficient for every purpoſe. But when there is likewiſe a full, hard, or quick pulſe, with other ſymptoms of fever, general blood-letting becomes neceſſary; the quantity of blood taken away being always to be determined by the violence of the diſorder, and by the age and ſtrength of the patient. Evacuation, however, ſhould never be carried to a greater height than what is merely neceſſary for moderating the febrile ſymptoms; for if ſuppuration ſhould take place after the ſyſtem is too much reduced, its progreſs is thereby rendered much more ſlow and uncertain, nor will the patient be ſo able to bear the diſcharge that muſt enſue upon opening the abſceſs. The uſe of gentle laxatives, together with cooling diaphoretic medicines, are alſo attended with very good effects.

Theſe different evacuations being premiſed, the next object of conſequence is to procure eaſe and quietneſs to the patient; which is often, in inflammatory caſes, of more real ſervice than any other circumſtance whatever. The moſt effectual remedy for this purpoſe is opium; which, when pain and irritation are conſiderable, as in extenſive inflammations very frequently happens, ſhould never be omitted. In large wounds, eſpecially after amputations and other capital operations, alſo in punctures of all kinds, large doſes of opium are always attended with remarkable good effects. In all ſuch caſes, however, opium, in order to have a proper influence, ſhould, as was obſerved, be adminiſtered in very large doſes; otherwiſe, inſtead of proving ſerviceable, it ſeems rather to have the contrary effect; a circumſtance which is perhaps the chief reaſon for opiates in general having been very unjuſtly condemned in every caſe of inflammation.

By a proper attention to the different circumſtances taken notice of, in the courſe of three or four days, and ſometimes in a ſhorter ſpace of time, reſolution of the tumor will in general begin to take place; at leaſt before the end of that period it may, for the moſt part, be known how the diſorder is to terminate. If the heat, pain, and other attending ſymptoms abate, and eſpecially if the tumor begins to decreaſe, without the occurrence of any gangrenous appearances, we may then be almoſt certain that by a continuance of the ſame plan a total reſolution will in time be effected.

But, on the contrary, if all the different ſymptoms rather increaſe; and eſpecially if the tumor turns larger, and ſomewhat ſoft, with an increaſe of throbbing pain; we may then with tolerable certainty conclude, that ſuppuration will take place; and ſhould therefore immediately deſiſt from ſuch applications as were judged proper while a cure was thought practicable by reſolution, and endeavour to aſſiſt nature as much as poſſible in the formation of pus, or what is called *maturation* of the tumor. For this purpoſe there is nothing better than to preſerve a proper degree of heat in the parts. This is commonly done by the means of warm fomentations and cataplaſms; and when theſe are regularly and frequently renewed, nothing, it is probable, could more effectually anſwer the purpoſe. But in the ordinary manner in which they are applied, by the cataplaſms being renewed only once, or at moſt twice a day, they muſt always, it is imagined, do more harm than good. For ſo ſoon as the degree of heat they were at firſt poſſeſſed of is diſſipated, the moiſture kept up by them, with the conſequent evaporation which enſues, muſt always render the part a great deal colder than if it had been merely wrapped in flannel without the uſe of any ſuch application.

44 Method of promoting ſuppuration.

In order to receive all the advantages of ſuch remedies, the part affected ſhould be well fomented with flannels preſſed out of any warm emollient decoction, applied as warm as the patient can eaſily bear them, continued at leaſt half an hour at once, and repeated four times a day.

Immediately after the fomentation is over, a large emollient poultice ſhould likewiſe be applied warm, and renewed every ſecond or third hour at fartheſt. Of all the forms recommended for emollient cataplaſms, a common milk-and-bread poultice, with a proportion of butter or oil, is perhaps the moſt eligible; as it not only poſſeſſes all the advantages of the others, but can at all times be more eaſily obtained.

Roaſted onions, garlic, and other acrid ſubſtances, are frequently made uſe of as additions to maturating cataplaſms. When there is not a due degree of inflammation in the tumor, and when it appears probable that the ſuppuration would be quickened by having the inflammatory ſymptoms ſomewhat increaſed, the addition of ſuch ſubſtances may then be of ſervice; but when ſtimulants are neceſſary in ſuch caſes, a ſmall proportion of ſtrained galbanum, or of any of the warm gums, diſſolved in the yolk of an egg, and added to the poultices, is a more certain form of applying them. Whenever the inflammation, however, takes place to a proper degree, ſuch ſtimulating ſubſtances never can be neceſſary; and in many caſes, it is apprehended, they may even do miſchief.

In ſuch tumors as, from their being poſſeſſed of little or no inflammation, are commonly ſaid to be of a cold nature, as they are generally indolent, and proceed very ſlowly to ſuppuration, plaſters compoſed of the warm gums are often had recourſe to with conſiderable advantage. In ſuch caſes, they are not only of uſe by the ſtimulus and irritation they occaſion, but by the heat which they tend to preſerve in the part. They become particularly neceſſary when the patient, by being obliged to go abroad, cannot have cataplaſms frequently enough renewed, or ſo coveniently applied; but when ſome ſuch objection does not occur, the latter, for very obvious reaſons, ſhould always be preferred.

45 Dry cupping.

Dry cupping, as it is termed, that is, cupping without the uſe of the ſcarificator, upon or as near as poſſible to the part affected, is frequently had recourſe to with advantage in promoting the ſuppuration of tumors. It is only, however, in ſuch as theſe laſt mentioned, where there ſeems to be a deficiency of inflammation, that it can ever either be neceſſary or uſeful; but in all tumors of a real indolent nature, and where there is ſtill ſome probability of a ſuppuration, no remedy is more effectual.

Theſe different applications, under the reſtrictions taken notice of, being continued for a longer or ſhorter time, according to the ſize of the tumor, its ſituation, and other circumſtances, a thorough ſuppuration may in general at laſt be expected.

46 Signs that matter is formed.

Matter being fully formed in a tumor, is known by a remiſſion of all the ſymptoms taking place; the throbbing pain, which before was frequent, now goes off, and the patient complains of a more dull, conſtant, heavy pain: the tumor points at ſome particular part, generally near to its middle; where, if the matter is not encyſted, or deep ſeated, a whitiſh yellow appearance is obſerved, inſtead of a deep red that formerly took place; and fluctuation of a fluid underneath is, upon preſſure, very evidently diſcovered. Sometimes, indeed, when an abſceſs is thickly covered with muſcular and other parts, though, from concurring circumſtances, there can be little doubt of there being even a very conſiderable collection of matter, yet the fluctuation cannot be readily diſtinguiſhed: it does not, however, often happen, that matter is ſo very deeply lodged as not to be diſcovered upon proper examination.

This, however, is a circumſtance of the greateſt conſequence in practice, and deſerves more attention than is commonly given to it. In no part of the ſurgeon's employment is experience in former ſimilar caſes of greater uſe to him than in the preſent; and however ſimple it may appear, yet nothing, it is certain, more readily diſtinguiſhes a man of obſervation and extenſive practice, than his being able eaſily to detect collections of deep-ſeated matter; whilſt nothing, on the contrary, ſo materially affects the character of a ſurgeon, as his having, in ſuch caſes, given an inaccurate or unjuſt prognoſis; as the event, in diſorders of that nature, comes generally at laſt to be clearly demonſtrated to all concerned.

Together with the ſeveral local ſymptoms of the preſence of pus already enumerated, may be mentioned the frequent ſhiverings to which patients are liable on its firſt formation: theſe, however, ſeldom occur ſo as to be diſtinctly obſerved, unleſs the collection is conſiderable, or ſeated internally in ſome of the viſcera.

47 Of opening abſceſſes.

After the matter is fully formed, and the abſceſs brought to maturity, the only remedy is to open it, and give vent to the pus it contains. In many caſes, indeed, nature will do the work, and abſceſſes, when ſuperficially ſeated, will certainly burſt of themſelves: but where the matter lies deep, we are by no means to wait for this ſpontaneous opening; as the pus will acquire an acrimony before it can break through the integuments, which may prove very prejudicial to health. However, it is a general rule not to open abſceſſes till a thorough ſuppuration has taken place; for, when laid open long before that period, and while any conſiderable hardneſs remains, they commonly prove more troubleſome, and ſeldom heal ſo kindly.

In ſome caſes, however, it is neceſſary to deviate from this general rule, and to open them a good deal ſooner; particularly in all ſuch critical abſceſſes as occur in malignant fevers. In like manner, in the plague, we are commonly adviſed to open ſuch tumors, ſo ſoon as they are at all tolerably advanced, and not to wait till they are fully maturated; as, from experience in theſe diſorders, it is found to be of more conſequence, for the removal of the original diſeaſe, to have a quick diſcharge of matter produced, than any harm the patient can ſuffer from having a ſwelling ſomewhat prematurely laid open.

In abſceſſes, alſo, ſituated on any of the joints, or upon

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either of the large cavities of the breaſt and abdomen, and more eſpecially when they ſeem to run deep, they ſhould always be opened as ſoon as the leaſt fluctuation of matter is diſcovered. For, when the reſiſtance is on every ſide equal, they juſt as readily point inwardly as outwardly: and the conſequence of a large abſceſs burſting into either of the large cavities, is well known moſt frequently to prove fatal: An inſtance of which, in the following caſe, with very little attention, might have been prevented. A ſurgeon of eminence, and of very extenſive practice, was applied to by a young healthy-looking man, with a large abſceſs upon the left ſide of his cheſt. A fluctuation of a fluid was, upon preſſure, very evidently diſcovered; and it was agreed by other two practitioners who were preſent, that an opening ſhould be made to give vent to the matter. But the operator, being much engaged in buſineſs, could not fix on an earlier period for doing it than the third day from the patient's applying to him: unluckily, however, the patient died ſuddenly in his bed the night before the abſceſs was to have been opened. On examining the body, the tumor had diſappeared entirely, without any external opening being obſervable; and, on opening the thorax, it was found to have burſt inwardly upon the lungs, and produced immediate ſuffocation.

In every other circumſtance, however, except in the caſes alluded to, the rule in opening abſceſſes is, as was already remarked, To allow a thorough ſuppuration to take place, before any vent whatever be given to the matter; and it being then determined to lay the collection open, the next queſtion that occurs, is with reſpect to the manner of doing it.

48
By cauſtic,

There are three ways of opening an abſceſs ſo as to give an outlet to the matter; by cauſtic, by inciſion, or by the introduction of a ſeton. The firſt is more agreeable to timid patients, who are afraid of the pain of inciſion, but is attended with ſome inconveniences which render the method of inciſion much preferable. Cauſtic acts ſlowly, and produces a long continued pain; beſides, no kind of cauſtic has yet been invented, the effects of which can be confined to a certain determinate extent; hence the patient is liable to ſuffer much unneceſſary pain, as the cauſtics commonly employed are either the lapis infernalis or lunar cauſtic. The abſceſs is to have a ſlip of adheſive plaſter applied to it, with a ſlit cut in it of a ſize ſomewhat leſs than the opening is intended to be. This ſlit is to be filled with cauſtic reduced into a powder, and wetted to make it act more quickly. It is then to be covered over with a plaſter, and the whole is ſecured with a firm compreſs and bandage. The time neceſſary for the cauſtic to make a ſufficient opening will depend upon the thickneſs of the ſkin, and ſtrength of the cauſtic; but generally it requires ſeveral hours. When we find that an eſchar is made, it is to be ſoftened with any emollient ointment until it can be readily ſeparated; after which, the matter is to be diſcharged, and the abſceſs treated as one opened by inciſion.

49
By the knife,

The method of opening abſceſſes by the knife is, to make an inciſion of ſuch a ſize as to give free vent to the matter. The opening is to be made in the under part of the tumor, that the matter may paſs readily out. It has been a practice among ſurgeons either to open a large abſceſs from end to end, or at leaſt through two-thirds of its length; but from the bad conſequences which often attend this method, the lateſt practitioners have thought it better merely to give a free diſcharge to the matter, without expoſing the part to the action of the air.

50
By a ſeton.

The third method, viz. that by the ſeton, is now frequently employed. It has the advantage of being attended with little pain, emptying the abſceſs in a gradual manner, and completely preventing the acceſs of the air, which, in the other two methods, is often attended with bad conſequences; and it frequently performs a cure in a much ſhorter time.

There are various inſtruments for introducing the ſeton: it may even frequently be done by a lancet and common probe; but the inſtruments repreſented in Plate CCCCLXXXVII. fig. 1. and 2. are more frequently employed. One of theſe being threaded with glover's ſoft ſilk, is to be introduced through the upper part of the tumor; but if the blunt one (fig. 2.) be employed, it will be neceſſary to have the aſſiſtance of a lancet; the inſtrument is then to be brought out at the under part of the tumor, and in this way the matter will be allowed to run gradually off.

The uſual mode of dreſſing an abſceſs the firſt time is with dry lint. In the courſe of dreſſing, it will be proper to have regard to the ſituation of the abſceſs, and as much as poſſible to make the patient favour the diſcharge by his ordinary poſture: and to this end alſo, the diſcharge muſt be aſſiſted by compreſs and bandage: the compreſs may be made of ſoft old linen, applied according to the nature of the part and the ſeaſon of the year. The frequency of dreſſing will depend on the quantity of diſcharge: once in 24 hours is ordinarily ſufficient; but ſometimes twice, or perhaps three times, is neceſſary.

SECT. II. *Of Gangrene.*

Gangrene.

The other conſequence of inflammation is gangrene, which may terminate in mortification. When the colour of an inflamed part changes to a dark red, when bliſters ariſe on it containing an ichorous fluid, we know that it has become gangrenous. When it becomes black, flaccid, and inſenſible, when it loſes heat, and acquires a putrid ſmell, it has proceeded to complete mortification. A gangrene ſeldom affects thoſe who enjoy a good habit of body, though even in them, it may be brought on accidentally by whatever deſtroys the texture of *a part;* as contuſion, long continued preſſure, or whatever deprives *a part* of its nouriſhment. In like manner, cold, by putting a ſtop to the circulation, may produce gangrene, and frequently does ſo in cold climates. This comes on ſuddenly, without any pain or previous inflammation; and the patient himſelf is frequently inſenſible of it, till he is informed of his ſituation by ſome other perſon.

A defect in the circulation, in extreme old age, frequently occaſions mortification in the extremities.

51
Dry gangrene.

There are ſome inſtances of what is called *dry gangrene,* in which the parts continue totally mortified for a great length of time, without either turning very flaccid, or running into diſſolution. But ſuch caſes never occur from inflammation; they happen commonly from the flow of blood to ſuch parts being put a ſtop to by compreſſion of one kind or another, as tumors, ligatures, or other ſimilar cauſes, obſtructing the principal arteries which uſed to ſupply them; which, when the ſtoppage of the circulation is complete, always occaſions a very ſlow, tedious, mortification; and as the parts in ſuch inſtances are no longer ſupplied with freſh quantities of fluids, while a conſiderable evaporation muſt ſtill be going on, ſuch a degree of humidity cannot therefore poſſibly occur as does in other caſes of gangrene. So that ſpecies of the diſorder has, perhaps, with propriety enough, been termed the *dry gangrene.*

52
White gangrene.

There is another variety of the diſeaſe termed *white gangrene;* in which the parts ſuppoſed mortified do not turn black, but retain nearly their former colour, &c. Whether ſuch a complaint, however, can with propriety be denominated *gangrene* or not, may properly be doubted: but as it is chiefly that ſpecies of the diſorder which ſucceeds inflammation that is here particularly treated of, and in which no ſuch varieties are ever obſerved, it is not neceſſary to carry the inquiry farther.

53 Prognoſis.

The prognoſis in every caſe of gangrene is doubtful at firſt, as, even in the ſlighteſt caſes, the patient may ſuffer from the ſpreading of the diſeaſe; but ſlight caſes, from external injuries, are more favourable than thoſe which ariſe from internal cauſes, though no perſon can be conſidered ſafe till the diſeaſed parts are ſeparated, and even entirely caſt off. When inflammation happens round a mortified part, more eſpecially if pus be formed, we may pretty certainly pronounce that the mortified part will be thrown off.

54 Means of preventing gangrene ariſing from inflammation.

When there is reaſon to ſuſpect from the violence of the fever and great heat of the inflamed part, that it will terminate in gangrene, blood-letting, and whatever may have a tendency to moderate the inflammation, may check its progreſs. But as the patient, in ſuch caſes, is ſometimes apt to ſink afterwards, nothing more ought to be done than is merely neceſſary to moderate the preſent ſymptoms. If an inflamed ſurface put on a gangrenous appearance when the patient is weak, and the pulſe low, we muſt have recourſe to whatever may invigorate the ſyſtem, viz. a nouriſhing diet, with the free uſe of wine. Peruvian bark likewiſe is to be given in as great quantities as the ſtomach of the patient will permit. When the ſtomach cannot bear enough in ſubſtance, which is the beſt form of exhibiting it, it may be given either in form of tincture or joined with aromatics. External applications, ſuch as are of a ſtimulating nature, may likewiſe be uſeful.

55 Ariſing from cold.

In the caſe of gangrene ariſing from cold, the part muſt be immerſed in very cold water, or rubbed with ſnow; for if any thing warm be applied, or the patient brought near a fire, it certainly mortifies. If the whole body has become torpid with cold, the ſame practice muſt be followed; the very cold water ſhould be afterwards changed for ſome that is a little warmer, and the patient gradually brought to a proper degree of heat. Rubbing with ſalt is ſometimes found uſeful. If the whole body be benumbed, cordials are not to be adminiſtered too ſuddenly. A glaſs of cold wine ſhould firſt be given, afterwards warm wine by itſelf, or with ſpices. If ſtronger cordials be required, ardent ſpirits may be employed. Notwithſtanding the greateſt attention, however, a mortification ſometimes takes place, and in ſome inſtances very ſuddenly; as in the caſe of carbuncle, where, after an inflammation has continued for ſcarcely 24 hours, the parts become black, and end in real mortification.

56 Scarifications and external applications to mortified parts improper.

In the treatment of mortified parts, a variety of external applications have been pointed out, and particularly thoſe of the antiſeptic kind; ſuch as all the warm gums and balſams, ardent ſpirits, and even alcohol: and to admit of their nearer application to the ſound parts, with a view to the preſervation of theſe from putrefaction, deep ſcarifications through the diſeaſed, and into the ſound parts, have been generally recommended. But although ſuch articles may be of uſe in preſerving dead animal-ſubſtances from corruption; yet that they will always prove ſerviceable in the ſame manner in living bodies, is probably very much to be doubted. And it is even apprehended, by the ſtrong irritation they always occaſion when applied to a living fibre, that, in ſuch caſes as the preſent, they may rather do miſchief; it being only a very ſlight degree of inflammation that is required to bring on a ſuppuration. The inciſions, when carried into the ſound parts, with a view to facilitate the operation of ſuch remedies, may likewiſe do harm; not only from the riſk of wounding the blood-veſſels, nerves, and tendons, that lie in the way, but alſo by allowing a free and farther entrance of the putreſcent fluids into the parts not yet affected: and unleſs they are carried ſo deep as freely to reach the ſound parts, applications of the antiſeptic kind can never have any effect in anſwering the purpoſe for which they were intended.

All the advantages commonly obſerved from the great variety of applications recommended for gangrene, are obtained with more eaſe, and generally with more certainty, from the uſe of any gentle ſtimulating embrocation; which, by exciting a ſlight irritation upon the ſurface, and eſpecially when aſſiſted by a free uſe of the bark, at laſt commonly produces ſuch a degree of inflammation as is wiſhed for. With this view, a weak ſolution of ſal ammoniac in vinegar and water has been known to anſwer exceedingly well: a dram of the ſalt to two ounces of vinegar and ſix of water, forms a mixture of a very proper ſtrength for every purpoſe of this kind; but the degree of ſtimulus can be eaſily either increaſed or diminiſhed according to circumſtances, by uſing a larger or ſmaller proportion of the ſalt.

Although, for the reaſons formerly advanced, inciſions may not in general be proper; yet in ſuch caſes where the mortification runs very deep, it is ſometimes of ſervice to make ſcarifications into the diſeaſed parts, ſo as to remove part of them; which, by taking off a conſiderable load perhaps of putrid fleſh, not only leſſens the fetor, which in ſuch caſes is always conſiderable, but often render it more eaſy for the ſound parts to free themſelves from the remainder. When with this view, however, inciſions are had recourſe to, care ſhould always be taken that they be not carried the length of the ſound parts.

When by the uſe of external or internal remedies, a ſeparation of the mortified part has been effected, and a diſcharge of pus produced, the remaining ſore is then to be conſidered merely as a ſimple purulent ulcer, and may be treated in the ſame manner.

CHAP. IV. *Of Ulcers, White Swellings, Cancers, and Burns.*

SECT. I. *Of Ulcers.*

A SOLUTION of continuity in any of the ſofter parts of the body, diſcharging either pus, ſanies, or any other vitiated matter, is termed *ulcer*; and when the ſame circumſtances happen to the bones, the term *caries* or *carious ulcer* is adopted.

57 Different kinds of ulcers.

Ulcers are diſtinguiſhed by their particular diſorders, though it ſeldom happens that the affections are not complicated; and when we lay down rules for the management of one ſpecies of ulcer, it is generally requiſite to apply them to almoſt all others. However, the characters of moſt eminence are, the callous ulcer, the ſinuous ulcer, and the ulcer with caries of the adjacent bone: beſides this there is the putrid, the corroſive, the varicoſe ulcers, &c.; but as they have acquired their names from ſome particular affection, we ſhall ſpeak of the treatment of them under the general head of ulcers.

It will be often in vain to purſue the beſt means of cure by topical application, unleſs we are aſſiſted by internal remedies; for as many ulcers are the effects of a particular indiſpoſition of body, it will be difficult to bring them into order while the cauſe of them remains. Thoſe which are cancerous and ſcrophulous ſeem to gain the leaſt advantage from phyſic; for if in their beginnings they have ſometimes been very much relieved, or cured, by ſalivation, or any other evacuation, they are alſo often irritated and made worſe by them.

58 Of callous ulcers.

When an ulcer becomes foul, and diſcharges a naſty thin ichor, the edges of it, in proceſs of time, tuck in, and, growing ſkinned and hard, give it the name of a *callous ulcer*;

cer; which, as long as the edges continue in that ſtate, muſt neceſſarily be prevented from healing. But we are not immediately to deſtroy the lips of it, in expectation of a ſudden cure; for while the malignity of the ulcer remains which was the occaſion of the calloſity, the new lips will be ſubject to a relapſe of the ſame kind, however often the external ſurface of them be deſtroyed: we are to endeavour to bring the body of the ulcer into a diſpoſition to recover by other methods. It ſometimes happens to poor laborious people, who have not been able to afford themſelves reſt, that lying a-bed will in a ſhort time give a diverſion to the humours of the part, and the callous edges, ſoftening, will without any great aſſiſtance ſhoot out a cicatrix, when the ulcer is grown clean and filled with good fleſh. The effect of a ſalivation is generally the ſame; and even an iſſue ſometimes diſpoſes a neighbouring ulcer to heal. But though calloſities be frequently ſoftened by theſe means, yet when the ſurface of the ulcer begins to yield thick matter and little granulations of red fleſh ſhoot up, it will be proper to quicken nature by deſtroying the edges of it, if they remain hard. The manner of doing this, is by touching them a few days with the lunar cauſtic, or *lapis infernalis*. Some chooſe to cut them off with a knife: but this is very painful, and not more efficacious. When the lips do not tuck down cloſe to the ulcer, but hang looſe over it, as in ſome venereal buboes, the eaſieſt method is to cut them off with the ſciſſars.

To digeſt the ulcer or to procure good matter from it when in a putrid ſtate, there are an infinity of ointments invented; but the baſilico flavum, alone, or ſoftened down ſometimes with turpentines, and ſometimes mixed up with different proportions of red precipitate, ſeems to ſerve the purpoſe of bringing an ulcer to cicatrization as well as any of the others. When the ulcer is incarned, the cure may be finiſhed as in other wounds; or if it do not cicatriſe kindly, it may be waſhed with aq. calcis, or aq. phag. or dreſſed with a pledgit dipt in tinct. myrrhæ: and if excoriations are ſpread round the ulcer, they may be anointed with ſperm. cet. ointment, or any other ſoft ointment.

The red precipitate has of late years acquired the credit it deſerves for the cure of ulcers; but, by falling into general uſe, is very often unſkilfully applied; when mixed with the baſilicon, or, what is nearer, a cerate of wax and oil, it is moſt certainly a digeſtive, ſince it hardly ever fails to make the ulcer yield a thick matter in 24 hours, which diſcharged a thin one before the application of it.

59
Of deſtroying fungous fleſh.

If the ulcer produces a ſpongy fleſh, ſprouting very high above the ſurface, it will be neceſſary to deſtroy it by ſome of the eſcharotics, or the knife. This fungus differs very much from that belonging to healing wounds, being more eminent and lax, and generally in one maſs; whereas the other is in little diſtinct protuberances. It approaches often towards a cancerous complexion, and when it riſes upon ſome glands ſometimes actually degenerates into a cancer. When theſe excreſcences have ariſen in venereal ulcers, eſcharotics ſhould be applied. Thoſe in uſe, are the vitriol, the lunar cauſtic, the lapis infernalis, and more generally the red precipitate powder.

It is but ſeldom that theſe inveterate funguſes appear on an ulcer; but it is very uſual for thoſe of a milder kind to riſe, which may often be made to ſubſide by preſſure and the uſe of mild eſcharotics; however, if the aſpect of the ſore be white and ſmooth, as happens in ulcers accompanied with a dropſy, and often in young women with obſtructions, it will anſwer no purpoſe to waſte the excreſcences until the conſtitution is repaired, when moſt probably they will ſink without any aſſiſtance. In ulcers alſo, where the ſubjacent bone is carious, great quantities of looſe flabby fleſh will grow up above the level of the ſkin: but as the caries is the cauſe of the diſorder, it will be in vain to expect a cure of the excreſcence until the rotten part of the bone be removed; and every attempt with eſcharotics will be only a repetition of pain to the patient, without any advantage.

When the pain and inflammation are exceſſive, bleeding and other evacuations will often be ſerviceable; and above all things, reſt and a horizontal poſition; which laſt circumſtance is of ſo great importance to the cure of ulcers of the legs, that unleſs the patient will conform to it ſtrictly, the ſkill of the ſurgeon will often avail nothing: for as the indiſpoſition of theſe ſores is in ſome meaſure owing to the gravitation of the humours downwards, it will be much more beneficial to lie along than ſit upright, though the leg be laid on a chair; ſince even in this poſture they will deſcend with more force than if the body was reclined.

60
Ulcers accompanied with varices.

In ulcers of the legs, accompanied with varices or dilatations of the veins, the method of treatment will depend upon the other circumſtances of the ſore; for the varix can only be aſſiſted by the application of bandage, which muſt be continued a conſiderable time after the cure. The neateſt bandage is the laced ſtocking, which is particularly ſerviceable in this caſe; though alſo, if the legs be œdematous, or if, after the healing of the ulcers, they ſwell when the patient quits his bed, it may be worn with ſafety, and advantage. There are inſtances of one vein only being varicous; which, when it happens, may be deſtroyed by tying it above and below the dilatation, as in an aneuriſm; but this operation ſhould only be practiſed where the varix is large and painful.

61
Cure of old ulcers dangerous.

Ulcers of many years ſtanding are very difficult of cure; and in old people the cure is often dangerous, frequently exciting an aſthma, a diarrhœa, or a fever, which deſtroys the patient, unleſs the ſore break out again: ſo that it is not altogether adviſable to attempt the abſolute cure in ſuch caſes; but only the reduction of them into better order, and leſs compaſs, which, if they be not malignant, is generally done with reſt and proper care. The cure of thoſe in young people may be undertaken with more ſafety; and in all caſes of ſtubborn ulcers, the bark, very copiouſly given, will be found of the utmoſt ſervice.

62
Of ſinuous ulcers.

When an ulcer or abſceſs has any ſinuſes or channels opening and diſcharging themſelves into the ſore, they are called *ſinuous ulcers*. Theſe ſinuſes, if they continue to drain a great while, grow hard in the ſurface of their cavity, and then are termed *fiſtulæ*, and the ulcer a *fiſtulous ulcer*; alſo, if matter be diſcharged from any cavity, as thoſe of the joints, abdomen, &c. the opening is called a *ſinuous ulcer* or a *fiſtula*.

63
Treatment.

The treatment of theſe ulcers depends upon a variety of circumſtances. If the matter of the ſinus be thick, ſtrict bandage and compreſs will ſometimes bring the oppoſite ſides of the ſinus to a reunion: if the ſinus grow turgid in any part, and the ſkin thinner, ſhowing a diſpoſition to break, the matter muſt be made to puſh more againſt that part, by plugging it up with a tent; and then a counter opening muſt be made, which proves often ſufficient for the whole abſceſs, if it be not afterwards too much tented, which locks up the matter and prevents the healing; or too little, which will have the ſame effect: for dreſſing quite ſuperficially does ſometimes prove as miſchievous as tents, and for nearly the ſame reaſon; ſince ſuffering the external wound to contract into a narrow orifice before the internal one be incarned, does almoſt as effectually lock up the matter as a tent. To preſerve, then, a medium in theſe caſes, a hollow tent of lead or ſilver may be kept in the orifice, which, at the ſame time that it keeps it open, gives vent to the matter. The abſceſſes where the counter opening is made moſt frequently are thoſe of compound fractures, and the breaſt: but the latter do oftener well without dilatation than the former; though it muſt be performed in both, if practicable, the whole length of the abſceſs, when after ſome trial the matter does not leſſen in quantity, and the ſides of it grow thinner; and if the ſinuſes be fiſtulous, no cure need be expected without dilatation.

64 Of carious ulcers.

When an ulcer with looſe rotten fleſh diſcharges more than the ſize of it ſhould yield, and the diſcharge is oily and ſtinking, in all probability the bone is carious; which may eaſily be diſtinguiſhed by running the probe through the fleſh: and if ſo, it is called a *carious ulcer*. The cure of theſe ulcers depends principally upon the removal of the rotten part of the bone, without which it cannot heal. Thoſe caries which happen from the matter of abſceſſes lying too long upon the bone, are moſt likely to recover: thoſe of lues venerea very often do well, becauſe that diſtemper fixes ordinarily upon the middle and outſide of the denſeſt bones, which admit of exfoliation; but thoſe produced by ſcrophula, where the whole extremities of the ſpongy parts of the bone are affected, are exceedingly dangerous. All enlarged bones are not neceſſarily carious; and there are ulcers ſometimes on the ſkin which covers them, which do not communicate with the bone, and conſequently do well without exfoliation: nay, it ſometimes happens, though the caſe be rare, that, in young ſubjects particularly, the bones will be carious to ſuch a degree, as to admit a probe almoſt through the whole ſubſtance of them; and yet afterwards admit of a cure, without any notable exfoliation.

65 Treatment.

The method of treating an ulcer with caries, is by applying a cauſtic of the ſize of the ſcale of the bone which is to be exfoliated; and after having laid it bare, to wait till the carious part can without violence be ſeparated, and then heal the wound. In order to quicken the exfoliation, there have been ſeveral applications deviſed; but that which has been moſt uſed in all ages, is the actual cautery, with which ſurgeons burn the naked bone every day, or every other day, to dry up, as they ſay, the moiſture, and by that means procure the ſeparation: but as this practice is never of great ſervice, and always cruel and painful, it is now pretty much exploded. Indeed, from conſidering the appearance of a wound, when a ſcale of bone is taken out of it, there is little doubt that burning retards rather than haſtens the ſeparation; for as every ſcale of a carious bone is flung off by new fleſh generated between it and the ſound bone, whatever would prevent the growth of theſe granulations would alſo in a degree prevent the exfoliation; which muſt certainly be the effect of a red hot iron applied ſo cloſe to it.

Some caries of the bones are ſo very ſhallow, that they crumble inſenſibly away, and the wound fills up; but when the bone will neither exfoliate nor admit of granulations, it will be proper to ſcrape it with a rugine, or perforate it in many points with a convenient inſtrument down to the quick. In ſcrophulous caſes, the bones of the carpus and tarſus are often affected; and from their ſpongineſs they are ſeldom cured: ſo that when theſe, or indeed the extremities of any of the bones, are carious through their ſubſtance, it is adviſable to amputate; though there are inſtances in the ſcrophula, but more eſpecially in critical abſceſſes, where, after long dreſſing down, the ſplinters, and ſometimes the whole ſubſtance, of the ſmall bones, have worked away, and a healthy habit of body coming on, the ulcer has healed; but theſe are ſo rare, that no great dependence is to be laid on ſuch an event. The dreſſings of carious bones, if they are ſtinking, may be doſſils dipped in the tincture of myrrh; otherwiſe thoſe of dry lint are eaſieſt, and keep down the edges of the ulcer better than any other gentle application.

SECT. II. *Of White Swellings.*

66 Rheumatic white ſwelling.

THERE are two ſpecies of white ſwellings, Mr Benjamin Bell obſerves; the one of a mild nature, and frequently admitting of a cure; which the other never does. The former, named by our author the *rheumatic* ſpecies of white ſwelling, begins with an acute pain, ſeemingly diffuſed over the whole joint, and frequently extending along the tendinous aponeuroſes of the muſcles which communicate with it. There is, from the beginning, an uniform ſwelling of the whole ſurrounding integuments. Great tenſion generally prevails; but at firſt there is ſeldom any external change of colour. From the commencement of the diſeaſe the motion of the joint is attended with exquiſite pain, and the patient keeps it conſtantly in a relaxed poſture, finding that the eaſieſt. Hence the tendons become extremely ſtiff and rigid, till at laſt the joints have the appearance of complete and real anchyloſes. The ſwelling now begins to augment, till the joint has acquired three or four times its natural ſize; the cuticular veins become turgid and varicoſe; at the ſame time that the muſcular ſubſtance of the limb below decays, though it frequently acquires an equality in ſize by becoming œdematous; the pain becomes intolerable, eſpecially when the perſon is warm in bed or otherwiſe heated; abſceſſes form in different parts, which, either breaking of themſelves, or by being laid open, diſcharge conſiderable quantities of matter, but without any remarkable effect in reducing the ſize of the ſwelling. The pus diſcharged from theſe is at firſt of a tolerable good conſiſtence, but ſoon degenerates into a thin ill-conditioned ſanies. However, the orifices from whence it flows ſoon heal up, unleſs they are kept open by art; and new collections breaking out, they burſt and heal up as before; ſo that in long continued diſorders of this kind, the ſurrounding integuments are often entirely covered with cicatrices.

In the mean time, the health of the patient gradually declines, from the violence of the pain, and the abſorption of matter into the ſyſtem, which takes place in ſome degree from its firſt formation in the different abſceſſes; but which never appears ſo evidently till the different abſceſſes have been laid open; after which a quick pulſe, night-ſweats, and a weakening diarrhœa, are ſure to occur, which generally carry off the patient, if the member is not either amputated, or the diſeaſe cured ſome other way.

67 Appearance of the affected limbs on diſſection.

On diſſecting limbs which have been amputated for white ſwellings, the original diſeaſe appears to have been a morbid thickening of the ſurrounding ligaments, without any other affection of the joint whatever; the bones and cartilages always remaining perfectly ſound, as likewiſe the ſynovia both in quantity and conſiſtence. In the more advanced ſtages of the diſorder, the thickneſs of the ligaments is more conſiderable, and is generally attended with an effuſion, into the ſurrounding cellular ſubſtance, of a thick glairy matter, which gives to ſwellings of this kind an elaſtic ſpringy feel, independent of the collections of matter the fluctuation of which may alſo be perceived. Through this glairy matter the collections of pus run in various directions, without ſeeming, however, to mix with it. In ſome inſtances alſo a great many ſmall hydatides are obſerved; all which form a confuſed maſs, incapable of further diſſection.

All the abovementioned appearances have been obſerved without any affection of the bones or cartilages. But when, by a very long continuance of the diſorder the ligaments come to be corroded by the different collections of matter, the cartilages and in conſequence thereof the bones ſoon begin to ſuffer. The tendons of the flexor muſcles, though very ſtiff and contracted, do not, upon diſſection, ſhow any ſigns of diſeaſe.

68 Scrophulous white ſwelling.

The above is an hiſtory of the mildeſt ſpecies of white ſwelling; the more inveterate kind our author names the *ſcrophulous white ſwelling*. In this the pain is commonly very violent; more acute than in the former; and, inſtead of being diffuſed, is confined to a particular ſpot commonly the very middle of the joint. The ſwelling is commonly inconſiderable at firſt; inſomuch that, on ſome occaſions, even when the pain has been very violent, little difference in point of ſize could be obſerved between the diſeaſed and the ſound joint. The motion of the joint is attended with very great pain, and the tendons become ſtiff. As the diſorder advances, the pain becomes more violent, and the ſwelling increaſes, with an evident enlargement of the ends of the bones. The ſame elaſtic feel, together with ſimilar abſceſſes, occur in this as in the laſt: but upon opening them they commonly diſcharge a thin fetid ſtuff; the bones are found to be carious, and pieces of them are frequently diſcharged at the openings.

By the continuance of the diſorder, the conſtitution ſuffers, as in the firſt ſpecies of the diſeaſe; and a diarrhœa with night-ſweats commencing, the patient is ſoon reduced to little more than ſkin and bone.

69 Appearances on diſſection.

Upon ſuch joints being diſſected in the firſt ſtages of the diſorder, the ſoft parts ſeem very little affected: but there is conſtantly obſerved an enlargement either of the whole ends of the bones, or of their epiphyſes; frequently of thoſe on one ſide of the joint only; in others, again, the bones on both ſides have been affected.

This enlargement ſometimes occurs without any other evident diſeaſe: but in general, and always in a more advanced ſtate of the complaint, the ſoft ſpongy parts of ſuch bones appear diſſolved into a thin, fluid, fetid matter; and that too, in ſome caſes, without the cartilages which ſurround them ſeeming much affected. In proceſs of time the cartilages are likewiſe diſſolved; and then the matter of the bones and ſofter parts mixing together, ſuch ſwellings exhibit in that ſtate a ſtill more confuſed collection than is generally obſerved even in the worſt ſtages of the other ſpecies of the diſorder.

In the farther progreſs of this diſeaſe the ſurrounding ſoft parts likewiſe ſuffer: The ligaments become thickened, and the contiguous cellular membrane is ſtuffed with the viſcid glairy matter obſerved in the other ſpecies of the diſorder.

70 Cauſes of this diſeaſe.

We come now to the conſideration of the different cauſes which tend to produce this diſeaſe. That the ligaments of the joints only are firſt affected in this diſorder is rendered evident by diſſection. The thick glairy effuſions into the cellular membrane are probably occaſioned by an exudation from the veſſels of thoſe ligaments that have been originally inflamed, as ſuch parts never furniſh a proper fluid for the formation of purulent matter: In the courſe of the diſeaſe, indeed, abſceſſes containing real pus always appear; but never till inflammation has been communicated to the ſurrounding parts. We may conclude, therefore, that the firſt ſpecies of white ſwelling is always occaſioned by an *inflammatory* or *rheumatic affection* of the ligaments of ſuch joints as it attacks, from whatever cauſe ſuch inflammation may originally have proceeded.

The other ſpecies of the diſorder ſeems to be originally an affection of the bones; the ſurrounding ſoft parts coming only to ſuffer in the progreſs of the diſeaſe from their connection with and vicinity to theſe. This laſt ſpecies of white ſwelling generally begins without the patient being in the leaſt able to account for it: and from the effects which it produces on the bones attacked, appears to be a ſpecies of *ſpina ventoſa*; a diſeaſe of the bones probably of the ſame nature as ſcrophula is of the ſoft parts. Indeed, the appearances of the two diſorders, after making allowance for their different ſituations, are exceedingly ſimilar: they both begin with conſiderable enlargements or ſwellings of the parts, which generally end in ulcerations; they both likewiſe frequently occur in the ſame perſon at the ſame time. This ſpecies of white ſwelling is generally either attended with other evident ſymptoms of ſcrophula; or the patient, in an early period of life, has been ſubject to that diſeaſe; or, which is nearly the ſame, he is deſcended from ſcrophulous parents, and probably has the ſeeds of that diſeaſe lurking in his conſtitution. From all theſe circumſtances, it may with probability be concluded, that this ſpecies of white ſwelling is of a ſcrophulous nature: and ſince the other ſpecies of the diſorder is to be conſidered as an inflammatory affection, a thorough diſtinction between them is of very great importance; it will not be improper therefore to give a ſhort enumeration of the ſeveral diagnoſtic or moſt characteriſtic ſymptoms of each.

The pain in the firſt ſpecies is always, from the beginning, diffuſed over the whole joint, and ſometimes extends a conſiderable way along the muſcles that are attached to it: in the other ſpecies it is always at firſt, and ſometimes even when the complaint has been of conſiderable ſtanding, confined to a very ſmall circumſcribed ſpace. In the former, the ſwelling is always confined to the ſoft parts, and is from the beginning exceedingly evident: but in the latter, it is generally for ſome time hardly perceptible; and when it appears the bones are the parts chiefly affected, the ſurrounding teguments coming only to ſuffer on a farther progreſs of the diſeaſe. Theſe are the chief local differences of the two ſpecies of this diſorder; but ſome aſſiſtance in the diſtinction may likewiſe be obtained from the general habit of the patient, and from the manner in which the complaint may ſeem to have been produced. Thus, when ſuch ſwellings occur in young, ſtrong, plethoric, people, eſpecially in ſuch as have formerly been ſubject to rheumatiſm, they moſt probably will always prove of the mildeſt or rheumatic ſpecies of the diſorder: But when they appear in patients of ſcrophulous diſpoſitions, we need be under very little doubt in concluding them to be of a ſcrophulous nature.

The great utility of properly diſtinguiſhing the two different ſpecies of white ſwellings appears in no circumſtance ſo evident as in the treatment. In the one, there being ſome chance, by proper remedies, of being ſerviceable to the patient; whereas in the other, viz. the ſcrophulous, it is not probable that art will ever be able to afford much aſſiſtance.

71 Treatment in the rheumatic white ſwelling.

In the rheumatic white ſwelling, as it is always at firſt evidently of an inflammatory nature, conſiderable advantages are commonly obtained by a due attention to a proper cooling courſe. The firſt remedy which, with this view, ſhould be put in practice, is blood-letting immediately from the part affected. Cupping and ſcarifying is here a principal remedy. The inſtrument ſhould be applied to each ſide of the diſeaſed joint; on each ſide of the rotula, for inſtance, when the knee is the part affected, and at leaſt eight or ten ounces of blood diſcharged; and this to be repeated at proper intervals, once, twice, or oftener, according to the violence of the ſymptoms and ſtate of the patient's ſtrength at the time.

Cupping is, in theſe caſes, much ſuperior to leeches, becauſe it is more expeditious, and becauſe of the ſwelling occaſioned by the application of any conſiderable number of theſe animals proves frequently very troubleſome, and ſometimes interrupts for a time the uſe of other remedies.

Upon the anterior part of the joint, where the cupping-glaſſes have not been placed, a ſmall bliſter ſhould be directly applied, and the part kept open with iſſue ointment, till the wounds from the ſcarificator are ſo far healed that a veſicatory may likewiſe be laid on one ſide of the joint; and ſo ſoon as that is nearly healed, the other ſide ſhould be alſo bliſtered. By thus alternately applying them, firſt to the one ſide and then to the other, almoſt a conſtant ſtimulus is kept up; which, in deep-ſeated inflammations, ſeems to have fully a greater influence than all the diſcharge occaſioned by bliſters. Gentle cooling laxatives at proper intervals are alſo of uſe; and the patient ſhould, in every reſpect, be kept upon a ſtrict antiphlogiſtic courſe, both as to diet and every other circumſtance.

It is in the firſt ſtages only of the diſeaſe that ſuch a courſe can be of much ſervice; and in ſuch it has frequently been a means of curing diſorders which otherwiſe might have proceeded to the laſt ſtages of white ſwellings.

The original inflammatory affection being once over, theſe ſort of drains ſeem to have little or no influence, and ought not then to be long perſiſted in, as they prevent the uſe of other remedies, which in an advanced ſtate of the diſeaſe, are commonly more efficacious.

The inflammation being moſtly gone, and while there are yet no appearances of the formation of matter, mercury has ſometimes been known of uſe; not given ſo as to ſalivate, but merely to affect the mouth gently, and to keep it ſomewhat ſore for a few weeks.

The beſt form of uſing it is by way of unction, as it allows, at the ſame time, the application of friction; which, in all ſuch ſwellings, may of itſelf be in ſome meaſure conſidered as a remedy. For this purpoſe, an ointment of quickſilver and hog's lard ſhould be prepared; but with ſo ſmall a proportion of the former, that the patient may admit of two drams of the ointment being rubbed in three times a-day. In order to rub that quantity of the medicine in with gentle friction, an hour each time is at leaſt neceſſary; for in the ordinary way of continuing friction for a few minutes only, it can ſeldom have much influence.

By Le Dran, and other French writers, falls of warm water on ſwellings of this nature are much recommended; and there is no doubt, that a long continued and reiterated application of that remedy may, in the firſt ſtages of ſuch complaints, be often attended with very good effects. By a proper uſe of theſe different applications, viz. of the ſeveral topical remedies in the firſt or inflammatory ſtate of the diſeaſe, and afterwards (ſtill, however, before the formation of matter) of mercurials, friction, &c. many affections of this nature have been entirely removed.

It frequently happens, by the bent poſition the limb has been for a long time kept in, that the uſe of the joint comes to be entirely loſt, having often acquired ſuch a degree of ſtiffneſs, that any attempts to move it are commonly attended with very great pain. This has been conſtantly attributed to one or other of two different cauſes, which are both in their nature incurable, viz. either to the ends of ſuch bones as compoſe the joints having run into one another, ſo as to become firmly conjoined in conſequence of the ſurrounding cartilages being abraded; or to the inſpiſſation, as it is termed, of the ſynovia of the joints, whereby their cavities are entirely filled up, and no ſpace left for the future motion of the bones.

Both theſe opinions, however, are in general very ill founded: as the ſtiffneſs almoſt always proceeds from a contraction of the muſcles and tendons. It may often be cured by a long continued uſe of emollients.

The beſt emollient that can be uſed is pure olive oil applied warm; as much of it as can be eaſily rubbed in by an hour's gentle friction ſhould be regularly done at leaſt three times a-day; and inſtead of confining the friction altogether to the rigid tendons, it ſhould be extended over the whole muſcles, even to the inſertions of their other extremities; but more eſpecially on their fleſhy muſcular parts, where the principal cauſe of the continuance of ſuch complaints is probably ſeated.

The web or omentum of a new-killed ſheep, or of any other animal, applied over all the diſeaſed parts directly on being cut out of the animal, is ſometimes attended with advantage. The application ſhould be renewed as frequently as poſſible, once a day at leaſt, or oftener when it can be done; for on being more than four or five hours applied it becomes diſagreeable; and after that time, indeed, as it commonly turns ſtiff, it cannot then probably be of much ſervice.

Bell's Surgery.

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When amputation ſhould be performed.

The diſorder has hitherto been ſuppoſed not to be ſo far advanced as to have occaſioned the formation of matter; for when come that length, no conſiderable advantages can be expected from any of the remedies as yet recommended: but even in that ſtate of the complaint, if the patient's health does not abſolutely require it, amputation of the member ſhould not be immediately had recourſe to. For by opening the different abſceſſes ſoon after their formation, the matter may be prevented from deſtroying the capſular ligaments of the joints, which, if once effected, would no doubt render that operation neceſſary. Even in point of ſucceſs from the operation, it ought never to be adviſed till the complaint is pretty far advanced. For in this diſorder, eſpecially, a greater proportion of patients have recovered after amputation, who have previouſly been conſiderably reduced by diarrhœas and other weakening ſymptoms, than of ſuch as have ſtill remained in a full plethoric habit of body.

All the different obſervations hitherto made upon the treatment relate particularly to the rheumatic ſpecies of the diſorder; and when had recourſe to in time, and duly perſiſted in, they will frequently be found of ſervice: but when the diſeaſe is ſo far advanced as to have deſtroyed the capſular ligaments of the joint, and perhaps even the cartilages and bones themſelves, amputation of the member is then no doubt the only reſource.

In the ſcrophulous white ſwellings, when the diſeaſed parts of the bone begin to caſt off, a cure may in that way, by aſſiſting the efforts of nature, be ſometimes obtained in the ſmall joints; but in all the large joints, as the knee, ankle, &c. it is not probable that any other reſource than amputation will ever afford much relief. And even the effects of that operation can ſeldom be depended on as laſting; for when the general ſcrophulous taint ſtill ſubſiſts in the conſtitution, the diſorder will moſt probably appear again in ſome other part; which, however, in the advanced ſtages of the diſeaſe, it is ſometimes neceſſary to run the riſk of, the pain being often ſo tormenting as to make it more eligible to ſubmit to any hazard rather than to bear it longer.

When, however, for ſome reaſon or other, amputation is determined againſt, as there being almoſt a certainty of the complaint ſoon returning, from the ſcrophulous diſpoſition appearing very ſtrong in the ſyſtem, it then becomes neceſſary to have recourſe to palliatives, ſo as to render the complaint as tolerable as poſſible: and with this view, opiates in large doſes, by moderating the pain and procuring reſt to the patient, will in general be found the principal remedy. In other reſpects, all ſuch medicines and articles of regimen as are found beneficial in ſcrophula, may be had recourſe to.

Sect. III. *Of Cancers.*

Cancers moſt commonly ariſe in the glandular parts of the body, where they are occaſioned by any bruiſe or contuſion, ſometimes a very ſlight one: and hence they are more common in the lips, and in the breaſts of women, than in any other parts of the body. Cancers have been generally diſtinguiſhed into *occult* and *open*. By the former are meant ſuch hard ſcirrhous ſwellings as are attended with frequent ſhooting pains, and which at laſt generally terminate in the latter.

73 Appearances of an ulcerated cancer.

By the *open cancerous ulcer*, is underſtood that ſpecies of ſore which commonly ſucceeds to hard ſwellings of the glands; although in ſome inſtances it occurs without any previous hardneſs. The edges of the ulcer are hard, ragged, and unequal, very painful, and reverſe in different ways, being ſometimes turned upwards and backwards, and on other occaſions inwards. The whole ſurface of the ſore is commonly very unequal, there being in ſome parts conſiderable riſings, and in others deep excavations. The diſcharge, for the moſt part, is a thin dark-coloured fetid ichor; and is often poſſeſſed of ſuch a degree of acrimony as to excoriate, and even deſtroy, the neighbouring parts. In the more advanced ſtages of the diſeaſe, by the eroſion of bloodveſſels which occurs, conſiderable quantities of pure blood are ſometimes alſo diſcharged.

Patients labouring under real cancerous affections univerſally complain of a *burning* heat over the whole ulcerated ſurface; which, in general, is the moſt tormenting ſymptom that attends the diſorder; and thoſe ſhooting lancinating pains, which were troubleſome in the more occult ſtate of the complaint, become now a great deal more ſo.

Theſe are the moſt frequent ſymptoms which attend an ulcerated cancer; but the appearances of ſuch ſores are ſo various, that it is almoſt impoſſible in any deſcription to comprehend every one. When two, three, or more, however, of thoſe enumerated, concur together in the ſame ulcer, we may always be pretty certain of its being of the cancerous kind.

74 Cauſes of cancer.

Concerning the cauſes of cancers, there have been a great many conjectures, but without any ſolid foundation. It is of ſome moment, however, to determine whether they ariſe from ſome general diſorder in the ſyſtem, or whether they are only to be accounted local diſeaſes. Many of the moſt eminent practitioners have been of opinion that they ariſe from a general diſorder of the ſyſtem; and hence conſider them as totally incurable even by extirpation, as the latent ſeeds of the diſeaſe, in their opinion, will not fail to bring on a return of it ſomewhere or other. Of this opinion the late Dr Monro appears to have been; and in a paper on this ſubject in the Edinburgh Medical Eſſays, declares, that "of near 60 cancers which he had been preſent at the extirparition of, only four patients remained free of the diſeaſe at the end of two years." From this bad ſucceſs, and the violent progreſs of the diſeaſe, he finally concludes againſt the extirpation of cancers, and propoſes only the palliative method of cure. But later practitioners have been a great deal more ſucceſsful; and a late publication by Mr Hill, ſurgeon at Dumfries, has put the uſefulneſs of extirpation beyond a doubt, when the operation is performed in time: though, after the diſeaſe has continued long, and the virus been abſorbed, the whole ſyſtem acquires a cancerous diſpoſition, and the diſeaſe almoſt certainly recurs in ſome other part. From internal medicines, we can expect little or nothing in the cure of cancers; and external applications can do no more than palliate. Great expectations were formed from the powder and extract of cicuta; but it has ſo univerſally failed, that few put much confidence in it at preſent. However, it has ſometimes been of ſervice in caſes of a ſimple indurated gland; and even where the diſeaſe has been farther advanced, it has produced a better diſcharge, and diminiſhed the fetor of the ſore; but as it cannot be depended upon for a radical cure, a delay of the operation is never to be recommended.

75 Cure.

76 Cancer of the mamma.

No part of the body is more ſubject to cancer than the breaſts of women. Cancer of the mamma may ariſe at any period of life, though it ſeldom appears till about the time the menſes uſually diſappear. Tumors ariſing in the breaſt previous to this period have been conſidered by ſome practitioners as being only of a ſcrophulous nature; and it is probably owing to that circumſtance that ſeveral cures have been of late years made on tumors of the breaſt by mercurial frictions and other remedies.

77 Its ſymptoms.

Scirrhus and cancer of the breaſts are diſtinguiſhed by the following marks: When the tumor is firſt obſerved, it is commonly in form of a ſmall hard knot in the glandular part of the mamma, while the ſkin at the ſame time is free from inflammation. It frequently continues in this ſtate for ſeveral months: by degrees, however, it increaſes conſiderably in ſize, and at laſt a ſharp pain is felt ſhooting towards the axilla. The lymphatic glands at the under edge of the pectoral muſcle and in the axilla are often enlarged, and an occult cancer is now formed. By degrees the integuments over this part of the tumor in the mamma become diſcoloured, and at laſt an ulceration or open cancer breaks out. Violent hemorrhagies now frequently enſue; the pain becomes ſtill more excruciating; and, unleſs proper aſſiſtance be given, the patient is generally cut off in not many months after the breaking out of the cancer.

In early ſtages, the diſeaſe in general may be conſidered as entirely a local affection, and a radical cure may be of courſe expected; but in proportion as the ſkin ſhall afterwards be found diſeaſed and adhering to the gland, and that to the pectoral muſcle, and the lymphatic glands near the mamma and in the arm-pit ſwelled, the chance of a cure becomes more doubtful, as the cancerous matter may have been abſorbed, and part of it carried into the ſyſtem. The moſt unfavourable ſtate for an operation is when there are ulcerations in the breaſt, large, deep, and of long ſtanding; and particularly if theſe are attended with great pain, when the arm of the affected ſide has become œdematous, and the health of the patient is much impaired. In this laſt ſtate very little is to be expected from a ſurgical operation.

78 Method of extirpating the mamma.

In extirpating the mamma, which we ſhall firſt ſuppoſe is to be done where the ſkin is ſound, and where the tumor has no uncommon adheſion to the pectoral muſcle, the patient ought to be placed horizontally in a bed, or upon a table covered with a mattreſs, &c. The operator is to be ſeated, and to have proper aſſiſtants. A longitudinal inciſion is then to be made with a common ſcalpel through the ſkin and cellular ſubſtance along the whole extent of the tumor, and at a little diſtance from the nipple, which is to be ſaved. When the longeſt diameter of the tumor is acroſs the body, inſtead of a longitudinal inciſion, a tranſverſe one is to be made. The integuments being diſſected from the mamma on both ſides of the inciſion, the patient's arm is to be extended to ſave the pectoral muſcle; and the whole glandular part is to be detached from the muſcle, though a ſmall portion only ſhould be diſeaſed, beginning at the upper ſide, and ſeparating downwards. If there be any indurated glands, they are to be carefully removed. If the patient be faint, a glaſs of wine, or ſome other cordial, is to be given. After the diſeaſed parts are removed, the wound is to be cleaned with a ſponge wrung out of warm water, which will generally render the ſmall bleeding veſſels more conſpicuous. The integuments are next to be cloſely applied to the parts underneath, and retained there by the twiſted ſuture, and likewiſe by a few adheſive ſtraps. A large pledgit of ſimple ointment is now to be laid over the whole; and this is to be covered with a thick compreſs of lint, tow, or ſoft linen; and the dreſſings to be kept in their place, and moderate preſſure made by the napkin and ſcapulary bandage.

By this method the integuments will generally ſoon adhere, and a cure will be formed by the firſt intention. But it does not often happen that the operation is performed while this favourable mode of practiſing it will anſwer.

In general, before extirpation of a breaſt is recommended by the ſurgeon, or ſubmitted to by the patient, a conſiderable portion of the external integuments are ſo much diſeaſed as to render it neceſſary to ſeparate them along with the glandular part of the mamma. It ſometimes happens likewiſe that the tumor adheres to the pectoral muſcle, and that again to the ribs. In either of theſe caſes it becomes neceſſary to remove all the diſeaſed parts. For this purpoſe, two inciſions of an oval form, with ſharp extremities, of a ſufficient ſize to include the whole of the affected parts, become neceſſary. If again it be found, that beſides the diſeaſe of the breaſt, the lymphatic glands in the neighbourhood are indurated, or otherwiſe diſeaſed, the firſt inciſion ought to extend at once over theſe; and after the other parts have been removed, and the veſſels ſecured, the whole of the diſeaſed glands are to be extirpated; and in performing this part of the operation, conſiderable aſſiſtance may be given by ſupporting them with a hook, or a ligature paſſed through them, till they are entirely removed. When they lie deep in the axilla, the points of the fingers, or the end of the handle, will ſometimes be ſafer than the edge of the knife. After having removed all the glands which are in the ſmalleſt degree affected, the cut edges of the ſkin are to be brought as near to each other as the nature of the caſe will allow, ſo as to heal as much as poſſible by the firſt intention. After the wound is nearly, or perhaps entirely healed, an iſſue, inſerted into the arm of the oppoſite ſide, will be the beſt means of preventing a relapſe.

SECT. IV. *Burns.*

79 Conſequences of burns. THE immediate conſequence of burns is a greater or leſs degree of inflammation; and the danger attending ſuch accidents is in proportion to the extent of the injury. Burns which irritate the ſkin only, without deſtroying the cuticle, act nearly in the way of a common bliſtering plaſter. When the cuticle is deſtroyed, no bliſter takes place; a mortified ſlough is obſerved; and when this ſeparates, an ulcer is left.

80 Cure. Where the cuticle is not deſtroyed, relief may be procured by holding the part affected a conſiderable time in very cold water, or ſometimes by plunging it two or three times into water a little below the boiling point. Solutions of ſaccharum ſaturni, and other preparations of lead, have been recommended, as in the caſe of other inflammations. Vinegar is found a very effectual application, whether the ſkin be ſound or bliſtered. The part may be entirely immerſed in it, or linen rags dipt in the vinegar may be applied, and the parts kept conſtantly moiſt, till the pain be removed. The ſame application is uſeful where the ſkin is rubbed off, or otherwiſe deſtroyed. In this caſe, indeed, the vinegar is apt to give additional pain on its firſt application; but this ſoon ceaſes, and the part becomes much cooler and eaſier. If the patient will not ſuffer the vinegar to be applied immediately to the ſurface of the ſore, a linen rag ſoaked in olive-oil may be previouſly laid on the part, covering the whole with the cloths dipped in vinegar; and theſe applications are to be occaſionally repeated till

the pain and inflammation be entirely removed; after which the parts are to be dreſſed in the ſame manner as in the caſe of a common bliſter. In extenſive burns, where the irritation is great, along with external applications, opium ſhould be preſcribed, in doſes adequate to the degree of pain. Even that ſtupor with which patients in this ſituation are ſometimes attacked, is found to be more readily removed by opium than by any other remedy. With reſpect to the bliſters which ariſe upon burns, it has been diſputed whether they ought to be opened, or allowed to remain till they dry up of themſelves. But, according to the opinions of the lateſt authors, they ought to be opened as ſoon as any conſiderable quantity of fluid is found in them. After the ſerum is diſcharged, a thin liniment of wax and oil, with a little ſaccharum ſaturni, ſhould be applied to the part.

In caſes of very ſevere burns, where, notwithſtanding the above treatment, there is danger of a violent inflammation being induced, blood-letting, cooling purgatives, and other remedies adapted to the peculiar ſymptoms, muſt be uſed. When, again, burns are from the firſt attended with loſs of ſubſtance, as commonly happens after the application of hot metallic bodies, we ought to have recourſe to the vinegar, as already mentioned, or to a liniment which is now in very common uſe for ſuch purpoſes, made of equal parts of lintſeed oil and lime-water, which, when ſhaken together, forms a thick white ſubſtance, which often gives ſpeedy relief; and it may be readily applied by daubing the parts frequently over with a ſoft pencil well ſoaked in it. Though this has been conſidered as one of the beſt applications in burns, yet, in ſome caſes, more immediate relief has been procured from the application of Goulard's cerate, or the unguentum nutritum; and a weak ſolution of ſaccharum ſaturni has ſometimes been of ſervice.

When burns are occaſioned by the exploſion of gunpowder, ſome of the grains of the powder are apt to be forced into the ſkin. 81 Burns occaſioned by gunpowder. At firſt they produce much irritation; and if they are not removed, they commonly leave marks which remain during life. They ſhould, therefore, be picked out as ſoon as poſſible after the accident, and to prevent inflammation, as well as to diſſolve any powder which may remain, the parts afflicted ſhould be covered, for a day or two, with emollient poultices. In other reſpects, injuries of this ſort are to be treated like any other kind of burns.—When burnt parts are contiguous to each other, they are apt to adhere. To prevent this, pledgits covered with any proper dreſſing ought to be inſerted between them during the courſe of the cure. Ulcers ariſing from burns are apt to become ſoft and fungous, and to riſe above their natural level. When this is obſerved, the emollient ointments, which may have been previouſly uſed, ſhould be laid aſide, and thoſe of a moderately aſtringent nature applied. Gentle compreſſion with a roller is alſo of particular ſervice. Advantage is likewiſe derived from saturnine waſhes, &c. One of the beſt ointments, in ſuch caſes, is the common calamine cerate. Theſe will commonly anſwer the purpoſe; but when they prove inſufficient, burnt alum, blue vitriol, or even lunar cauſtic, may be neceſſary.

CHAP. V. *Of Inflammatory Tumors.*

INFLAMMATORY TUMORS are ſuch as are quick in their progreſs when compared with thoſe of the indolent kind, and are attended with conſiderable pain and other ſymptoms of inflammation. We have here mentioned ſuch only whoſe treatment more properly belongs to the province of the ſurgeon, and which are placed according to their ſituations in the different parts of the body.

SECT. I. *Inflammation and Abſceſs of the Breaſts of Women.*

THIS diſorder occurs moſt frequently in nurſes by the ſtoppage of the milk, which is always occaſioned by ſudden or imprudent expoſure to cold.

In the early ſtages of the affection, reſolution is always to be attempted, unleſs the ſwelling appears to have an evident tendency towards ſuppuration. The remedies uſed in inflammation, in general, ſeem uſeful in every caſe of inflammation of the breaſts. When the patient happens to be nurſing, a ſudden evacuation of blood is apt to diminiſh the quantity of milk: In ſuch caſes, therefore, blood is to be extracted in ſmall quantities at a time. The application of cooling ſaturnine poultices is adviſable. When ſuppuration has taken place, the matter is to be diſcharged by making an inciſion in the moſt depending part of the tumor.

SECT. II. *Inflammation of the Teſticles.*

THIS diſeaſe is often owing to expoſure to cold, violent exerciſe, &c.; but moſt frequently to gonorrhœa virulenta, and never to matter falling down upon the teſtes, as was ſuppoſed by thoſe who gave it the name of *hernia humoralis*. Inflammation here rarely terminates in ſuppuration.

The beſt method for diſcuſſing the inflammation is by the application of leeches; after which the penis ought to be kept conſtantly moiſtened with a ſolution of ſaccharum ſaturni, and the ſcrotum and teſtes ſupported by a proper bandage. The bowels ſhould be kept moderately open; the patient ſhould uſe a low diet, and keep as much as poſſible in an horizontal poſture. If lues venerea be preſent, a cure cannot be expected without mercury. If the diſeaſe is owing to a ſudden ſtoppage of the diſcharge in gonorrhœa, the running ought to be reſtored, and promoted by bathing the penis in warm water, injecting warm oil, and the uſe of bougies. Theſe means will generally diſcuſs the inflammation. If matter form, it muſt be diſcharged.

SECT. III. *Of Venereal Buboes.*

A SWELLING of any of the lymphatic glands of the body is called a *bubo*; and when ſuch a ſwelling proceeds from venereal poiſon, it is termed *venereal bubo*. They ſeldom or never appear except in the lymphatic glands of the groin, arm-pit, or extremities, and much more frequently in the groin than any where elſe.

In the treatment of buboes, a ſtrict antiphlogiſtic regimen is to be uſed to promote a reſolution; the application of leeches to the hardened glands is particularly proper. In diſcuſſing venereal buboes, the application of mercurial ointment has a conſiderable effect. After ſuppuration is completely formed, the application of cauſtic to open the bubo is dangerous, leſt it ſhould corrode ſome of the conſiderable blood-veſſels, which generally lie contiguous to the bubo. Buboes, when opened by the knife, are ſaid to heal with more difficulty, and generally to leave a ſcar behind them. To allow them to burſt of themſelves, is therefore for the moſt part proper, except when the collection is ſo conſiderable as to preſs upon the neighbouring blood veſſels. In ſuch a caſe, a ſmall inciſion may be made by the lancet, taking as much care as poſſible to prevent the admiſſion of the external air into the wound. When the edges of the opening grow callous, the application of lunar cauſtic to them becomes neceſſary. During the remaining part of the cure, mercury joined with opium is to be uſed.

SECT. IV. *Lumbar Abſceſs.*

THE term *lumbar* may be applied to every abſceſs ſeated in the loins; but that which is here meant is ſuch as begins about the top of the os ſacrum, and is ſeated in the vicinity of the great pſoas muſcle.

82 Symptoms of lumbar abſceſs.

The ſymptoms begin with pain and tenſion about the loins, ſhooting upwards to the ſpine and downwards to the thigh. The diſeaſe has ſometimes a ſtrong reſemblance to nephritic affections, and is ſometimes miſtaken for lumbago. After ſuppuration takes place, ſhivering fits come on; and the pain now becoming dull, the patient imagines himſelf better, till matter points at the ſide of the anus, or in the groin. The firſt caſe is rare; and when it does occur, the tumor burſts, or is opened as a common abſceſs. In the other caſe, the matter is ſeated behind the faſcia of the groin, and ſometimes deſcends as far as the knee. The teguments commonly retain their natural appearance. Fluctuation is evident, eſpecially when the patient is in an upright poſture. It is often miſtaken for crural hernia; but may be eaſily diſtinguiſhed from it, by its ſlow progreſs, by pain in the lumbar region at the commencement of the diſeaſe, by the patient allowing the tumor to be handled freely, by fluctuation being evident, by the tumor becoming flaccid when the patient is in an horizontal ſituation, and by the abſence of all the ſymptoms by which hernia is diſtinguiſhed. Both diſeaſes may occur at once; but this is very rare, and a diſtinction is ſtill to be made.

83 Cauſe of this diſeaſe.

It is diſcovered that this diſeaſe has, in general, been induced by conſiderable injury being done to the ſmall of the back or loins, either by twiſts, or ſevere bruiſes, or by ſudden expoſure to cold after the heat occaſioned by ſevere exerciſe, particularly in ſcrophulous habits. Were accidents of this nature immediately treated with that attention which their importance deſerves, the diſeaſe might frequently be prevented.

84 Treatment.

In the treatment the ſtricteſt antiphlogiſtic regimen ought to be obſerved. Blood-letting ought immediately to be performed, by ſcarifying deeply and leeching the injured part: neither are bliſters, opiates, gentle purgatives, and other remedies uſeful in inflammations, to be neglected.

Authors have an idea that little advantage can be derived from laying open the abſceſs, on account of the great danger which may enſue from the admiſſion of air. Mr Benjamin Bell, however, is of an oppoſite opinion, and has always given vent to matter here as elſewhere, and no bad conſequences have been obſerved. The matter, when long lodged, has been found to deſtroy the ſoft parts and bones, and ſometimes to make its way into the cavity of the abdomen; all of which might be prevented by an early evacuation. For this purpoſe a trocar ſhould be uſed, which was tried by Mr Bell in one caſe with complete ſucceſs.

Some other caſes are lately narrated by authors, where, by the introduction of a ſeton, and drawing off the matter by ſlow degrees, and then by uſing compreſs, and ſometimes injections of gently irritating fluids, a cure has been performed in the courſe of a few months. If the caſe is doubtful, an opening ſhould be made with the knife in the ſame manner as in hernia. If the flow of matter continue conſiderable for the ſpace of two or three weeks, injections of a weak ſolution of ſaccharum ſaturni, lime water, or other gentle aſtringents, may be employed.

SECT. V. *Paronychia or Whitloe, and Chilblains.*

85 Of whitloe.

WHITLOE is a painful and inflammatory ſwelling at the extremities of the fingers under the nails, terminating in an effuſion of clear ſerum below the ſkin, which is ſometimes ſo acrid as to corrode the perioſteum, and render the bones carious. At other times the inflammation runs ſo high that the whole of the arm ſwells, particularly the lymphatics, and ſometimes even the glands in the axilla.

When this affection ariſes from external violence, the remedies employed for inflammation, in general, will be of ſervice. When it ariſes from unknown cauſes, ardent ſpirits and aſtringents have been found uſeful, particularly when topical and general bleedings have been previouſly uſed. When an effuſion of a ſerous matter takes place, it is immediately to be diſcharged, as it is almoſt impoſſible to convert it into proper pus. When this ſerum has continued ſo long as to render the bone carious, a removal of the whole bone, or of the carious portion, becomes neceſſary, in order to effect a complete cure.

86 Chilblains. Chilblains are inflammatory ſwellings, of a purple colour, chiefly affecting the heels, and ſometimes alſo the fingers, toes, arms, hands, or feet, or even the tips of the noſe and ears, attended with a ſtinging pain, and a degree of itching. The ſwelling ſometimes cracks, and diſcharges an acrid ſerum: ſometimes a mortification takes place, and an ulcer follows very difficult to heal.

This diſorder is owing to the weaker action of the ſmall veſſels moſt remote from the heart, occaſioned by cold or dampneſs, and occurs moſt frequently in people of a delicate conſtitution.

When the patient has been for ſome time expoſed to the cold, and the parts are froſt-bitten, they ought to be plunged into the coldeſt water and rubbed with ſalt; when they are only benumbed, rubbing them with camphorated ſpirit of wine will anſwer equally well: but when cracks take place, and an oozing of acrid matter enſues, poultices may be applied, but not long, as they are apt to give riſe to fungous excreſcences.

Sect. VI. *Of Contuſions and Sprains.*

87 Symptoms of contuſions and ſprains. Contusions of the integuments and muſcles produce pain, ſwelling, and inflammation; and theſe, in ſome caſes, may extend to a conſiderable degree; but in general they are leſs violent than what take place in caſes of ſprains of ligaments or tendons; for in theſe there is frequently a total loſs of motion for many weeks, and ſometimes for years, if proper attention be not paid. An effuſion of fluids always ſucceeds the injury, which ſeems to be, for the moſt part, of a ſerous nature, as the ſkin uſually retains its natural colour; ſometimes the tumefied parts are of a deep red, or leaden colour, owing to a rupture of ſome veſſels conveying red blood.

88 Treatment. In the treatment of contuſions and ſprains, two circumſtances require attention. 1. To endeavour to prevent the ſwelling as far as is practicable; 2. To employ thoſe remedies afterwards which are known to be moſt powerful in preventing or removing inflammation. In contuſions of the cellular ſubſtance, and even of the muſcles, the effuſed fluids are commonly ſoon abſorbed; but in ſprains of the tendons or ligaments, a very troubleſome, painful thickneſs of the injured parts is apt to continue for a great length of time, and in ſome inſtances even for life.

It is neceſſary, therefore, to obviate theſe ſymptoms as ſoon as poſſible; and for this purpoſe, cold aſtringent applications, as water, vinegar, &c. are moſt commonly uſed. Others again, with a view to relax the parts fully, make uſe of water as hot as the patient can bear it. By immerſing the injured part in theſe immediately after the injury is received, the effuſion will at leaſt be ſomewhat obviated. When the pain is exceſſive, opiates become neceſſary.

After blood has been freely diſcharged, a repetition of the remedies already mentioned will be found to give great relief; care ſhould be taken, at the ſame time, that the injured parts be kept in a relaxed and eaſy poſture.

Chap. VI. *Of Indolent Tumors.*

89 Different kinds of indolent tumors. These are ſuch as are ſlow in their progreſs, and may continue for a long time without being attended with either pain or inflammation; though occaſionally almoſt all of them may be inflamed, and ſome of them, in that ſtate, attended with conſiderable pain. They are of different kinds according to the nature of their contents, and appear in various parts of the body. They are ſeated in the adipoſe and cellular membrane; whence it often happens that they take place in the viſcera themſelves, where they are frequently mortal. Sometimes they are filled with a ſubſtance of the conſiſtence of honey, and are thence called *meliceratous* tumors; ſometimes they are filled with an harder ſubſtance, and are then called *atheromatous* tumors; at other times they are filled with a ſubſtance of the conſiſtence of fat, and are then called *ſteatomatous*. Sometimes, however, they are found to be repleniſhed with a fluid lymph coagulable by heat, and are then called *hydatids*. One ſet are filled with matter like the ſynovia of the joints, and get the name of *ganglions*.

90 How they are diſtinguiſhed from oth tumors an from one another. Tumors of this kind are eaſily diſtinguiſhed from all others, as having neither heat, pain, nor pulſation, as is to be obſerved in thoſe which incline to ſuppurate; and they are diſtinguiſhed from each other, before they are laid open, by fluctuation being readily perceived in the meliceris: the atheroma is ſoft and compreſſible, but has no fluctuation; while the ſteatoma is commonly firm and rolls under the ſkin. But theſe rules are liable to conſiderable exceptions. The meliceris and atheroma are moſt commonly found upon the head, and the ſteatoma upon the other parts of the body; while ganglions are ſituated over the tendons of the muſcles. 91 Treatmen Theſe tumors muſt be either extirpated entirely, or laid open ſo as to diſpoſe the cyſt to ſlough off or granulate. If the matter be fluid, we may evacuate it by an opening made with a lancet, or by means of a ſeton; but as the matter is apt to collect again, it is better to remove the ſac entirely. If large veſſels or nerves prevent this from being done, then it is to be laid freely open and expoſed to the air, ſo that the bag may granulate, or be thrown off. When the tumor is to be extirpated, a longitudinal inciſion is to be made through the integuments; after which the tumor may be frequently removed by the point of the finger, or by the end of a ſpatula, replacing the integuments with a view to heal by the firſt intention. In every pendulous tumor of this kind, with a narrow neck, we ought to divide the teguments near the bottom of the tumor, in an oval form, ſo that the wound may be afterwards properly covered with the remaining integuments. After the tumor is removed, the ſkin is to be replaced over the wound, and fixed with adheſive ſtraps, covering it with a pledgit of cerate, a ſmall compreſs of linen, with a bandage above all, to make a gentle preſſure on the parts.

Sect. I. *Of Steatomatous and Sarcomatous Tumors.*

92 Steatomatous tumors. Steatomatous tumors have been ranked by authors among thoſe of the encyſted kind; but they have no other cyſt containing them than the common cellular ſubſtance, ſomewhat condenſed; and the particles of fat compoſing them are found of the ſame ſize with thoſe in a ſound part of the body.

Authors formerly adviſed the diſcuſſion of ſteatoms, or the prevention of their growth, by the application of preſſure; but by ſuch means the growth is rather promoted than retarded, nor have internal remedies been of any advantage. They can be removed therefore only by an operation which is the ſame with that for the extirpation of encyſted tumors.

93 Sarcomatous tumors. Sarcomatous tumors have nearly the ſame external appearance with thoſe of the ſteatomatous kind. The term has been applied, in a general way, to ſcirrhi of the glands; but

nglions, Swel- gs of the rſæ Mu- æ.

but ſarcomatous tumors are likewiſe found in various other parts of the body, and are diſtinguiſhed from ſteatoma by being firmer to the touch; internally they are found of a redder colour, or approaching that of muſcles, in conſequence of the greater number of veſſels entering into their ſubſtance. Theſe are to be treated in the ſame manner as ſteatoms; but the operation ought to be performed early, as they are more apt to degenerate into cancer.

Sect. II. *Of Ganglions, or Swellings of the Burſæ Mucoſæ.*

Ganglions of the tendons are likewiſe tumors of the encyſted kind, ſeated in the burſæ mucoſæ, or ſheaths of the tendons which belong to the extremities. They are moſt frequently met with over the tendons upon the back of the wriſt, and often likewiſe about thoſe of the ankle and other parts of the extremities. When preſſed, they are found to poſſeſs a conſiderable degree of elaſticity, from which, and from their ſituation, they may generally be diſtinguiſhed from other encyſted tumors. They ſeldom arrive at any great bulk, are not often attended with pain, and commonly the ſkin retains its natural appearance. On being laid open, they are found to contain a tough, viſcid, tranſparent fluid, reſembling the glaire of an egg.

94 reatment gangli- ns.

They are generally produced by ſprains, or contuſions of the joints, or by rheumatiſm. In many inſtances, they go off inſenſibly, without any aſſiſtance from art; but as this is often not the caſe, means ought to be uſed for removing them. For this purpoſe, moderate friction frequently repeated, or gentle compreſſion applied to them by means of thin plates of lead, &c. ſometimes remove them. In ſome inſtances they have been removed by the application of bliſters; but the moſt certain method is, to make a ſmall puncture into the ſac, and to draw a cord through it; or, after the puncture is made, to preſs out the contents, and then inject ſome gently ſtimulating fluid, as port wine and water heated blood-warm. Sometimes, in tumors of this kind, bodies of a cartilaginous nature, and of different ſhapes and ſizes, are found; ſome quite ſmooth, others with peduncles; by which they are ſuppoſed by Dr Monro, in his work upon the burſæ mucoſæ, to have been attached to the burſæ. As theſe cannot be removed by any remedy with which we are yet acquainted, it is found neceſſary to diſcharge them. But as the parts may ſometimes ſuffer from inflammation when the tumor is laid fully open, it may be punctured at each end; and, after preſſing out the contents a ſmall cord may be introduced; after which gentle preſſure may be applied with a compreſs and bandage over the courſe of the tumor. The cord however ſhould not be continued ſo long as to induce any great degree of inflammation, for it is found that a ſlight degree of this ſufficiently anſwers the purpoſe.

Sect. III. *Of Collections within the Capſular Ligaments of Joints, and of Cartilaginous Bodies contained there.*

Collections here may conſiſt of ſerum, blood, or pus and ſynovia combined. They are moſt frequently met with in the joint of the knee, and may be produced either by internal or external cauſes. Theſe kinds of collections may in general be diſtinguiſhed from each other.

95 Cauſes of dropſical ſwellings of the joints.

Watery effuſions, commonly called *dropſical* ſwellings of the joints, ariſe chiefly in conſequence of ſevere rheumatic complaints; and when the tumor is not very large, the fluctuation of the fluid may be felt by preſſure. When a large effuſion appears immediately after a violent bruiſe, it is probable that it conſiſts chiefly of blood: but when it ſucceeds a violent ſprain, attended with great pain, inflammation, and ſwelling, terminating in an effuſion, there is every reaſon to think that the contained fluid conſiſts of pus mixed with ſynovia.

Collections within the Capſular Ligaments of Joints, &c.

96 How diſtinguiſhed from other affections.

Swellings of the joints are moſt apt to be confounded with collections in the burſæ mucoſæ, or with matter effuſed in the adjacent cellular ſubſtance. From the firſt of theſe they are generally diſtinguiſhed by the contained fluid paſſing readily from one ſide of the joint to the other, and from its being diffuſed over the whole of it; whereas, when it is contained in the burſæ, the tumor is confined to a particular part, and is ſeldom attended with much pain.

97 Treatment.

When ſuch collections can ſafely be allowed to remain, the capſular ligament ought never to be opened, as they can often be removed by diſcutients. Even conſiderable collections ariſing from rheumatiſm may commonly be diſcuſſed by friction, fomenting the parts with warm vapour, keeping them conſtantly moiſt with ſaturnine ſolutions, covering them properly with flannel, and applying bliſters. When theſe fail, ſupporting the part with a laced ſtocking, or with a roller, has frequently been of ſervice. But whether a rheumatic tumor can be diſcuſſed or not, it ought not to be opened; for the inconvenience attending it is more intolerable than the pain and inflammation which may enſue. But when the matter would do miſchief by lodging, it ſhould be diſcharged. Effuſed blood and matter which ſucceed high degrees of inflammation are of this kind. Blood is frequently extravaſated among ſoft parts without much detriment; but when in contact with cartilage or bone, it ſoon hurts them materially.

98 Method of diſcharging the matter.

The matter ought to be diſcharged ſo as moſt effectually to prevent the admiſſion of air into the cavity of the joint. For this purpoſe the opening ſhould be made with a trocar; and the ſkin, previouſly drawn tight to the upper part of the tumor, ſhould be pulled down immediately on withdrawing the canula. A piece of adheſive plaſter ſhould be directly laid over the opening, and the whole joint ſhould be firmly ſupported by a flannel roller properly applied. If the patient be plethoric, he ſhould be blooded to ſuch an extent as his ſtrength will bear; he ſhould be put upon a ſtrict antiphlogiſtic regimen, and in every reſpect ſhould be managed with caution; for inflammation being very apt to enſue, we cannot too much guard againſt it.

99 Concretions in the joints,

Joints are ſometimes rendered painful and ſtiff by the formation of different ſubſtances within the capſular ligaments. Theſe are ſometimes looſe, and as firm as cartilage; and ſometimes of a ſoft membranous nature, ſimilar to thoſe already obſerved in treating of ſwellings of the burſæ mucoſæ.

In ſome caſes theſe ſubſtances, eſpecially the laſt ſpecies, retain nearly the ſame ſituation, without being much affected either by preſſure or by the motion of the joint: in that caſe the pain is conſtant, but ſeldom ſevere. The firſt ſpecies, however, is commonly very moveable; and on being touched, they ſlip with ſuch facility that it is difficult to fix them even with the fingers. Theſe are only painful in particular ſituations.

100 When perfectly looſe, may be extracted.

Where theſe concretions appear, upon examination, to be perfectly looſe and detached, if the pain which they excite is very ſevere, we ſhould venture in a cautious manner to take them out, by making an inciſion into the joint. But if there is reaſon to ſuſpect that they are connected with any part of the joint, the patient ought to be adviſed to ſubmit to the pain they induce, which in general will be rendered moderate by ſhunning exercſe; but if, notwithſtanding this, it becomes inſupportable, amputation is the only reſource.

101 Manner of extracting them.

The limb being firmly ſecured by aſſiſtants, in that poſture which admits of the body to be taken out being felt

moſt

Collections within the Capſular Ligaments of Joints, &c.

moſt diſtinctly, the ſurgeon ſhould endeavour to fix it with his fingers towards the upper part of the joint, after an aſſiſtant has drawn the ſkin as much as poſſible upwards from the part where the inciſion is to be made. The operator with a ſcalpel is now to make an inciſion through the teguments and capſular ligament, directly upon the ſubſtance itſelf, of ſuch a ſize as will admit of its being eaſily taken out; which may be done either with the finger or with the end of a blunt probe. If it is found to be connected by any ſmall filaments either to the capſular ligament or to the cartilages of the joint, they ſhould be cautiouſly divided, either with a probe-pointed biſtoury, or probe-pointed ſciſſars, after drawing the ſubſtance itſelf as far out as it can be got. When more concretions than one are found, they ſhould all be taken out at the ſame opening, when this can be done; but when it cannot, it will be better to allow the firſt inciſion to heal before attempting the ſecond, ſo as to avoid as much as poſſible the exciting of inflammation.

After the concretion is removed, the ſkin ſhould be immediately drawn over the wound in the capſular ligament; and the lips of the opening in the ſkin being laid together, they ſhould be ſecured in this ſituation by pieces of adheſive plaſter, ſo as to prevent the air from finding acceſs to the cavity of the joint. Till the wound be completely healed, the patient ſhould not only be confined to bed, but the limb ſhould be kept as much as poſſible in one poſture, and a ſtrict antiphlogiſtic regimen ſhould be preſerved.

Sect. IV. *Of Spina Bifida.*

Spina bifida, is a tumor which ſometimes appears upon the lower part of the ſpine in new-born children. A fluctuation is diſtinctly perceived in it, and the fluid it contains can in ſome meaſure be preſſed in at an opening between the vertebræ. In ſome caſes this opening is owing to a natural deficiency of bone; in others, to the ſeparation of the ſpinous proceſſes of the vertebæ.

The diſeaſe proceeds from ſerum collected within the coverings of the ſpinal marrow. It is always fatal. Children labouring under it have been known to live for two or three years; but, in general, they linger and die in a few weeks. All that art has been able to do is to ſupport the tumor by gentle preſſure with a proper bandage. When a tumor of this kind is laid open or burſts, the child dies in a few hours. A tumour nearly of the ſame nature with this is ſometimes met with upon different parts of the head in new-born children: it is formed by a fluid lodged beneath the membranes of the brain, which have been forced out at ſome unoſſified part of the ſkull. What we have ſaid with reſpect to the former is exactly appplicable to this.

Sect. V. *Of Scrophulous Tumors.*

We ſhall here only mention the ſurgical treatment of ſcrophulous tumors, having ſpoken of ſcrophula in general under the article Medicine. Some practitioners have recommended poultices, &c. to bring ſcrophulous tumors to ſuppuration; but the beſt practitioners have laid them aſide, becauſe they increaſe the ſoft and ſpongy ſtate of the parts, by which they are prevented from healing.

102 Treatment of ſcrophulous tumors.

As external applications are ineffectual, it is better to allow ſcrophulous tumors to be as much expoſed as poſſible, as this frequently renders the ſubſequent ulcer more eaſily cured. The other methods recommended for diſcuſſing theſe tumors are, the internal uſe of cicuta, burnt ſponge, muriated barytes, a long continued uſe of the cold bath, particularly of ſea-bathing, and drinking mineral or ſea-water. Theſe, to produce any effect, ſhould be begun early, while the tumors are ſmall, and long perſiſted in. When the tumors come to a ſtate of ſuppuration, if they are ſeated upon the thorax or abdomen, or any of the large joints, free vent ought always to be given to the matter to prevent its burſting into theſe cavities; and when the abſceſs is large, this ſhould be done with a trocar, or by paſſing a cord thro' it, in order to exclude the external air. When the tumors are not ſituated upon great cavities, it is better to allow them to break of themſelves, as the ſores commonly heal more readily, and the ſcar is pretty ſimilar in both. The moſt proper applications to ſcrophulous ſores ſeem to be thoſe of the ſaturnine kind, as they diminiſh inflammation, and in ſome meaſure prevent the ſore from ſpreading. When the bones become carious, they are to be treated like carious bones from other cauſes; but amputation cannot here be attended with advantage, as the diſeaſe proceeds from a fault in the conſtitution. After the ſores are healed up, the introduction of an iſſue may aſſiſt in preventing their return.

Scrophulous Tumors.

103 How diſtinguiſhed from ſcirrhous tumors.

Tumors of a ſcrophulous nature are ſometimes apt to be miſtaken for thoſe of the ſcirrhous kind, and thus may be improperly extirpated. Scrophulous tumors deeply ſeated commonly have a degree of firmneſs, which, if they happen to be ſeated near a ſuſpicious part, as cloſe by the ſide of a woman's breaſt, may give occaſion to ſuch a miſtake. But they may generally be diſtinguiſhed by the ſoftneſs even of the firmeſt kind of them, when compared with ſcirrhus. They have always a ſmooth equal ſurface; whereas ſcirrhus is ſomewhat unequal or knotty, and ſeated in the real ſubſtance of the gland; and a ſhooting pain is commonly felt in it from time to time, even from its firſt appearance. They are generally accompanied, too, with other ſymptoms of ſcrophula, which is not neceſſarily the caſe with ſcirrhus.

Sect. V. *Of Bronchocele.*

This is a tumor on the fore part of the neck, ſeated between the trachea and ſkin, termed in French *goitre*. In this country it is very rare; but it is frequent among the inhabitants of the Alps, and other mountainous countries, and is ſuppoſed to be owing to the uſe of ſnow-water. It is ſeated moſt frequently in the thyroid gland; tho' in two caſes examined by Mr Benjamin Bell this gland was diminiſhed from the compreſſion of the tumor, which was chiefly formed of condenſed cellular ſubſtance, with effuſions in different parts of it of a viſcid brown matter. Dr Proſſer conſiders bronchocele as a dropſical affection of the thyroid gland; and in confirmation of this, he gives an account of a diſſection of a diſeaſed gland of this kind by Dr Hunter, who found in it a great number of capſules filled with water.

104 Symptoms of bronchocele.

The ſwelling is at firſt ſoft, without pain or any evident fluctuation, and the ſkin retains its natural appearance; but as the tumor advances in ſize, it becomes unequally hard; the ſkin acquires a copper colour, and the veins of the neck become varicoſe; the face becomes fluſhed, and the patient complains of frequent headachs, as well as of ſtinging pains through the body of the tumor.

105 Treatment.

Calcined egg-ſhells have been recommended by authors as a ſpecific for this diſeaſe; but little dependence is to be placed on ſuch a remedy. Frequent frictions are found uſeful, eſpecially when employed early; ſaponaceous and mercurial plaſters, too, have in ſome caſe proved ſerviceable; and repeated bliſters have been known to retard its progreſs. In the enlarged ſtate of the tumor no remedy yet known is powerful enough to diſcuſs it. When the diſeaſe is far advanced, the removal of the tumor by an operation muſt be attended with great danger, on account of the enlarged ſtate of the arteries, as well as its vicinity to the common carotids. It is therefore thought by ſome of the moſt experienced practitioners, that in ſuch a ſituation it would not be adviſable to attempt extirpation, and that the patient ſhould rather truſt to the common palliative treatment. When the tumor, however, is not much increaſed, if other remedies have failed, and the diſeaſe is advancing, a ſurgeon might be warranted in attempting its extirpation.

Sect. VI. *Of Nævi Materni, Corns, and Warts.*

106 Nævi materni.

Nævi materni are thoſe marks which frequently appear upon the bodies of children at birth, and which are ſuppoſed to originate from impreſſions made on the mind of the mother during pregnancy. They are of various forms; their colour is likewiſe various; though moſt frequently reſembling that of claret or red port-wine. Many of theſe marks are perfectly flat, and never riſe above the level of the ſkin: theſe do not require the aſſiſtance of ſurgery; but in ſome caſes they appear in the form of ſmall protuberances, which frequently increaſe to a great ſize in the courſe of a few months. They appear to be firm and fleſhy. They ſometimes hang by ſlender attachments to the contiguous parts, but more generally they are fixed by broad baſes. They may be removed with as little danger as any other tumor of the ſarcomatous kind. They are ſupplied indeed more plentifully with blood than moſt other tumors are; and even ſometimes they appear to be entirely formed by a congeries of ſmall blood-veſſels; but the arteries which ſupply them may, for the moſt part, eaſily be ſecured by ligature. The operation ſhould never be long delayed; for as the ſize of the veſſels correſponds with that of the tumor, they ſometimes are ſo large as to throw out a good deal of blood before they can be ſecured. In performing it, the tumor is to be cut out, the arteries taken up, and the remaining ſkin brought as well together as the nature of the part will allow, and kept ſo by adheſive plaſter or ſuture. When the tumor is pendulous, and connected only by a narrow neck, it ſhould be extirpated by ligature.

107 Corns.

Corns are ſmall hard tubercles, commonly ſituated on the toes or other parts of the feet, and ſometimes on the hands. They are of a horny nature. They proceed from a diſeaſed ſtate of the cuticle, occaſioned by preſſure. The part becomes hard and thickened, with a ſmall white ſubſtance in the centre, which has a diſpoſition to become prominent. It likewiſe forms a depreſſion in the ſubjacent cutis vera, and ſometimes is ſaid to penetrate it. When corns are ſituated on parts much expoſed to preſſure, they irritate the ſkin, and produce an increaſed ſenſibility of the part, and thus occaſion much pain. The beſt preventive of corns is the wearing of wide ſhoes, and avoiding every kind of preſſure; and unleſs this be attended to, it will be found difficult to keep free from them. Various remedies are recommended for the cure or removal of corns. One is to bathe the part about half an hour in warm water, then to pare as much off them as poſſible without giving pain, and to apply over them any emollient ointment. If this treatment be frequently repeated, while preſſure from ſhoes is prevented, they generally fall off, and do not return if preſſure be afterwards avoided. Another method is to allow them to grow to ſome length through pieces of perforated leather, properly ſecured by plaſter or by any other means, and afterwards to cut round their root, by which they may for the moſt part be eaſily turned out. Or if ſuch irritating ſubſtances be applied to them as will raiſe a bliſter by ſeparating the cuticle from the cutis, the corn will be raiſed along with the cuticle, and may then be readily removed by a ſcalpel or ſciſſars. The ſurface of the cutis being now expoſed, is to be healed like any other part that has been bliſtered.

108 Warts.

Warts are ſmall, hard, indolent tumors, with a rough ſurface, appearing on different parts of the body, chiefly the hands and face, and more commonly in young people. When they appear in advanced life they are apt to degenerate into cancers, eſpecially when of a livid colour and with a ſmooth ſurface. If they do not prove troubleſome, nothing ſhould be done to them, as they generally either fall off or waſte gradually away. When from their ſize or ſituation they require to be removed, this, if they are pendulous or have narrow necks, is eaſily done by ligature; but if their baſes be broad, the ſcalpel or eſcharotic applications will be neceſſary. As few, however, will ſubmit to the former, the latter are generally employed. Eſcharotics of a mild nature give leaſt pain, and are leaſt apt to excite inflammation, which in theſe caſes it is difficult to remove, and are found to be quite ſufficient for the purpoſe. One of the beſt of theſe is crude ſal ammoniac: it ſhould firſt be moiſtened in water, and then well rubbed upon the warts two or three times a-day. Liquid ſalt of tartar, and ſometimes ſpirit of hartſhorn, has anſwered the ſame purpoſe: ſome recommend alſo the juice of onions.

109 Warts on the penis.

Warts appearing on the penis as a ſymptom of venereal infection, are of the ſame nature, and to be cured by the ſame means. Mercury is of no advantage here, and commonly indeed does harm. When every other part of the diſeaſe is eradicated, the warts may generally be removed by waſhing them morning and evening in lime-water, or in a weak ſolution of ſaccharum ſaturni. They may be removed alſo by the knife, and the parts from whence they are cut afterwards touched with lunar cauſtic, to prevent them from returning: but when this method is practiſed, the operator ought to be certain that he has removed the wart entirely, for where part has been left the moſt formidable ſymptoms have ſometimes enſued.

Sect. VII. *Of Polypi.*

110 Polypi divided into two kinds.

Polypi are pendulous, fleſhy, indolent tumors, ſo called from their ſuppoſed reſemblance to the animal of that name. They may be found in different cavities of the body, and originate from the lining membrane; but thoſe which come under ſurgical treatment are found in the noſe, mouth, throat, and outer paſſage of the ear, and in the vagina and rectum. They are divided into two claſſes; the one ſoft and compreſſible, the other extremely firm. Both of them bleed on being fretted or roughly handled. The ſoft kind ſhrivels and contracts in a dry atmoſphere, (this is particularly the caſe with thoſe of the noſe); but the firm are not affected by the influence of the weather. Their colour is commonly pale and tranſparent, and ſometimes a deep red.

The pain at the commencement of the diſorder is always inconſiderable; but increaſes in thoſe of a hard nature as they increaſe in ſize. Sometimes polypi of this kind become unequal, and form ulcers over the whole ſurface, diſcharging fetid matter in conſiderable quantity. They are apt at this time, unleſs extirpated, to degenerate into cancer.

111 Their cauſe.

Moſt frequently they ariſe from local injury, or whatever tends to produce and ſupport an inflamed ſtate of the part. Scrophula and lues venerea, though conſidered by ſome authors as frequently giving riſe to them, ſeem only to be exciting cauſes; for in lues venerea in particular, polypi when preſent remain after the diſeaſe is cured.

112 Prognoſis.

The prognoſis muſt depend much upon their ſituation and their conſiſtence. The ſoft kind being ſeldom painful, may be removed at any period with little danger; but the hard kind are generally not only painful, but more apt to degenerate into cancer, or to return after being removed. The ſoft kind therefore may be removed in general with ſucceſs; but when polypi of a harder nature exiſt, the prognoſis will be much more unfavourable.

113 Treatment. With reſpect to the treatment.—As long as they remain ſtationary, they are not to be touched; but when they continue to grow, we ought to uſe aſtringent remedies, eſpecially a ſtrong ſolution of alum, a decoction of oak bark, vinegar, ardent ſpirits, &c. The ſofter kinds of polypi may frequently be prevented for a long time from increaſing in ſize, and ſometimes they even become conſiderably ſmaller. Mercury has been found rather to make them worſe; cauſtic and other corroding applications have been of uſe in the ſofter kind, though they have not produced a cure. Setons have likewiſe been uſed with little advantage. It is therefore found neceſſary to have recourſe to a more effectual practice; and with this view the knife, ſciſſars, forceps, or ligature, are more generally recommended. The knife and ſciſſars may be uſed when the roots of the tumor can be readily come at; but polypi are ſeldom ſo ſituated as to render exciſion practicable; and even when they are, the hemorrhagy may be attended with conſiderable danger. The removal of a polypus by tearing or twiſting it with the forceps, Plate CCCCLXXXVII. fig. 4. is occaſionally practiſed; but as ligatures are leſs painful, and fully as effectual, they are now more generally employed. The ligatures conſiſt of wire, catgut, ſilk cord, &c. Different methods have been employed for paſſing theſe over polypi, according to their different ſituations.

114 Method of applying a ligature to them. When the ligature is to be applied, it is to be paſſed double over the tumor, and conducted to the root of it by means of the fingers or by ſlit probes, as in plate CCCCLXXXVII. fig. 5. or rings, Plate CCCCLXXXVII. fig. 6. as may be beſt ſuited to the ſhape and ſize of the paſſage. The ends of the ligature are then to be introduced into a ſingle or double canula, as in Plate CCCCLXXXVII. fig. 7. which is to be puſhed along the oppoſite ſide of the polypus till the end of the canula reach the root of it, when the ligature is to be drawn ſomewhat tight, and faſtened to the canula which is to be left in the paſſage. The ligature is to be daily tightened till the tumor drop off. In this manner the largeſt polypus may be removed equally well with thoſe of a ſmaller ſize. Should any part of it remain, it may be deſtroyed by cauſtic, and different inſtruments are contrived for conducting this to the root of the tumor.

What has been ſaid of the treatment of polypi in general, readily applies to thoſe ſeated in the noſe, outer paſſage of the ear, the rectum, and the vagina. It likewiſe applies to thoſe in the throat; only that inſtead of paſſing the ligature through the mouth it is to be paſſed through one of the noſtrils. The operator is then to introduce one or two of his fingers into the mouth, and open the doubling of the ligature, which he is to paſs over the polypus, and having preſſed it down to the root of it, to proceed as before directed.

Chap. VII. *Of Diſeaſes of the Bones.*

The bones, as well as the ſofter parts, are liable to be ſwelled, either throughout their whole length, or to have tumors formed on particular parts of them.

115 Exoſtoſis. Exoſtoſis is one ſpecies of tumor of the bone. According to Mr Bromefield, no ſwelling ſhould be called ſo, but an excreſcence continued from a bone, like a branch from the trunk of a tree. Under this head therefore is ranked the *benign node*, which may be produced by external injury, ſuch as contuſions and fractures: it can hardly be called a diſeaſe, as pain ſeldom ſucceeds, but rather a deformity.

116 Tophus. There are riſings or tumors obſervable on the bones which are often the conſequents of venereal virus, and are termed *tophi*, *gummi*, or *nodes*.—Tophus is a ſoft tumor in the bone; and ſeems to be formed of a chalky ſubſtance, that is intermediate between the oſſeous fibres. Theſe cretaceous extravaſations are ſometimes found on the ligaments and tendons, as well as on the bone; and may ſometimes be taken out by the knife. We have many inſtances where chalk ſtones in gouty people make their way out through the ſkin of the fingers and toes.

117 Gummi. Gummi is a ſoft tumor on the ſurface of the bone, between it and the perioſteum; and its contents reſemble gum ſoftened, from whence it has taken its name. Poſſibly, by obſtruction in the nutrient veſſels of the bone, a rupture of ſome of them occaſions the ſerous liquor to eſcape, which, by making its way between the the fibres of the bone, arrives at its ſurface; and being detained by the reſiſtance of the perioſteum, its moſt liquid parts being evaporated, and the remainder condenſed by the inflammation, and conſequently this inelaſtic covering being ſtretched, it becomes inſpiſſated, and forms this ſpecies of *exoſtoſis*, as it is generally called. When this is the cauſe, and the indiſpoſition of the habit in general got the better of, preſſure by a ſteel inſtrument, adapted to the part affected, is the proper cure.

118 Nodes. The confirmed venereal node has the appearance of a divarication of the oſſeous fibres, probably from ſome inſpiſſated humour obſtructing the nutrient veſſels, but not extravaſated; this occaſioning an extenſion of the perioſteum, produces a violent pain, which, when nocturnal, is the characteriſtic of a venereal cauſe. When the perioſteum is thickened, but the bone not affected, a courſe of mercury, by attenuating the obſtructed humour, and fitting it to be carried out of the body by the proper outlets, will often produce a perfect cure: but when the bone itſelf is diſeaſed, this method will fail. But here the diviſion of the extended perioſteum has been known to give perfect eaſe.

The uſual method, formerly, was to apply a cauſtic equal to the extent of the node, which being laid bare, required exfoliation before it could be cicatrized. If the inciſion is made early, that is, before matter be found under the inveſting membrane, it ſeldom requires exfoliation; and, as we often find that the bone itſelf is not affected, but only the perioſteum thickened, we may be deceived even after a careful examination: it is therefore proper that the patient ſhould be pretty far advanced in a courſe of mercurial unction before even the inciſion is made; for, ſhould the tumor decreaſe, and the pain abate during the courſe, chirurgical aſſiſtance, with the knife, moſt likely may become unneceſſary.

119 Abſceſſus in medulla, or true ſpina ventoſa. A bone may become carious firſt in its internal parts; and that from external injury, as well as from a vitiated ſtate of the animal-fluids. Authors ſeem not to agree as to the technical term for this kind of diſeaſe of the bones; ſome calling it *cancer* or *gangræna oſſis*; others, *ſpina ventoſa*, from the pointed extuberances uſually attendant on this diſorder of the bone; and ſome again *teredo*, from the appearance of the carious bone, like wood that is worm-eaten.

It is univerſally allowed, that this diſeaſe takes its riſe from matter being formed either in the diploe, or in the marrow: whenever obſtruction is begun in the veſſels expanded on, or terminating in, the medullary cyſts, the conſequence will be inflammation, and, if not early removed, matter will form; for this reaſon this caſe may be called *abſceſſus in medulla*. 120 Symptoms of this diſeaſe. Whenever, then, a patient complains of dull heavy pain, deeply ſituated in the bone, poſſibly conſequent to a violent blow received on the part ſome time before, though the integuments appear perfectly ſound, and the bone itſelf not in the leaſt injured, we have great reaſon to ſuſpect an abſceſſus in the medulla. Children of a bad habit of body, though they have not ſuffered any external injury, will often become lame, and complain of the limb being remarkably heavy; and though not attended with acute pain, yet the dull throbbing uneaſineſs is conſtant. If rigors happen during the time the patient labours under this indiſpoſition, it generally implies that matter will be formed within the ſubſtance of the bone. If the extremities of the bone complained of begin, or if it becomes enlarged throughout its whole extent, it may be known to be an abſceſſus in medulla, or true ſpina ventoſa, as it is called: if neither of theſe ſymptoms take place, the great inſenſibility of the bone in ſome ſubjects will prevent that acuteneſs of pain uſual in other parts where matter is formed, though the acrid matter is eroding the bone during the whole time it is contained within it. This matter at length having made its way through, arrives at the perioſteum, where it creates moſt violent pain, as well from its ſharpneſs as from its increaſed quantity, occaſioning an extenſion of the perioſteum. The integuments then become ſwelled and inflamed, and have a ſort of emphyſematous feel. On being examined by preſſure, the tumor will ſometimes be leſſened, from part of the matter retiring into the bone: from this appearance to the touch, moſt likely the name of *ventoſa* was added to the term *ſpina*.

121 Treatment.

When we are aſſured of matter being under the perioſteum, we cannot be too early in letting it out, as it will ſave a conſiderable deal of pain to the patient, though probably it may not be of any conſiderable advantage in reſpect to the carious bone; for, where the fluids in general are vitiated, no chance of cure can be expected from topical remedies; but where the conſtitution is mended, nature will ſometimes aſtoniſh us in her part, as the carious bone will be thrown off from the epiphyſes, or the teredines will be filled up by the oſſific matter that flows from the parts of the bone where ſome of the ſpinæ have come away.

If proper medicines are given, the children well ſupported, and the parts kept clean and dry, patience and perſeverance will frequently give great credit to the ſurgeon. In caſe it ſhould have been thought adviſable to apply a trephine, to give free diſcharge to the matter, the waſhing it away, as well as the ſmall crumblings of the carious bone, by means of deterſive and drying injections, has been known to contribute greatly to the curing this kind of caries, after the habit of body in general had been mended.

122 Of brittleneſs of the bones.

Beſides thoſe abovementioned, the bones are liable to two oppoſite diſeaſes; the one termed *friabilitas*, the other *mollities*; the former peculiar to adults, the latter more frequent in infants, though ſometimes ſeen in adults, from a vitiated ſtate of their juices.

The bones, when deprived of their cementing liquor, by paſſing through fire, become friable. From repeated ſalivations, and in old people, they have been rendered extremely brittle; inſomuch that in many ſubjects they have been fractured merely from their weight and the action of the muſcles: but in ſuch caſes, this is not owing to the friability of the bones, but to the loſs of ſubſtance, from the eroſion of the bone by an acrimonious humour thrown on it; to which cauſe perhaps may be attributed the diſeaſe called *rickets* in children. The effects of ſcorbutic humour in rendering the bones ſoft in many inſtances, have often been remarked.

123 Rickets.

By proper diet, gentle friction with coarſe cloths, exerciſe, and cold bathing, rickety children will frequently get their conſtitution ſo much changed, as that, by the time they arrive at the age of 20 years, there ſhall not remain the leaſt veſtige of their former diſeaſe. The epiphyſes are generally moſt affected in this ſpecies of the diſorder. For want of early attention to invalids of this ſort, we find that their bones not only become ſoft, and yield to the powers of the muſcles, but remain diſtorted the reſt of their lives, though they have acquired a perfect degree of ſolidity. In ſuch caſes, correcting the vitiated juices only will not reſtore the bones to their natural ſtate; therefore the aſſiſtance of a ſkilful mechanic is neceſſary both to ſupport the parts improperly acted on, and to alter the line of direction of the diſtorted oſſeous fibres.

124 Symptoms of rickets.

Though the curvature of the extremities, or thickneſs of the ends of the bones near their articulations, may give the firſt alarm to thoſe who are conſtantly with children, yet there are other ſymptoms that give earlier notice than theſe; and had they been timely diſcovered by proper judges, it is highly probable that the curvature of the limbs in many children might not have happened. The belly generally becomes larger in this diſeaſe, from the increaſed ſize of the contained bowels, as it is not unlikely but that the meſenteric glands are the firſt parts obſtructed; obſtructions of the liver, ſpleen, and pancreas, ſoon follow; the head then becomes enlarged; then a difficulty of breathing, which is generally ſuppoſed to be the effects of taking cold, ſucceeds; the ſternum is elevated and ſharp, and the thorax becomes contracted; the ſpine is protruded in ſeveral parts; the pelvis altered, according to the preſſure of the parts within, and habitual inclination of the patient, at times, to obtain that line of direction in which the perpendicular from the centre of gravity may fall within the common baſe of the body, the extremities of the cylindrical bones, and the ends of the ribs next the ſternum, become enlarged; ſoon after this the bones in general become ſoft and flexible, yielding in ſuch directions as the ſtrongeſt muſcles determine by their actions.

125 Appearance of the bones of rickety children.

The bones of children who die of this diſorder, we obſerve, are not only rendered ſoft, but the veſſels within their ſubſtance are replete with blood of a texture totally broken, and having more the appearance of thin chocolate than blood; the perioſteum in many places is ſeparated, and the intermediate ſpace between it and the bone filled with extravaſated fluid; and caries is almoſt as frequent as the ſeparation of the perioſteum. The muſcles in ſuch bodies generally appear pale and flabby.

126 Method of cure recommended by Mr Bromefield.

Where the affection of the meſenteric glands is evident, Mr Bromefield aſſerts, that after a doſe or two of the pulvis baſilicus to empty the inteſtines thoroughly, the purified crude quickſilver is by much the moſt efficacious medicine to remove obſtructions in thoſe glands. When the belly begins to ſoften and ſubſide, the chyle paſſes without interruption, and the child begins to get fleſh; then the cold bath becomes truly ſerviceable, and the decoction or cold infuſion of the Peruvian bark is a proper reſtorative; but the cold bath uſed too early, or the bark given before there is a free circulation of chyle through the lacteals, would be very injurious.

127 Of mollities oſſium.

The mollities oſſium, in ſome caſes, may be produced from a redundancy of the oleaginous parts of the blood, or from a laxity of the ſolids, by which the fluids are not ſufficiently attenuated, nor properly blended and mixed: the conſequence of which will be obſtructed perſpiration, the habit in general loaded with groſs, phlegmatic, and ſerous humours, and the oſſific matter not united or condenſed as in an healthy ſtate. The method of cure confirms us in the cauſe of theſe ſymptoms; for, by ſtrengthening the fibrous ſyſtem, by uſing gentle exerciſe, a dry diet, good air, aromatics, and cold bathing, this kind of invalids are generally reſtored to health.

128 Palſy of the lower extremities from curvature of the ſpine.

Among the diſeaſes of the bones we may likewiſe take notice of that *palſy of the lower extremities* which takes place, as is generally ſuppoſed, in conſequence of a curvature in ſome part of the ſpine. To this diſtemper both ſexes and all ages are equally liable. When it attacks an infant of only a year or two old or under, the true cauſe of it is ſeldom diſcovered until ſome time after the effect has taken place. The child is ſaid to be uncommonly backward in the uſe of his legs, or it is thought to have received ſome hurt in the birth. When the child is of an age ſufficient to have already walked, and who has been able to walk, the loſs of the uſe of his legs is gradual, though in general not very ſlow. He at firſt complains of being very ſoon tired, is languid, liſtleſs, and unwilling to move much or at all briſkly. Soon after this he may be obſerved frequently to trip and ſtumble, though there be no impediment in his way; and whenever he attempts to move briſkly, he finds that his legs involuntarily croſs each other, by which he is frequently thrown down without ſtumbling; and when he endeavours to ſtand ſtill in an erect poſture without ſupport, even for a few minutes, his knees give way and bend forward. As the diſtemper advances, it will be found that he cannot, without much difficulty and deliberation, direct either of his feet exactly to any one point; and very ſoon after this, both legs and thighs loſe a good deal of their natural ſenſibility, and become quite uſeleſs. In adults, the progreſs of the diſeaſe is much quicker, but the ſymptoms nearly the ſame.

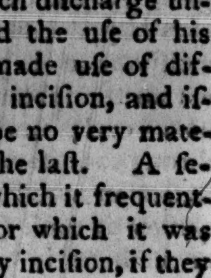
Until the curvature of the ſpine is diſcovered, the complaint generally paſſes for a nervous one; but when the ſtate of the back-bone is adverted to, recourſe is almoſt always had to ſome previous violence to account for it. That this might have been the caſe in ſome few inſtances might be admitted; but in by far the greateſt number ſome prediſpoſing cauſe muſt be looked for.

Mr Pott, who has written a treatiſe upon this diſeaſe, recommends it to our obſervation, that though the lower limbs are rendered almoſt uſeleſs, or even entirely ſo, yet there are ſome circumſtances in which it differs from a common nervous palſy. The legs and thighs, though ſo much affected, have neither the flabby feel of a truly paralytic limb; nor have they that ſeeming looſeneſs at the joints, nor the total incapacity of reſiſtance which allows the latter to be twiſted almoſt in all directions: on the contrary, the joints have frequently a conſiderable degree of ſtiffneſs, particularly the ankles; by which ſtiffneſs the feet of children are generally pointed downward, and they are prevented from ſetting them flat upon the ground.

At firſt the general health of the patient ſeems not to be at all, or at leaſt not materially affected; but when the diſeaſe has continued for ſome time, and the curvature is thereby increaſed, many inconveniences and complaints come on; ſuch as difficulty in reſpiration, indigeſtion, pain, and what they call *tightneſs at the ſtomach*, obſtinate conſtipations, purgings, involuntary flux of urine and fæces, &c. with the addition of ſome nervous complaints, which are partly cauſed by the alterations made in the form of the cavity of the thorax, and partly by impreſſions made on the abdominal viſcera.

Mr Pott was led to a knowledge of the true cauſe and cure of this diſtemper, from obſerving the caſe of a youth of 14, who was reſtored to the uſe of his limbs immediately after a ſeemingly accidental abſceſs near the part. From this he was inclined to think, that the curvature of the ſpine was not the original cauſe of the diſorder, but that the ſurrounding parts were prediſpoſed towards it by ſome affection of the ſolids and fluids there; and he was confirmed in theſe ſuſpicions by a variety of appearances, which he obſerved both in the living body and upon diſſection of the ſubject after death; all of which are narrated at full length in his treatiſe upon this ſubject.

"The remedy (ſays he) for this moſt dreadful diſeaſe conſiſts merely in procuring a large diſcharge of matter, by ſuppuration, from underneath the membrana adipoſa on each ſide of the curvature, and in maintaining ſuch diſcharge until the patient ſhall have perfectly recovered the uſe of his legs. To accompliſh this purpoſe, I have made uſe of different means, ſuch as ſetons, iſſues made by inciſion, and iſſues made by cauſtic; and although there be no very material difference, I do upon the whole prefer the laſt. A ſeton is a painful and a naſty thing: beſides which it frequently wears through the ſkin before the end for which it was made can be accompliſhed. Iſſues made by inciſion, if they be large enough for the intended purpoſe, are apt to become inflamed, and to be very troubleſome before they come to ſuppuration; but openings made by cauſtic are not in general liable to any of theſe inconveniences, at leaſt not ſo frequently nor in the ſame degree: they are neither ſo troubleſome to make or maintain. I make the eſchars about this ſize and ſhape on each ſide the curve, taking care to leave a ſufficient portion of ſkin between them. In a few days, when the eſchar begins to looſen and ſeparate, I cut out all the middle, and put into each a large kidney-bean: when the bottoms of the ſores are become clean by ſuppuration, I ſprinkle, every third or fourth day, a ſmall quantity of finely powdered cantharides on them, by which the ſores are prevented from contracting, the diſcharge increaſed, and poſſibly other benefit obtained. The iſſues I keep open until the cure is complete; that is, until the patient recovers perfectly the uſe of his legs, or even for ſome time longer: and I ſhould think that it would be more prudent to heal only one of them firſt, keeping the other open for ſome time; that is, not only until the patient can walk, but until he can walk firmly, briſkly, and without the aſſiſtance of a ſtick: until he can ſtand quite upright, and has recovered all the height which the habit or rather the neceſſity of ſtooping, occaſioned by the diſtemper, had made him loſe."



CHAP. VIII. *Of Blood-letting.*

SECT. I. *Of Blood-letting in general.*

BLOOD-LETTING is performed either to leſſen the quantity of circulating fluid, or to relieve a particular part: hence we have the terms of *general* and *local* blood-letting.

General blood-letting is either performed upon a vein or an artery; and from this circumſtance ariſe the appellations of *phlebotomy* and *arteriotomy*.

Local or topical blood-letting is performed by ſcarificators and cupping-glaſſes, by leeches, or by punctures made with a lancet, as may be moſt ſuitable to the nature of the diſeaſe it is intended to remedy.

129 General rules reſpecting blood-letting.

There are ſome general rules and obſervations which relate equally to this operation in whatever part of the body it is practiſed: theſe we ſhall in the firſt place enumerate, and ſhall afterwards proceed to treat particularly of blood-letting in the arm and other parts.

130 Poſture of the patient.

I. In this, as in every other operation, the ſituation of the patient, and of the operator likewiſe, ought to be preciſely fixed. The ſituation of a patient, during the operation of blood-letting, has a conſiderable influence on the effect produced, and therefore merits particular attention. In ſome diſorders, it is the object of this remedy to evacuate a conſiderable quantity of blood without inducing fainting: When this is the caſe, and when from former experience it is known that the patient is liable during the evacuation to fall into a faintiſh ſtate, a horizontal poſture ought to be preferred to every other; for fainting is not near ſo ready to occur in a horizontal as in an erect poſture. It now and then happens, however, that one material advantage expected from the operation of blood-letting, is the production of a ſtate of deliquium; as, for inſtance, in caſes of ſtrangulated hernia, where a general relaxation of the ſyſtem is ſometimes deſirable. In all ſuch circumſtances, inſtead of a horizontal poſture, the more erect the patient is kept, the more readily will a ſtate of fainting be induced. The patient ought to be ſo placed, that the principal light of the apartment ſhall fall directly upon the part to be operated upon, that the vein to be opened may be made as apparent as poſſible.

131 Method of compreſſing the vein.

II. The patient being properly ſeated, the next ſtep is, by means of a proper bandage of ſilk, linen, or woollen cloth, which has more elaſticity, ſo to compreſs the vein intended to be opened, as to prevent the blood from returning to the heart. An equal degree of preſſure ought to be applied to all the other veins of the part: for if this be not attended to, the communication preſerved by the collateral correſponding branches would render the preſſure upon any one particular vein of very little importance. This preſſure upon the veins, by inducing an accumulation of their contents, tends to bring them more evidently into view, and conſequently renders it eaſier for the operator to effect a proper opening than he would otherwiſe find it. The preſſure, however, ought never to be carried ſo far as to obſtruct the circulation in the correſponding arteries, otherwiſe no diſcharge of blood can take place. When we ſee that it has the effect of raiſing the veins, while at the ſame time the pulſation of the artery is diſtinctly felt in that part of the member which lies on the ſide of the ligature moſt diſtant from the heart, we may be certain that it is to a very proper degree, and that it ought not to be carried farther; for by the ſwelling of the veins we are ſure that they are ſufficiently compreſſed; and by the arteries continuing to beat, it is evident that a continued flow of blood may be expected.

132 Inſtrument to be uſed.

III. The reflux of blood to the heart being in this manner prevented, the next queſtion to be determined is, the beſt method of making an opening into the vein. Different inſtruments have been invented for this purpoſe; but there are two only which have been retained in uſe, and which are all therefore that here require to be mentioned. Theſe are the lancet and the phlegm. This laſt, on being placed immediately on the part to be cut, is, by means of a ſpring, puſhed ſuddenly into the vein, and produces an opening of the exact ſize of the inſtrument employed.

When it is determined to employ the lancet, which is by far the ſafeſt, the form of that inſtrument is next the object of attention. The broad ſhouldered lancet ought to be laid entirely aſide; becauſe the broadneſs of its ſhoulders produces always a wound in the external teguments of perhaps three times the ſize of the opening made in the vein; a circumſtance which adds no advantage whatever to the operation; on the contrary, it produces much unneceſſary pain; renders it frequently a very difficult matter to command a ſtoppage of the blood; and the wounds produced by it are commonly ſo extenſive as to be liable to terminate in partial ſuppurations.

The ſpear pointed lancet, on the contrary, repreſented in Plate CCCCLXXXVII. fig. 8. is in every reſpect well calculated for the purpoſe of veneſection. From the acuteneſs of its point, it enters the teguments and vein with very little pain; which is with many patients a circumſtance of no ſmall importance. We are ſure of making the opening in the vein equal, or nearly ſo, to the orifice in the external teguments; and the diſcharge of blood produced by an opening made with one of theſe lancets, is commonly put a ſtop to with great eaſe immediately on removing the ligature upon the vein.

133 Method of performing the operation.

IV. The form of lancet being thus fixed upon, we come now to ſpeak of the method of uſing it. The ſurgeon and patient being both properly ſeated, and the ligature having been applied for a ſhort ſpace of time in order to produce ſome degree of ſwelling in the veins, that vein is to be made choice of which, at the ſame time that it appears conſpicuouſly enough, is found to roll leſs than the others on being preſſed upon by the fingers. It is ſcarcely thought neceſſary to obſerve here, that when a vein appears to be ſo immediately connected with a contiguous artery or tendon, as evidently to produce ſome riſk of wounding theſe parts in the operation, another vein not liable to ſuch hazard, if it can be procured, ought undoubtedly to be preferred. Veins may lie directly above both arteries and tendons, and yet no manner of riſk be incurred by opening them, provided the operator is ſufficiently ſteady and attentive; but it does now and then happen, that veins are ſo nearly and intimately connected with theſe parts, as to render it hazardous even for the moſt dexterous ſurgeon to attempt this operation.

The vein being at laſt made choice of, the ſurgeon, if he is to uſe his right-hand in the operation, takes a firm hold of the member from whence the blood is to be drawn with his left, and with the thumb of the ſame hand he is now to make ſuch a degree of preſſure upon the vein, about an inch and a half below the part where the orifice is to be made, as not only to render the ſkin and teguments ſomewhat tenſe; but at the ſame time to interrupt for a little all communication between the under part of the vein and that portion of it lying between the ligature and the thumb placed as thus directed.

The lancet being drawn out ſo as to form nearly a right angle with the ſcales, the operator now takes it between the finger and thumb of his right-hand; and leaving at leaſt one half of the blade uncovered, he reſts his hand on the middle-finger, ring-finger, and little-finger, all placed as conveniently as poſſible in the neighbourhood of the vein from whence the blood is to be taken; and having puſhed the point of the inſtrument freely through the ſkin and teguments into the vein, he now carries it forward in an oblique direction, till the orifice is of the ſize he inclines to have it; taking care, during the time of puſhing on the lancet, that its point be kept in as ſtraight a direction as poſſible, for fear of dipping into the parts below.

The inſtrument is now to be withdrawn; and the ſurgeon, removing the thumb of his left hand, is to allow the vein to empty itſelf freely into the different cups previouſly provided for the purpoſe.

It is of importance to obſerve, that during the time the blood is diſcharging, the member ought to be kept in exactly the ſame poſture it was in when the lancet was firſt introduced: otherwiſe the orifice in the ſkin is apt to ſlip over the opening in the vein; a circumſtance which always proves inconvenient, and on ſome occaſions produces a good deal of trouble by the blood from the vein inſinuating itſelf into the ſurrounding cellular ſubſtance.

134 Method of producing a ſufficent flow of blood.

V. When the vein is properly cut, and the orifice is made ſufficiently large, it rarely occurs that any difficulty is experienced in procuring all the blood that is wanted. But when this laſt circumſtance occurs, from the patient becoming faintiſh, a ſtream of freſh air ought to be admitted to the apartment, wine or ſome other cordial ſhould be adminiſtered, and the patient ought to be laid in a horizontal poſture. By theſe means the faintiſhneſs will in general be ſoon removed; but if ſtill the blood ſhould not flow freely, the member ought to be put into all the variety of poſitions that can probably aſſiſt in bringing the openings of the ſkin and other teguments to correſpond with that of the vein; which will ſoon be known to have happened by the blood beginning inſtantly to flow. Throwing the muſcles of the part into conſtant action, by giving the patient a cane or any other firm ſubſtance to turn frequently round in his hand when the operation is done in the arm, will often anſwer in producing a conſtant flow of blood from a vein when every other means has failed: And, laſtly, when the pulſe in the inferior part of the member is felt very feeble, or eſpecially if it cannot be diſtinguiſhed at all, we may be thereby rendered certain that the ligature is too tight, and may in general have it in our power to produce an immediate flow of blood, by removing the compreſſion thus improperly made upon the arteries of the part.

135 Method of ſtopping too great a flux.

VI. A quantity of blood proportioned to the nature of the diſorder being thus diſcharged, the preſſure upon the ſuperior part of the vein ſhould be immediately removed; and this being done, if the ſpear-pointed lancet has been uſed, all farther loſs of blood will in general ſtop immediately. The contrary of this, however, ſometimes occurs, and blood continues to flow freely even after the ligature is removed. When this is the caſe, the operator ought to compreſs the vein both above and below the orifice, by means of the finger and thumb of one hand, ſo as to prevent any farther loſs of blood. This being done, and the orifice being cleared of every particle of blood, the ſides of it ſhould be laid as exactly together as poſſible; and a piece of court or any other adheſive plaſter being ſo applied as to retain them, it will ſeldom happen that any kind of bandage is neceſſary: but when the blood has iſſued with uncommon violence during the operation, and has been difficult to command after the removal of the ligature, in ſuch inſtances it will be prudent to apply a ſmall compreſs of linen over the plaſter, and to ſecure the whole with a linen roller properly applied round the member.

SECT. II. *Of Veneſection in different Parts of the Body.*

136 Veneſection in the arm.

WHEN veneſection is to be performed in the arm, the ligature for ſtopping the circulation ought to be placed about an inch or an inch and a half above the joint of the elbow, and brought twice round: in order to prevent the ends of it from interfering with the lancet, the knot ſhould be made on the outſide of the arm. In general, one knot might anſwer; but a ſlip-knot being made above the reſt, renders it more ſecure, and it is very eaſily done.

In forming the choice of a vein from whence blood is to be taken, the general rules we have already laid down upon this point muſt be here particularly attended to. In general the artery lies ſo low in this place, that the median baſilic vein, under which it commonly runs, may be opened with perfect ſafety; and as this vein in general appears more conſpicuous than any of the others, probably from the continued pulſation of the artery below obſtructing in ſome meaſure the paſſage of its contents, it is in this reſpect therefore more properly calculated for this operation than any of the others. Other circumſtances occur too which render the median baſilic preferable to the cephalic or median cephalic veins for the operation of blood-letting. The former, viz. the median baſilic, is leſs deeply covered with cellular ſubſtance; and by lying towards the inner part of the arm, it is more thinly covered with the tendinous expanſion of the biceps muſcle than either of the others. From theſe circumſtances, the operation is always attended with leſs pain when done in this vein than in any of the others.

In very corpulent people, it ſometimes happens that all the larger veins lie ſo deep as not to be diſcovered by the eye; but when they are ſenſibly felt by the fingers, even although they cannot be ſeen, they may be always opened with freedom. In a few inſtances, however, they can neither be diſtinguiſhed by the eye nor by the finger: in ſuch a ſituation, as they may in general be met with about the wriſt or on the back part of the hand, the ligature ſhould be removed from the upper part of the arm; and being applied about half way between the elbow and wriſt, the veins below will thereby be brought into view; and wherever a vein can be evidently obſerved, there can be no danger in having recourſe to the operation.

137 Veneſection in the neck.

There is only one vein of the neck, viz. the poſterior external jugular, which can eaſily be brought ſo much into view as to be with propriety opened; and even this lies deeply covered with parts, not only with the ſkin and cellular ſubſtance, but with the fibres of the platiſma myoides muſcle; ſo that a conſiderable degree of preſſure becomes neceſſary in order to raiſe it to any height. With a view to produce this, the operator's thumb is commonly adviſed to be placed upon the vein, ſo as to compreſs it effectually about an inch or an inch and a half below where the opening is to be made. This, however, ſeldom proves ſufficient for the purpoſe, as the blood, on being ſtopped in its progreſs through this branch, eaſily finds a paſſage to the other veins; ſo that unleſs the principal vein on the other ſide of the neck is alſo compreſſed, the vein to be opened can never be fully diſtended. In order to effect this, a firm compreſs of linen ſhould be applied on the largeſt vein on the oppoſite ſide of the neck; and an ordinary garter, or any other proper ligature, being laid directly over it, ſhould be tied with a firm knot below the oppoſite arm pit; taking care to make ſuch a degree of preſſure, as to put an entire ſtop to the circulation in the vein, which in this way may be eaſily effected without producing any obſtruction to the patient's breathing. But to prevent every inconvenience of this kind, ſee an inſtrument contrived for the purpoſe, Plate CCCCLXXXVII. fig. 9.

This being done, and the patient's head properly ſupported, the operator, with the thumb of his left hand, is now to make a ſufficient preſſure upon the vein to be opened; and with the lancet in his right hand is to penetrate at once into the vein; and before withdrawing the inſtrument, an orifice ſhould be made large enough for the intended evacuation. It may be proper to obſerve, that a more extenſive opening ought always to be made here than is neceſſary in the arm, otherwiſe the quantity of blood is generally procured with difficulty: and beſides, there is not the ſame neceſſity for caution on this point here that there is in the arm; for it ſeldom or never happens that any difficulty occurs in this ſituation, in putting a ſtop to the blood after the preſſure is removed from the veins; all that is commonly neceſſary for this purpoſe being a ſlip of adheſive plaſter without any bandage whatever.

In order to bring the vein more clearly into view, ſo as afterwards to be able to open it with more exactneſs, it has been recommended, that the ſkin, cellular ſubſtance, and muſcular fibres covering the vein, ſhould be previouſly divided with a ſcalpel before attempting to puſh the lancet into it. There is not, however, any neceſſity for this precaution, as it rarely happens that any difficulty is experienced in procuring a free diſcharge of blood by opening the vein and teguments at once in the manner directed. And it is here, as in every inſtance where it is neceſſary to take blood by a lancet, if it is not done at once, the patient is much diſappointed, and is ſure to attribute the failure entirely to a fault in the operator.

138 Veneſection in the ankles and feet.

When blood is to be diſcharged from the veins of the ankle or feet, the ligature being applied a little above the ankle-joint, all the branches of the vena ſaphena, both in the inſide and outſide of the foot, come at once into view; and as this vein lies everywhere very ſuperficial, being in general covered with ſkin only, wherever a proper eneſec-on in dif-rent Parts the Bo-

per vein appears conſpicuouſly it may with ſafety be opened.

With a view to encourage the diſcharge of blood, it has been a conſtant practice in blood-letting, in theſe veins, to dip the feet into warm water immediately on the orifice being made. But this is a very inaccurate method of proceeding, as the quantity of blood taken in this manner can never be aſcertained with preciſion; for the blood being all mixed with the water, the operator can never be in any degree certain as to this point: and beſides, there does not appear to be any neceſſity for this aſſiſtance; for when the compreſſion of the ſuperior part of the veins is made effectual, and the orifice is of a proper ſize, there is ſeldom more difficulty in obtaining a full diſcharge of blood from the veins of theſe parts than from any other veins of the body.

On removing the ligature, the diſcharge is generally ſtopped at once; ſo that a piece of adheſive plaſter applied over the orifice anſwers all the purpoſe of a bandage. The arm, neck, and ankles are the parts from whence blood is uſually taken by veneſection; but on ſome occaſions, where the contiguous parts have been particularly affected, it has been thought adviſeable to perform veneſection in other places.

139 eneſec-on under e tongue.

When veneſection is to be performed in the veins called *ranulæ* under the tongue, the apex of the tongue is to be elevated, and the vein on each ſide opened, becauſe the opening of one only will hardly ever diſcharge blood enough. After a ſufficient quantity has been diſcharged, ſome cold aſtringent fluid taken into the mouth will generally ſtop the hemorrhagy.

140 eneſec-on in the enis.

The vena dorſalis penis, which runs along the back or upper ſide of this member, being generally pretty much diſtended, and conſpicuous in an inflammation of this part, may be opened about the middle or back part of the penis; and a ſufficient quantity of blood be diſcharged proportionable to the urgency of the ſymptoms. This being done, apply a compreſs and bandage proper for the penis. The arteries and nerves which lie on each ſide of the vein are to be avoided: nor ought the bandage to be too tight, otherwiſe the inflammation and other ſymptoms may turn out worſe than before.

When it is found neceſſary to diſcharge blood in this manner from the penis, the veins can be eaſily brought into view, by producing an accumulation of their contents in the ſame manner as in other parts of the body, through the intervention of a ligature: but in the tongue, in the hæmorrhoidal veins about the anus, and other parts where compreſſion cannot be applied, all that the ſurgeon can do, is to make an orifice of a proper ſize in that part of the vein which ſhows itſelf moſt evidently; and if a ſufficient diſcharge of blood is not thus produced, as there is no other method of effecting it, immerſing the parts in warm water may in ſuch circumſtances be a very neceſſary meaſure.

141 eneſec-on in the yes.

There are ſeveral ways of performing the operation of blood-letting in the eyes. We ſhall here only relate the chief: Firſt, the patient is to be ſeated conveniently on the bed ſide or on a chair, with his head held in a proper poſture by an aſſiſtant; which done, the ſurgeon makes a tranſverſe inciſion with a lancet upon the turgid ſmall veſſels in the corners of the eye, ſo as to open them or cut them quite acroſs. Some uſe a ſmall pair of ſciſſars, inſtead of a lancet, to divide the veſſels; but in uſing either of them, the eye-lids muſt be ſeparated from each other by the fingers of one hand, while the veſſels are cut by inſtruments held in the other. Some, again, elevate the ſmall turgid veſſels with a crooked needle before they divide them, the eye-lids being in the mean time held aſunder by an aſſiſtant. The ſmall veſſels being thus opened or divided, their diſcharge of blood ſhould be promoted by fomentations of warm water frequently applied to the eye by means of a ſponge or ſoft linen rags.

Arteriotomy.

Among other methods that have been propoſed for ſcarifying the blood-veſſels of the eye, the beards of rough barley were at one period much extolled, and are ſtill employed by ſome individuals. By drawing them over the ſurface of the eye, in a direction contrary to the ſharp ſpiculæ with which they are furniſhed, a conſiderable diſcharge of blood is thereby produced: But the pain attending this operation is exquiſite; and as it does not poſſeſs any ſuperior advantage to the method with the lancet, it is now falling into general diſuſe.

Sect. III. *Of Arteriotomy.*

142 Arteriotomy ſeldom practiſed.

Whatever particular advantages may in theory have been expected from arteriotomy, and however ſome of its ſupporters may have recommended it, not only as being in many inſtances preferable to veneſection, but as an operation perfectly ſafe even in veſſels of conſiderable ſize; yet the moſt ſtrenuous friends to the practice have ſhrunk from any real attempt of this kind on the larger arteries. Inſtances have no doubt occurred of large arteries having been opened without any danger enſuing; but theſe are ſo exceedingly rare, that no practitioner of experience will, from that conſideration, be induced coolly to proceed to open any artery of importance. The ſmaller branches of arteries may indeed be opened with great ſafety, when they are not deeply covered, and eſpecially when they lie contiguous to bones; but in any of the larger arteries, the attempt muſt be always attended with ſo much hazard, and the advantages to be expected from it, in preference to veneſection, are apparently ſo trifling, as muſt in all probability prevent it from ever being carried into execution.

143 Arteries uſually opened.

There are very few arteries, therefore, which, with any propriety, can be opened: the different branches of the temporal are the only arteries indeed from whence blood, in ordinary practice, is ever taken; for although the opening of ſome other branches of arteries has by ſome been propoſed, yet they are ſituated in ſuch a manner that they either cannot be readily come at, or being in the neighbourhood of ſo large nerves, the opening of them might be attended with bad conſequences.

144 Method of performing the operation.

In performing this operation on any of the temporal branches, if the artery lies ſuperficial, it may be done with one puſh of the lancet, in the ſame manner as was directed for veneſection; but when the artery lies deeply covered with cellular ſubſtance, it is always neceſſary to lay it fairly open to view, before making the orifice with the lancet: for in all the ſmaller arteries, when they are cut entirely acroſs, there is little chance of being able to procure any conſiderable quantity of blood from them; as, when divided in this manner, they are ſure to retract conſiderably within the ſurrounding parts, which commonly puts a ſtop to all farther evacuation.

Some degree of nicety is alſo neceſſary in making the opening into the artery of a proper oblique direction, neither quite acroſs nor directly longitudinal; for a longitudinal opening never bleeds ſo freely, either in an artery or in a vein, as when its direction is ſomewhat oblique.

If the opening has been properly made, and if the artery is of any tolerable ſize, it will at once diſcharge very freely without any compreſſion; but when the evacuation does not go on ſo well as could be wiſhed, the diſcharge may be always aſſiſted by compreſſing the artery immediately above the orifice, between it and the correſponding veins. The quantity of blood being thus diſcharged, it will commonly happen, that a very ſlight compreſſion on theſe ſmaller arteries will ſuffice for putting a ſtop to the evacuation: and whatever preſſure is found neceſſary, may be here applied in the ſame manner as was directed in veneſection.

It happens, however, in ſome inſtances, that this does not ſucceed, the orifice continuing to burſt out from time to time, ſo as to be productive of much diſtreſs and inconvenience.

145 Method of ſtopping the blood.

In this ſituation there are three different methods by which we may with tolerable certainty put a ſtop to the farther diſcharge of blood. 1ſt, If the artery is ſmall, as all the branches of the temporal arteries commonly are, the cutting it entirely acroſs, exactly at the orifice made with the lancet, by allowing it to retract within the ſurrounding parts, generally puts an immediate ſtop to the diſcharge. 2d, When that is not conſented to, we have it always in our power to ſecure the bleeding veſſel with a ligature, as we would do an artery accidentally divided in any part of the body. And, laſtly, if neither of theſe methods is agreed to by the patient, we can, by means of a conſtant regular preſſure, obliterate the cavity of the artery at the place where the operation has been performed, by producing the accretion of its ſides. Different bandages have been contrived for compreſſing the temporal artery; but none of them anſwer the purpoſe ſo eaſily and ſo effectually as the one figured in Plate CCCCLXXXVII. fig. 10. This method is more tedious; but to timid patients it generally proves more acceptable than either of the other two.

Sect. IV. *Of Topical Blooding.*

146 Method of blooding with the ſcarificator.

When, either from the ſeverity of a local fixed pain, or from any other cauſe, it is wiſhed to evacuate blood directly from the ſmall veſſels of the part affected, inſtead of opening any of the larger arteries or veins, the following are the different modes propoſed for effecting it, viz. by means of leeches; by ſlight ſcarifications with the ſhoulder or edge of a lancet; and, laſtly by means of an inſtrument termed a *ſcarificator*, (Plate CCCCLXXXVII. fig. 11.); in which ſixteen or twenty lancets are commonly placed, in ſuch a manner, that, when the inſtrument is applied to the part affected, the whole number of lancets contained in it are, by means of a ſtrong ſpring, puſhed ſuddenly into it, to the depth at which the inſtrument has been previouſly regulated. This being done, as the ſmaller blood-veſſels only by this operation are ever intended to be cut, and as theſe do not commonly diſcharge freely, ſome means or other become neceſſary for promoting the evacuation.

147 And cupping-glaſſes.

Various methods have been propoſed for this purpoſe. Glaſſes fitted to the form of the affected parts, with a ſmall hole in the bottom of each, were long ago contrived; and theſe being placed upon the ſcarified parts, a degree of ſuction was produced by a perſon's mouth ſufficient for nearly exhauſting the air contained in the glaſs: and this accordingly was a ſure enough method of increaſing the evacuation of blood to a certain extent. But as this was attended with a good deal of trouble, and beſides did not on every occaſion prove altogether effectual, an exhauſting ſyringe was at laſt adapted to the glaſs: which did indeed anſwer as a very certain method of extracting the air contained in it; but the application of this inſtrument for any length of time is very troubleſome, and it is difficult to preſerve the ſyringe always air-tight.

The application of heat to the *cupping-glaſſes*, repreſented in Plate CCCCLXXXVII. fig. 12. has been found to rareſy the air contained in them to a degree ſufficient for producing a very conſiderable ſuction. And as the inſtrument in this ſimple form anſwers the purpoſe in view with very little trouble to the operator, and as it is at all times eaſily obtained, the uſe of the ſyringe has therefore been laid aſide.

There are different methods adopted for thus applying heat to the cavity of the glaſs. By ſupporting the mouth of it for a few ſeconds above the flame of a taper, the air may be ſufficiently rarefied; but if the flame is not kept exactly in the middle, but is allowed to touch either the ſides or bottom of the glaſs, it is very apt to make it crack. A more certain, as well as an eaſier, method of applying the heat, is to dip a piece of ſoft bibulous paper in ſpirit of wine; and having ſet it on fire, to put it into the bottom of the glaſs, and, on its being nearly extinguiſhed, to apply the mouth of the inſtrument directly upon the ſcarified part. This degree of heat, which may be always regulated by the ſize of the piece of paper, and which it is evident ought always to be in proportion to the ſize of the glaſs, if long enough applied, proves always ſufficient for rarefying the air very effectually, and at the ſame time, if done with any manner of caution, never injures the glaſs in the leaſt.

The glaſs having been thus applied, if the ſcarifications have been properly made, they inſtantly begin to diſcharge freely: and ſo ſoon as the inſtrument is nearly full of blood, it ſhould be taken away; which may be always eaſily done by raiſing one ſide of it, ſo as to give acceſs to the external air. Where more blood is wiſhed to be taken, the parts ſhould be bathed with warm water; and being made perfectly dry, another glaſs, exactly the ſize of the former, ſhould be inſtantly applied in the very ſame manner: and thus, if the ſcarificator has been made to puſh to a ſufficient depth, ſo as to have cut all the cutaneous veſſels of the part, almoſt any neceſſary quantity of blood may be obtained. It ſometimes happens, however, that the full quantity intended to be diſcharged cannot be got at one place. In ſuch a caſe, the ſcarificator muſt be again applied on a part as contiguous to the other as poſſible; and this being done, the application of the glaſſes muſt alſo be renewed as before.

When it is wiſhed to diſcharge the quantity of blood as quickly as poſſible, two or more glaſſes may be applied at once on contiguous parts previouſly ſcarified; and, on ſome occaſions, the quantity of blood is more quickly obtained by the cupping-glaſſes being applied for a few ſeconds upon the parts to be afterwards ſcarified. The ſuction produced by the glaſſes may poſſibly have ſome influence in bringing the more deep-ſeated veſſels into nearer contact with the ſkin, ſo that more of them will be cut by the ſcarificator.

A ſufficient quantity of blood being procured, the wounds made by the different lancets ſhould be all perfectly cleared of blood; and a bit of ſoft linen or charpie, dipped in a little milk or cream, applied over the whole, is the only dreſſing that is neceſſary. When dry linen is applied, it not only creates more uneaſineſs to the patient, but renders the wounds more apt to feſter than when it has been previouſly wetted in the manner directed.

148 Dry cupping.

Dry cupping conſiſts in the application of the cupping-glaſſes directly to the parts affected, without the uſe of the ſcarificator. By this means a tumor is produced upon the part; and where any advantage is to be expected from a determination of blood to a particular ſpot, it may probably be more eaſily accompliſhed by this means than by any other.

149 Application of leeches.

When the part from which it is intended to produce a local evacuation of this kind is ſo ſituated, that a ſcarificator and cupping-glaſſes can be applied, this method is greatly preferable to every other; but in inflammatory affections of the eye, of the noſe, and of other parts of the face, &c. the ſcarificator cannot be properly applied directly to the parts affected. In ſuch inſtances, leeches are commonly had recourſe to, as they can be placed upon almoſt any ſpot from whence we would wiſh to diſcharge blood.

In the application of theſe animals, the moſt effectual method of making them fix upon a particular ſpot, is to confine them to the part by means of a ſmall wine-glaſs. Allowing them to creep upon a dry cloth, or upon a dry board, for a few minutes before application, makes them fix more readily; and moiſtening and cooling the parts on which they are intended to fix, either with milk, cream, or blood, tends alſo to cauſe them adhere much more ſpeedily than they otherwiſe would do. So ſoon as the leeches have ſeparated, the ordinary method of promoting the diſcharge of blood, is to cover the parts with linen cloths wet in warm water. In ſome ſituations, this may probably be as effectual a method as any other; but wherever the cupping-glaſſes can be applied over the wounds, they anſwer the purpoſe much more effectually.

Chap. IX. *Of Iſſues.*

Issues are a kind of artificial ulcers formed in different parts of the body with a view to procure a diſcharge of purulent matter, which is frequently of advantage in different diſorders.

150 ſe of iſſues.

Practitioners were formerly of opinion that iſſues ſerved as drains to carry off the noxious humours from the blood, and therefore they placed them as near the affected part as poſſible. But as it is now known that they prove uſeful merely by the quantity of matter which they afford, they are generally placed where they will occaſion the leaſt inconvenience. The moſt proper parts for them are, the nape of the neck; the middle, outer, and fore part of the humerus; the hollow above the inner ſide of the knee; or either ſide of the ſpine of the back; or between two of the ribs; or wherever there is a ſufficiency of cellular ſubſtance for the protection of the parts beneath: they ought never to be placed over the belly of a muſcle; nor over a tendon, or thinly covered bone; nor near any large blood-veſſel.

The iſſues commonly uſed are, the bliſter-iſſue, the pea-iſſue, and the ſeton or cord.

151 The bliſter-iſſue.

When a bliſter-iſſue is to be uſed, after the bliſter is removed, a diſcharge of matter may be kept up by dreſſing the part daily with an ointment mixed with the powder of cantharides. If the diſcharge be too little, more of the powder may be uſed; if too great, or if the part be much inflamed, the iſſue ointment may be laid aſide, and the part dreſſed with baſilicon, or with Turner's cerate, till the diſcharge be diminiſhed and the inflammation abated. It is moſt proper ſometimes to uſe the iſſue ointment and a mild one alternately.

152 The pea-iſſue.

A pea iſſue is formed either by making an inciſion with a lancet, or by cauſtic, large enough to admit one or more peas; though ſometimes inſtead of peas, kidney-beans, Gentian root, or orange-peas, are uſed. When the opening is made by an inciſion, the ſkin ſhould be pinched up and cut through, of a ſize ſufficient to receive the ſubſtance to be put into it. But when it is to be done by cauſtic, the common cauſtic or lapis infernalis of the ſhops anſwers beſt: it ought to be reduced to a paſte with a little water or ſoft ſoap, to prevent it from ſpreading; and adheſive plaſter, with a ſmall hole cut in the centre of it, ſhould be previouſly placed, and the cauſtic paſte ſpread upon the hole in the centre. Over the whole an adheſive plaſter ſhould be placed to prevent any cauſtic from eſcaping. In ten or twelve hours, the whole may be removed, and in three or four days the eſchar will ſeparate, when the opening may be filled with peas, or any of the other ſubſtances already mentioned.

153 The ſeton.

The ſeton is uſed where a large quantity of matter is wanted, and eſpecially where it is wiſhed for from deep ſeated parts. It is frequently uſed in the back of the neck for diſeaſes of the head or eyes, or between two of the ribs in affections of the breaſt.

When the cord, which is to be made of threads of cotton or ſilk, is to be introduced, the parts at which it is to enter and paſs out ſhould be previouſly marked with ink, and a ſmall part of the cord being beſmeared with ſome mild ointment, and paſſed through the eye of the ſeton-needle, Plate CCCCLXXXVII. fig. 13. the part is to be ſupported by an aſſiſtant, and the needle paſſed fairly through, leaving a few inches of the cord hanging out. The needle is now to be removed and the part dreſſed. By this method matter is produced in quantity proportioned to the degree of irritation applied; and this can be increaſed or diminiſhed by covering the cord daily before it is drawn with an irritating or mild ointment.

Chap. X. *Of Sutures and Ligatures of Arteries.*

Sect. I. *Of Sutures.*

The intention of ſutures is to unite parts which have been divided, and where the retraction of the lips of the wound has been conſiderable. The ſutures in ordinary uſe at preſent, among ſurgeons, are the interrupted, the quilled, and the twiſted. Beſides theſe ſutures, adheſive plaſters are uſed for uniting the lips of wounds, which have been termed the *falſe* or *dry* ſuture, in oppoſition to the others which have obtained the name of *true* or *bloody*. The true ſuture is uſed in caſes of deep wounds, while the falſe is employed in thoſe of a ſuperficial nature.

154 Of the interrupted ſuture.

The interrupted ſuture is made as follows. The wound being emptied of the grumous blood, and the aſſiſtant taking care that the lips of it lie quite even, the ſurgeon is carefully to carry the needles from the bottom outwards; uſing the caution of making them come out far enough from the edge of the wound, which will not only facilitate the paſſing the ligature, but will alſo prevent it from cutting through the ſkin and fleſh; as many more ſtitches as may be required will be only repetitions of the ſame proceſs. The threads being all paſſed, let thoſe be firſt tied which are in the middle of the wound: though, if the lips are held carefully together all the while, as they ſhould be, it will be of no great conſequence which is done firſt. The moſt uſeful kind of knot is a ſingle one firſt, and then a ſlip-knot, which may be looſened upon any conſiderable inflammation taking place. If a violent inflammation ſhould ſucceed, looſening the ligature only will not ſuffice; it muſt be cut through and drawn away, and the wound be treated afterwards without any ſuture. When the wound is ſmall, the leſs it is diſturbed by dreſſing the better; but in large ones, there will ſometimes be a conſiderable diſcharge; and if the threads be not cautiouſly carried through the bottom of it, abſceſſes will frequently enſue from the matter being pent up underneath, and not finding iſſue. If no accident happen, after the lips are firmly agglutinated, the ligatures are to be removed, and the orifices which they leave dreſſed.

It will readily be underſtood, that the ſtrength of the ligature and ſize of the needle ought always to be proportionable to the depth of the ſore and retraction of the parts. The proper form of needles is repreſented in Pl. CCCCLXXXVII. fig. 14.

It muſt likewiſe be remembered, that during the cure the ſuture muſt be always aſſiſted by the application of bandage, if poſſible, which is frequently of the greateſt importance; and that ſort of bandage with two heads, and a ſlit in the middle, which is by much the beſt, will in moſt caſes be found practicable.

155 Of the quilled ſuture.

In deep wounds, attended with much retraction, it is always a neceſſary precaution, to aſſiſt the operation of the ligatures by means of bandages, ſo applied as to afford as much ſupport as poſſible to the divided parts: But even with every aſſiſtance of this nature, it now and then happens, that the divided parts cannot be kept together, retraction occurs to a greater or leſſer degree, and the ligatures of courſe cut aſunder the ſoft parts they were at firſt made to ſurround.

With a view to prevent this receding of the teguments and other parts, it was long ago propoſed to add to the interrupted ſuture what was ſuppoſed would afford an additional ſupport, viz. quills or pieces of plaſter rolled up into the form of quills; one of which being placed on each ſide of the wound, the double of the ligature is made to include the one, and the knot to preſs directly upon the other, inſtead of being made immediately on the edges of the ſore, as was directed for interrupted ſutures.

It is at once evident, however, that the ligatures muſt here make the ſame degree of preſſure on the parts through which they paſs as they do in the interrupted ſuture; and this being the caſe, it is equally obvious, that the interpoſition of theſe ſubſtances cannot be of any uſe. This ſuture is accordingly now very rarely practiſed, and it is probable that it will be ſoon laid entirely aſide.

156 Of the twiſted ſuture.

By the term *twiſted ſuture*, is meant that ſpecies of ligature by which parts, either naturally or artificially ſeparated, are united together, by means of ſtrong threads properly twiſted round pins or needles puſhed through the edges of the divided parts.

157 Uſes to which it may be put.

This ſuture is commonly employed for the purpoſe of uniting the parts in caſes of hare-lip; and this indeed is almoſt the only uſe to which it has been hitherto applied: But it may with great advantage be put in practice in a variety of other caſes, particularly in all artificial or accidental diviſions either of the lips or cheeks; and in every wound in other parts that does not run deep, and in which ſutures are neceſſary, this ſuture is preferable to the interrupted or any other. The pins made uſe of for twiſting the threads upon ought to be made of a flat form, ſo as not to cut the parts through which they paſs ſo readily as the ligatures employed in the interrupted ſuture. And thus one great objection to the latter is very effectually obviated: for every practitioner muſt be ſenſible of this being the moſt faulty part of the interrupted ſuture, that when muſcular parts are divided ſo as to produce much retraction, the ligatures employed for retaining them almoſt conſtantly cut them through before a reunion is accompliſhed; whereas the flatneſs of the pins uſed in the twiſted ſuture, and upon which the whole preſſure produced by the ligatures is made to reſt, proves in general a very effectual preventive againſt all ſuch occurrences.

The pins uſed in this operation are repreſented in Plate CCCCLXXXVII. fig. 15. They are commonly made of gold or ſilver; and in order to make them paſs with greater eaſe, ſteel points are added to them. They are ſometimes uſed, however, of gold or ſilver alone.

158 Method of employing the twiſted ſuture.

The manner of performing this operation is as follows. The divided parts intended to be reunited, muſt by the hands of an aſſiſtant, be brought nearly into contact; leaving juſt as much ſpace between the edges of the ſore as to allow the ſurgeon to ſee that the pins are carried to a proper depth. This being done, one of the pins muſt be introduced through both ſides of the wound, by entering it on one ſide externally, puſhing it forwards and inwards to within a little of the bottom of the wound, and afterwards carrying it outwardly through the oppoſite ſide, to the ſame diſtance from the edge of the ſore that it was made to enter at on the other.

The diſtance at which the needle ought to enter from the edge of the ſore muſt be determined by the depth of the wound, and by the degree of retraction produced in the divided parts. In general, however, it is a proper regulation, in deep wounds, to carry the pins nearly to the ſame diſtance from the ſide of the ſore as they are made to penetrate in depth: And whatever the deepneſs of the wound may be, the pins ought to paſs within a very little of its bottom: otherwiſe the parts which lie deep will run a riſk of not being united; a circumſtance which muſt always give riſe to troubleſome collections of matter.

The firſt pin being paſſed in this manner very near to one end of the ſore, and the parts being ſtill ſupported by an aſſiſtant, the ſurgeon, by means of a firm waxed ligature, paſſed three or four times round and acroſs the pin, ſo as nearly to deſcribe the figure of 8, is to draw the parts through which it has paſſed into immediate and cloſe contact: and the thread being now ſecured with a looſe knot, another pin muſt be introduced in the ſame manner at a proper diſtance from the former; and the thread with which the other was fixed being looſed, and in the ſame manner carried round this pin, others muſt be introduced at proper diſtances along the whole courſe of the wound; and the ſame ligature ought to be of a ſufficient length for ſecuring the whole.

159 Number of pins to be uſed.

The number of pins to be uſed muſt be determined entirely by the extent of the wound. Whenever this ſuture is practiſed, a pin ought to be introduced very near each end of the wound, otherwiſe the extremities of the ſore are apt to ſeparate ſo as not to be afterwards eaſily reunited. In large wounds, if the pins are introduced at the diſtance of three quarters of an inch from one another, it will in general be found ſufficient; but in cuts of ſmaller extent a greater number of pins become neceſſary in proportion to the dimenſions of the ſores.

Thus in a wound of an inch and half in length, three pins are abſolutely requiſite; one near to each end, and another in the middle of the ſore: whereas five pins will always be found fully ſufficient for a wound of three inches and a half in extent, allowing one to be within a quarter of an inch of each extremity of the wound, and the others to be placed along the courſe of the ſore at the diſtance of three quarters of an inch from one another.

The pins being all introduced and ſecured in the manner directed, nothing remains to be done, but to apply a piece of lint wet with mucilage all along the courſe of the wound, with a view to exclude, as effectually as poſſible, every acceſs to the external air.

When the pins remain long they generally do harm, by the unneceſſary irritation and conſequent retraction of parts with which they are always attended; and if they are not continued for a ſufficient length of time, that degree of adheſion is not produced between the divided parts which is neceſſary for their future retention; ſo that the effect of the operation comes to be in a great meaſure, if not entirely, loſt.

In wounds of no great depth, for inſtance of three quarters of an inch or ſo, a ſufficient degree of adheſion always takes place in the ſpace of five days; and ſix, or at moſt ſeven days, will generally be found ſufficient for wounds of the greateſt depth. But with reſpect to this circumſtance, it muſt always be underſtood, that the patient's ſtate of health muſt have a conſiderable influence on the time neceſſary for producing adheſion between divided parts.

When the pins are withdrawn, the uniting bandage may be applied with great advantage; but as ſlips of leather ſpread with ordinary glue, when applied to each ſide of the cicatrix, may, by means of ligatures properly connected with them, be made to anſwer the purpoſe more effectually, this mode of ſupporting the parts ought of courſe to be preferred.

Sect. II. *Of the Ligature of Arteries.*

When a ſurgeon is called immediately to a wound of any great artery of a limb, he ſhould clap the point of his finger upon the wounded artery, or make his aſſiſtant hold it; cut the wound ſo far open as to ſee the artery fairly; draw it out if it be cut acroſs, and have ſhrunk among the fleſh; or tie it like the artery of the arm in aneuriſm by paſſing ligatures under it. When, however, the wound happens in ſuch ſituations that we cannot command the blood, it is better to cloſe the lips of the wound, and try to make them adhere by means of a very ſteady compreſs and bandage. Thus an aneuriſm will form; the operation for the cure of which ſhall be afterwards deſcribed.

When accidents of this nature occur in any of the extremities, and where preſſure can be made with eaſe on the ſuperior part of the artery, we are poſſeſſed of an inſtrument which never fails to put a ſtop to all further loſs of blood: we mean the tourniquet. See Plate CCCCLXXXVII. fig. 16.

160 The tourniquet.

The tourniquet has undergone many improvements; but the one here repreſented is conſidered as the beſt. By means of it the blood in any limb is very eaſily and effectually commanded; and as it graſps the whole member equally, all the collateral branches, as well as the principal arteries, are equally compreſſed by it. It has this material advantage too over every other inſtrument of this kind, that, when properly applied, a ſingle turn, or even half a turn, of the ſcrew, is ſufficient for producing either a flow of blood, or for putting a total ſtop to it. The manner of uſing it is as follows.

161 Manner of uſing it.

Let a cuſhion of three inches in length by one inch and half in diameter be prepared of a linen roller, tolerably firm, but not ſo hard as to render preſſure produced by it very painful. This being placed upon the courſe of the principal artery of the limb, is to be firmly ſecured in that ſituation by one or two turns of a circular roller, of the ſame breadth with the cuſhion itſelf.

The inſtrument, with the ſtrap connected with it, being now placed upon the limb, with the handle of the ſcrew on the oppoſite ſide of the member to the cuſhion upon the artery, the ſtrap is to be carried round the limb directly over the cuſhion, and to be firmly connected on the other ſide of the buckle. In thus connecting the ſtrap and buckle together, particular attention is neceſſary in doing it with great firmneſs, ſo as that the ſcrew may afterwards operate with as much advantage as poſſible in producing a ſufficient degree of preſſure. When proper attention is paid to this circumſtance, a ſingle turn of the ſcrew proves ſufficient for putting an entire ſtop to the circulation of blood in the limb: but when the ſtrap has not originally been made very tight, ſeveral turns of the ſcrew become neceſſary; an occurrence which may be always very eaſily prevented, and which, when not attended to, frequently proves very embarraſſing in the courſe of an operation.

162 Method of tying arteries by means of the tenaculum.

Various methods have been invented for ſecuring arteries by means of ligatures. The practice till lately in ordinary uſe was, by means of a curved needle, to paſs a ligature of ſufficient ſtrength round the mouth of the bleeding veſſel, including a quarter of an inch all round of the ſurrounding parts, and afterwards to form a knot of a proper tightneſs upon the veſſel and other parts comprehended in the nooſe. But this method was found to give ſo much pain, and in ſome caſes to be attended with ſuch violent convulſions, not only in the part chiefly affected, but of the whole body, that the beſt practitioners have thought proper to reject it, and to tie up the blood-veſſels by themſelves; for it is now well known that even very ſmall arteries are poſſeſſed of much firmneſs; and that even in the largeſt arteries a ſlight degree of compreſſion is ſufficient not only for reſtraining hemorrhagy, but for ſecuring the ligature on the very ſpot to which it is firſt applied.

In order to detect the arteries to be tied, the tourniquet, with which they are ſecured, muſt be ſlackened a little by a turn or two of the ſcrew; and the moment the largeſt artery of the ſore is diſcovered, the ſurgeon fixes his eye upon it, and immediately reſtrains the blood again by means of the tourniquet. An aſſiſtant now forms a nooſe on the ligature to be made uſe of; and this nooſe being put over the point of the tenaculum, Plate CCCCLXXXVII. fig. 17. the operator puſhes the ſharp point of the inſtrument through the ſides of the veſſel, and at the ſame time pulls ſo much of it out, over the ſurface of the ſurrounding parts, as he thinks is ſufficient to be included in the knot which the aſſiſtant is now to make upon the artery. In forming this ligature a ſingle knot moderately drawn, and over it another ſingle knot, is perfectly ſufficient.

163 With the crooked needle.

When from the deepneſs of a wound, or from any other cauſe, ſome particular artery cannot be properly ſecured by the tenaculum; in this caſe there is a neceſſity of employing the crooked needle, and the following is the method of uſing it.

A needle of the ſhape repreſented Pl. CCCCLXXXVII. fig. 14. armed with a ligature of a ſize proportioned to itſelf and to the veſſel to be taken up, is to be introduced at the diſtance of a ſixth or eighth part of an inch from the artery, and puſhed to a depth ſufficient for retaining it, at the ſame time that it is carried fully one half round the blood-veſſel. It muſt now be drawn out; and being again puſhed forward till it has completely encircled the mouth of the artery, is is then to be pulled out; and a knot to be tied of a ſufficient firmneſs, as was already directed when the tenaculum is uſed.

Chap. XI. *Of Aneuriſms.*

164 Definition.

The term *Aneuriſm* was originally meant to ſignify a tumor formed by the dilatation of the coats of an artery; but by modern practitioners it is made to apply not only to tumors of this kind, but to ſuch as are formed by blood effuſed from arteries into the contiguous parts. There are three ſpecies; the true or encyſted, the falſe or diffuſed, and the varicoſe aneuriſm.

165 The true or encyſted aneuriſm.

The *true* or *encyſted* aneuriſm, when ſituated near the ſurface of the body, produces a tumor at firſt ſmall and circumſcribed; the ſkin retains its natural appearance; when preſſed by the fingers, a pulſation is evidently diſtinguiſhed; and with very little force the contents of the ſwelling may be made to diſappear; but they immediately return upon removing the preſſure. By degrees the ſwelling increaſes, and becomes more prominent; but ſtill the patient does not complain of pain: on preſſure the tumor continues of an equal ſoftneſs, and is compreſſible. After this the ſwelling becomes large, the ſkin turns paler than uſual, and in more advanced ſtages œdematous: the pulſe ſtill continues; but parts of the tumor become firm from the coagulation of the contained blood, and yield little to preſſure; at laſt the ſwelling increaſes in a gradual manner, and is attended with a great degree of pain. The ſkin turns livid, and has a gangrenous appearance. An oozing of bloody ſerum occurs from the integuments; and, if a real mortification do not take place, the ſkin cracks in different parts; and the artery being now deprived of the uſual reſiſtance, the blood burſts out with ſuch force as to occaſion the almoſt immediate death of the patient. Thus the diſeaſe terminates in the large cavities of the body; but in the extremities we can, by means of the tourniquet, prevent the ſudden termination of the diſeaſe.

When affections of this kind happen in the larger arteries, the effects produced upon the neighbouring parts are often ſurpriſing: the ſoft parts not only yield to a great extent, but even the bones frequently undergo a great degree of derangement.

166 The falſe or diffuſed aneuriſm. The *falſe* or *diffuſed* aneuriſm conſiſts in a wound or rupture in an artery, producing, by the blood thrown out of it, a ſwelling in the contiguous parts. It is moſt frequently produced by a wound made directly into the artery.

The following is the uſual progreſs of the diſorder. A tumor, about the ſize of a horſe-bean, generally riſes at the orifice in the artery ſoon after the diſcharge of the blood has been ſtopped by compreſſion. At firſt it is ſoft, has a ſtrong degree of pulſation, and yields a little to preſſure, but cannot be made entirely to diſappear; for here the blood forming the tumor being at reſt, begins to coagulate. If not improperly treated by much preſſure, it generally remains nearly of the ſame ſize for ſeveral weeks. The enlargement however proceeds more rapidly in ſome caſes than in others. Inſtances have occurred of the blood being diffuſed over the whole arm in the ſpace of a few hours; while, on the contrary, ſwellings of this kind have been many months, nay even years, in arriving at any conſiderable ſize.

As the tumor becomes larger, it does not, like the true aneuriſm, grow much more prominent, but rather ſpreads and diffuſes itſelf into the ſurrounding parts. By degrees it acquires a firm conſiſtence; and the pulſation, which was at firſt conſiderable, gradually diminiſhes, till it is ſometimes ſcarcely perceptible. If the blood at firſt thrown out proceed from an artery deeply ſeated, the ſkin preſerves its natural appearance till the diſorder is far advanced: but when the blood gets at firſt into contact with the ſkin, the parts become inſtantly livid, indicating the approach of mortification; and a real ſphacelus has ſometimes been induced. The tumor at firſt produces little uneaſineſs; but as it increaſes in ſize, the patient complains of ſevere pain, ſtiffneſs, numbneſs, and immobility of the whole joint; and theſe ſymptoms continuing to augment, if the artery be large, and aſſiſtance not given, the teguments at laſt burſt, and death muſt enſue.

167 Varicoſe aneuriſm. When an artery is punctured through a vein, as in bloodletting at the arm, the blood generally ruſhes into the yielding cellular ſubſtance, and there ſpreads ſo as to ſhut the ſides of the vein together. But in ſome inſtances where the artery happens to be in contact with the vein, the communication opened has been preſerved; and the vein not being ſufficiently ſtrong for reſiſting the impulſe of the artery, muſt conſequently be dilated. This is a varicoſe aneuriſm. It was firſt accurately deſcribed by Dr Hunter, and ſince that time has been frequently obſerved by different practitioners. Here the ſwelling is entirely confined to the veins. Soon after the injury the vein immediately communicating with the artery begins to ſwell, and enlarge gradually. If there be any conſiderable communications in the neighbourhood, the veins which form them are alſo enlarged. The tumor diſappears upon preſſure, the blood contained in it being chiefly puſhed forwards in its courſe towards the heart; and when the tumor is large, there is a ſingular tremulous motion, attended with a perpetual hiſſing noiſe, as if air was paſſing into it through a ſmall aperture.

If a ligature be applied upon the limb immediately below the ſwelling, tight enough to ſtop the pulſe in the under part of the member, the ſwelling diſappears by preſſure, but returns immediately upon the preſſure being removed. If, after the ſwelling is removed by preſſure, the finger be placed upon the orifice in the artery, the veins remain perfectly flaccid till the preſſure is taken off. If the trunk of the artery be compreſſed above the orifice ſo as effectually to ſtop the circulation, the tremulous motion and hiſſing immediately ceaſe; and if the veins be now emptied by preſſure, they remain ſo till the compreſſion upon the artery be removed. If the vein be compreſſed a little above, as well as below the tumor, all the blood may generally, though not always, be puſhed through the orifice into the artery; from whence it immediately returns on the preſſure being diſcontinued.

When the diſeaſe has continued long, and the dilatation of the veins has become conſiderable, the trunk of the artery above the orifice generally becomes greatly enlarged, while that below becomes proportionably ſmall; of conſequence the pulſe in the under part of the member is always more feeble than in the ſound limb of the oppoſite ſide.

168 Cauſes of aneuriſm. The cauſes producing aneuriſms, in general, are a natural diſeaſe of the arteries. Thus a partial debility of their coats may readily produce the diſeaſe; or they may ariſe, eſpecially in the internal parts of the body, from great bodily exertions. They are likewiſe produced by wounds of the coats of the arteries, as now and then happens in bloodletting at the arm; or from acrid matter contained in a neighbouring ſore; or from the deſtruction of ſurrounding parts, by which the natural ſupport is removed.

169 Diagnoſis. Aneuriſms have frequently been miſtaken for abſceſſes and other collections of matter, and have been laid open by inciſion; on which account great attention is ſometimes required to make the proper diſtinction. In the commencement of the diſeaſe the pulſation in the tumor is commonly ſo ſtrong, and other concomitant circumſtances ſo evidently point out the nature of the diſorder, that little or no doubt reſpecting it can ever take place; but in the more advanced ſtages of the diſeaſe, when the ſwelling has become large and has loſt its pulſation, nothing but a minute attention to the previous hiſtory of the caſe can enable the practitioner to form a judgment of its nature.

Aneuriſms may be confounded with ſoft encyſted tumors, ſcrophulous ſwellings, and abſceſſes ſituated ſo near to an artery as to be affected by its pulſation. But one ſymptom, when connected with ſtrong pulſation, may always lead to a certain determination that the ſwelling is of the aneuriſmal kind, viz. the contents of the tumor being made eaſily to diſappear upon preſſure, and their returning on the compreſſion being removed. The want of this circumſtance, however, ought not to convince us that it is not of that nature; for it frequently happens, eſpecially in the advanced ſtages of aneuriſms, that their contents become ſo firm that no effect is produced upon them by preſſure. Hence the propriety, in doubtful caſes, of proceeding as if the diſeaſe was clearly of the aneuriſmal kind.

170 Prognoſis. In the prognoſis, three circumſtances are chiefly to be attended to; the manner in which the diſeaſe appears to have been produced, the part of the body in which the ſwelling is ſituated, and the age and habit of the body of the patient.

If an aneuriſm has come forward in a gradual manner, without any apparent injury done to the part, and not ſucceeding any violent bodily exertion, there will be reaſon to ſuppoſe that the diſeaſe depends upon a general affection either of the trunk in which it occurs, or of the whole arterious ſyſtem. In ſuch caſes art can give little aſſiſtance: whereas if the tumor has ſucceeded an external accident, an operation may be attended with ſucceſs.

171 An operation ſeldom neceſſary in varicoſe aneuriſm.

In the varicoſe aneuriſm a more favourable prognoſis may generally be given than in either of the other two ſpecies. It does not proceed ſo rapidly; when it has arrived at a certain length, it does not afterwards acquire much additional ſize; and it may be ſuſtained without much inconvenience for a great number of years. As long as there is reaſon to expect this, the hazard which almoſt always attends the operation ought to be avoided.

In the ſecond volume of the London Medical Obſervations, two caſes are related by Dr Hunter of the varicoſe aneuriſm. One of them at that time was of 14 years ſtanding, and the other had ſubſiſted for five years, without there being any neceſſity for an operation. And in vol. iii. of the ſame work a ſimilar caſe of five years duration is related by Dr Cleghorn.

In a letter afterwards from Dr Hunter to Mr Benjamin Bell, the Doctor ſays, "The lady in whom I firſt obſerved the varicoſe aneuriſm is now living at Bath in good health, and the arm is in no ſenſe worſe, although it is now 35 years ſince ſhe received the injury:" and the Doctor farther obſerves, that he never heard of the operation being performed for the varicoſe aneuriſm which was known to be ſuch.

Mr Bell ſays, he was informed by Dr William Cleghorn of Dublin, that the caſe of varicoſe aneuriſm, related in the 3d volume of the London Medical Obſervations, remained nearly in the ſame ſtate as at the time that account of it was made out, which included a period of at leaſt 20 years; only that the veins were rather more enlarged. The patient recovered, and the limb became nearly as ſtrong and ſerviceable as the other. Mr Pott alſo met with three different inſtances of this ſpecies of aneuriſm; and obſerves, that the operation never became neceſſary in any of them.

Among other inſtances of varicoſe aneuriſm which have appeared here, a young man from Paiſley was examined ſeveral years ago by different ſurgeons of this place. The diſeaſe was very clearly marked, and no operation was adviſed. He was afterwards found ſerving in the navy, where he underwent great fatigue without any inconvenience from the aneuriſm, though then of 13 years ſtanding.

But though this aneuriſm, when it has arrived at a certain ſize, commonly remains ſtationary, and may be borne without much inconvenience for a long time, this is not always the caſe; for ſome inſtances have occurred, where the diſeaſe was attended with great uneaſineſs, and where the operation was performed with much difficulty.

In judging further of the probable event of aneuriſms in general, the ſituation of the tumor next requires attention. When it is ſo ſituated that no ligature or effectual compreſſion can be applied for ſtopping the circulation in the part, if the artery be large, there would be the greateſt danger in opening it. In this caſe therefore the moſt fatal conſequences are to be apprehended.

When aneuriſms are ſituated near the upper parts of the extremities, ſurgeons have been hitherto doubtful whether, after tying up the humeral or femoral arteries, the lower parts of the limb would be ſupplied with blood; and tho' ſeveral ſucceſsful inſtances of performing that operation have been publiſhed, the ſucceſs has been pretty generally aſcribed to unuſual branching of the great arteries of thoſe patients, on whom the operation was performed, above the aneuriſm. Mr. John Bell, however, in his late very ingenious and important *Diſcourſes on Wounds*, has proved, to our ſatisfaction at leaſt, that the inoſculations which take place between the internal iliac and the arteries of the leg, by means of the glutæal arteries and the profunda femoris, are in every caſe ſufficient to ſupply nouriſhment to the limb; that the ſame is the caſe in the arm; and that therefore in every aneuriſm, even of the humeral or femoral artery, we ought to perform the operation. Several inſtances of ſucceſs are there related; among others, an operation performed by Mr J. Bell himſelf, which, as it is perhaps the greateſt that has hitherto been performed, we ſhall here abridge for the gratification of our readers.

172 Remarkable aneuriſm.

A leech-catcher fell as he was ſtepping out of a boat; and a pair of long-pointed ſciſſars pierced his hip exactly over the ſciatic notch, where the great iliac artery comes out from the pelvis. The artery bled furiouſly: the patient fainted. The ſurgeon eaſily ſtopt up the wound, as it was very narrow and deep, and healed it. A great tumor ſoon formed. The man travelled from the north country in ſix weeks to the Edinburgh infirmary, with a prodigious tumor of the hip, the thigh rigidly contracted, the ham bent, the whole leg ſhrunk and cold and uſeleſs. There was no pulſation nor retroceſſion of blood on preſſure; but the diſtention was attended with great pain, and the man was extremely anxious to have an operation performed. Though there was little doubt of its being aneuriſm, it might be a great abſceſs. It was reſolved therefore to make a ſmall inciſion, and juſt touch the bag with the point of a lancet, and if it contained blood, a full conſultation was to be called. Mr Bell accordingly made an inciſion two inches and a half in length; the great faſcia formed the coat of the tumor, and under it were ſeen the fibres of the great glutæus muſcle. As ſoon as it was opened at one point, great clots of blood came out; and Mr Bell, after being certain that it was an aneuriſm of the great artery of the thigh, cloſed up the wound with a tent-like compreſs, put the patient to bed, and a pupil held his hand on the hip. This was done at one o'clock; at four the conſultation met, and the operation was performed. On making an inciſion eight inches long, the blood was thrown out with a whiſhing noiſe, and with ſuch impetuoſity, that the aſſiſtants were covered with it. In a moment twenty hands were about the tumor, and the bag was filled with ſponges and cloths of all kinds; the blood, however, ſtill made its way; and the man who had ſupported himſelf on his elbow, fell down; his arms and head hung down, he uttered two or three heavy groans, and they thought him dead. At that critical moment Mr Bell ran the biſtoury upwards and downwards, and at once made the wound two feet long; thruſt his hand to the bottom of the tumor, felt the warm jet of blood, put his finger on the mouth of the artery, the pulſe of which he felt diſtinctly; which firſt aſſured him that the man was alive. The artery was then tied; and when Mr Bell lifted up his finger, it was diſcovered to be the poſterior iliac; that it had been cut fairly acroſs, and had bled with open mouth. The patient was ſo low, that after dreſſing the wound, they were obliged to bring in a bed, and leave him to ſleep in the operation room. He was cured of this great wound in leſs than ſeven months, and afterwards recovered the uſe of his leg completely.

173 Effects of preſſure in aneuriſm.

In every caſe of aneuriſm, the uſe of preſſure has been indiſcriminately recommended, not only in the incipient period of the diſeaſe, but even in its more advanced ſtages.

In the diffuſed or falſe aneuriſm, as preſſure cannot be applied to the artery alone, without at the ſame time affecting the refluent veins; and as this, by producing an increaſed reſiſtance to the arterial pulſations, muſt force an additional quantity of blood to the orifice in the artery—no advantage is to be expected from it, though it may be productive of miſchief.

In the early ſtages of encyſted aneuriſm, while the blood can be yet preſſed entirely out of the ſac into the artery, it often happens, by the uſe of a bandage of ſoft and ſomewhat elaſtic materials, properly fitted to the part, that much may be done in preventing the ſwelling from receiving any degree of increaſe; and on ſome occaſions, by the continued ſupport thus given to the weakened artery, complete cures have been at laſt obtained. In all ſuch caſes, therefore, particularly in every inſtance of the varicoſe aneuriſm, much advantage may be expected from moderate preſſure.

But preſſure, even in encyſted aneuriſm, ought never to be carried to any great length; for tight bandages, by producing an immoderate degree of reaction in the containing parts to which they are applied, inſtead of anſwering the purpoſe for which they were intended, have evidently the contrary effect. Indeed the greateſt length to which preſſure in ſuch caſes ought to go, ſhould be to ſerve as an eaſy ſupport to the parts affected, and no farther.

174 Method of performing the operation for aneuriſm.

In performing the operation for aneuriſm, the firſt ſtep ought to be to obtain a full command of the circulation in the inferior part of the member by means of the tourniquet. This being done, the patient ſhould be ſo placed, that the diſeaſed limb, on being ſtretched on a table, is found to be of a proper height for the ſurgeon; who, as the operation is generally tedious, ought to be ſeated. The limb being properly ſecured by an aſſiſtant, the operator is now with the ſcalpel, Plate CCCCLXXXVII. fig. 18. to make an inciſion through the ſkin and cellular ſubſtance along the whole courſe of the tumor; and as freedom in the remaining parts of the operation is here a matter of much importance, it is even of uſe to carry this external inciſion half an inch or ſo both above and below the fartheſt extremities of the ſwelling.

All the effuſed blood ought then to be wiped off by means of a ſponge; and the ſofteſt part of the tumor being diſcovered, an opening ought there to be made into it with the lancet, Plate CCCCLXXXVII. fig. 19. large enough for admitting a finger of the operator's left-hand. This being done, and the finger introduced into the cavity of the tumor, it is now to be laid open from one extremity to the other, by running a blunt-pointed biſtoury, Plate CCCCLXXXVII. fig. 20. along the finger from below upwards, and afterwards from above downwards, ſo as to lay the whole cavity fairly open.

The cavity of the tumor being thus laid freely open, all the coagulated blood is to be taken out by the fingers of the operator, together with a number of tough membranous filaments commonly found here. The cavity of the tumour is now to be rendered quite dry, and free from the blood which, on the firſt opening of the ſwelling, is diſcharged into it from the veins in the inferior part of the member: the tourniquet is then to be ſlackened to diſcover, not only the artery itſelf, but the opening into it, from whence the blood collected in the tumor has been all along diſcharged. This being done, the next point to be determined is the manner of ſecuring this opening into the artery, ſo as to prevent in future any farther effuſion of blood. Various means have been propoſed for accompliſhing this; but the effects of all of them may be comprehended under the three following heads.

175 Method of ſecuring the wound of the artery,

176 By aſtringents,

1. The effects of ligature upon a large artery having on ſome occaſions proved fatal to the inferior part of the member, it was long ago propoſed, that ſo ſoon as the opening into the artery has been diſcovered, inſtead of applying a ligature round it, which for certain is to obliterate its cavity entirely, a piece of agaric, vitriol, alum, or any other aſtringent ſubſtance, ſhould be applied to the orifice, in order if poſſible to produce a reunion of its ſides.

177 Or by ſutures,

2. Upon the ſame principle with the preceding, viz. that of ſtill preſerving the circulation in the artery, it was ſeveral years ago propoſed by an eminent ſurgeon of Newcaſtle, Mr Lambert, that the orifice in the artery ſhould be ſecured by means of the twiſted ſuture. A ſmall needle being puſhed through the edges of the wound, they are then directed to be drawn together by a thread properly twiſted round the needle, as was formerly directed when treating of ſutures.

178 Improper

Strong objections, however, occur to both of theſe methods. In the firſt place, no aſtringent application with which we are acquainted is poſſeſſed of ſuch powers as to deſerve much confidence. In almoſt every inſtance in which they have been uſed, the hemorrhagy has recurred again and again, ſo as to prove very diſtreſſing, not only to the patient, but to the practitioner in attendance; little or no attention is therefore to be paid to remedies of this kind in ordinary practice.

Mr Lambert's method of ſtitching the orifice in the artery is certainly a very ingenious propoſal; and would in all probability, at leaſt in moſt inſtances, prove an effectual ſtop to all farther diſcharge of blood: but as we have yet only one inſtance of its ſucceſs, little can be ſaid about it. Two material objections, however, ſeem to occur to this practice. One is, that in the operation for the aneuriſm, in almoſt every inſtance, a very few only excepted, the artery lies at the back-part of the tumor; ſo that when all the collected blood is removed, there is ſuch a depth of wound, that it muſt be always a very difficult matter, and on many occaſions quite impracticable, to perform this nice operation upon the artery with that attention and exactneſs which, in order to enſure ſucceſs, it certainly requires. But there is another very material objection. By introducing a needle through the ſides of the orifice, and drawing theſe together by a ligature, the cavity of the artery muſt undoubtedly be at that point much diminiſhed. Indeed Mr Lambert, in his account of the caſe in which this operation was performed, acknowledges that the diameter of the artery was thereby diminiſhed. Now the paſſage of the blood being thus contracted at one point, the impulſe upon that particular part muſt be very conſiderable: So that the very remedy employed for the cure of one ſpecies of aneuriſm, will in all probability prove a very powerful agent in inducing another; for the blood being thus obſtructed in its uſual courſe, there will be no ſmall danger incurred of a dilatation being produced immediately above this preternatural ſtricture.

3. Neither of the methods we have yet been conſidering being found eligible for ſecuring the orifice in the artery, we ſhall now proceed to deſcribe the ordinary manner of performing this operation; which conſiſts in obliterating the arterial cavity entirely by means of ligatures.

179 Method of doing it by ligature.

The artery being laid bare in the manner directed, and all the coagulated blood being carefully removed from the cavity of the tumor, on the tourniquet being now ſlackened ſo as to bring the orifice in the artery into view, a ſmall probe curved at the extremity is to be introduced at the opening, in order to raiſe the artery from the neighbouring parts, ſo as that the ſurgeon may be enabled with certainty to paſs a ligature round it, without comprehending the contiguous nerves, which in general run very near to the large blood-veſſels of a limb. By this precaution the nerves may be always avoided; and by doing ſo, a great deal of miſchief may be prevented, which otherwiſe might ſupervene. When the diſorder is ſituated either in the ham, or in the uſual part of blood-letting in the arm, bending the joints of the knee or of the elbow, as it relaxes the artery a little, renders this part of the operation more eaſily effected than when the limbs are kept fully ſtretched out.

The artery being thus gently ſeparated from the contiguous parts, a firm waxed ligature muſt be paſſed round it, about the eighth part of an inch or ſo above the orifice, and another muſt in the ſame manner be introduced at the ſame diſtance below it.

The ligatures being both finiſhed in the manner directed, the tourniquet is now to be made quite looſe; and if no blood is diſcharged at the orifice in the artery, we may then reſt ſatisfied that the operation is ſo far properly completed.

180 Subſequent treatment of the patient.

The wound is now to be lightly covered with ſoft lint, with a pledgit of any emollient ointment over the whole; and a compreſs of linen being applied over the dreſſings, all the bandage in any degree requiſite is two or three turns of a roller above and as many below the centre of the wound, making it preſs with no more tightneſs than is abſolutely neceſſary for retaining the application we have juſt now mentioned.

The patient being now put into bed, the member ſhould be laid in a relaxed poſture upon a pillow, and ought to be ſo placed as to create the leaſt poſſible uneaſineſs from the poſture in which it is laid.

As the operation for the aneuriſm is always tedious, and produces much pain and irritation, a full doſe of laudanum ſhould be given immediately on the patient being got into bed. In order to diminiſh ſenſibility during ſome of the more capital operations, different trials have been made of opiates given an hour or ſo before the operation. On ſome occaſions this proved evidently very uſeful; but in others it ſeemed to have the contrary effect; particularly in weak nervous conſtitutions, in which with any doſes, however ſmall, they appeared to be rendered more irritable and more ſuſceptible of pain, than if no opiate had been given. Immediately after this operation, however, an opiate ought to be exhibited, to be repeated occaſionally according to the degrees of pain and reſtleſſneſs.

181 State of the limb after the operation.

In ſome few caſes of aneuriſm, it has happened that the pulſe in the under part of the member has been diſcovered immediately after the operation. This, however, is a very rare occurrence: For as this diſorder is ſeldom met with in any other part than at the joint of the elbow as a conſequence of blood-letting, and as it rarely happens that the brachial artery divides till it paſſes an inch or two below that place, the trunk of this artery is therefore moſt frequently wounded; and when, accordingly, the ligature, in this operation, is made to obliterate the paſſage of almoſt the whole blood which went to the under part of the arm, there cannot be the leaſt reaſon to expect any pulſation at the wriſt, till in a gradual manner the anaſtomoſing branches of the artery have become ſo much enlarged as to tranſmit ſuch a quantity of blood to the inferior part of the member as is ſufficient for acting as a ſtimulus to the larger branches of the artery.

Immediately after the operation, the patient complains of an unuſual numbneſs or want of feeling in the whole member; and as it generally, for a few hours, becomes cold, it is therefore right to keep it properly covered with warm ſoft flannel; and in order to ſerve as a gentle ſtimulus to the parts below, moderate frictions appear to be of uſe. In the ſpace of ten or twelve hours from the operation, although the numbneſs ſtill continues, the heat of the parts generally begins to return; and it frequently happens, in the courſe of a few hours more, that all the inferior part of the member becomes even preternaturally warm.

Immediately after this operation, the want of feeling in the parts is often very great; and in proportion as the circulation in the under part of the member becomes more conſiderable, the degree of feeling alſo augments. If we could ſuppoſe the nerves of the parts below to be always included in the ligature with the artery, that numbneſs which ſucceeds immediately to the operation might be eaſily accounted for; but it has been alſo known to happen when nothing but the artery was ſecured by the ligature.

In the mean time, the patient being properly attended to as to regimen, by giving him cordials and nouriſhing diet when low and reduced, and confining him to a low diet if his conſtitution is plethoric, the limb being ſtill kept in an eaſy relaxed poſture, towards the end of the fourth or fifth day, ſometimes much ſooner, a very weak feeble pulſe is diſcovered in the under part of the member, which becoming ſtronger in a gradual manner, the patient in the ſame proportion recovers the uſe and feeling of the parts.

So ſoon as there is an appearance of matter having formed freely about the ſore, which will ſeldom happen before the fifth or ſixth day, an emollient poultice ſhould be applied over it for a few hours, in order to ſoften the dreſſings, which may be then removed. At this time the ligatures might be taken away; but as their continuance for a day or two longer can do no harm, it is better to allow them to remain till the ſecond or third dreſſing, when they either drop off themſelves, or may be taken away with perfect ſafety. The dreſſings, which ſhould always be of the ſofteſt materials, being renewed every ſecond or third day according to the quantity of matter produced, the ſore is in general found to heal very eaſily; and although the patient may for a conſiderable time complain of great numbneſs and want of ſtrength in the whole courſe of the diſeaſed limb, yet in moſt inſtances a very free uſe of it is at laſt obtained.

182 Hemorrhagies often ſucceed the operation.

Very often after the artery ſeems to be ſecured it gives way, and fatal hemorrhagies enſue; nor is the patient free from this danger for a great length of time. In one of Mr Hunter's operations the artery gave way on the 26th day. It is to this difficulty of procuring adheſion between the ſides of the artery that a great part of the danger of this operation is to be aſcribed.

Chap. XII. *Of Affections of the Brain from External Violence.*

183 Symptoms of compreſſion of the brain.

When the brain is compreſſed, a ſet of ſymptoms enſue extremely dangerous, though ſometimes they do not make their appearance till after a conſiderable interval. But at whatever time they appear, they are uniformly of the ſame kind, and are in general as follow: drowſineſs, giddineſs, and ſtupefaction, dimneſs of ſight, dilatation of the pupil; and, where the injury done to the head is great, there is commonly a diſcharge of blood from the eyes, noſe, and ears. Sometimes the fractured bone can be diſcovered through the integuments, at others it cannot. There is an irregular and oppreſſed pulſe, and ſnoring or apoplectic ſtertor in breathing. There is likewiſe nauſea and vomiting, with an involuntary diſcharge of fæces and urine. Among the muſcles of the extremities and other parts, there is loſs of voluntary motion, convulſive tremors in ſome parts of the body, and palſy in others, eſpecially in that ſide of the body which is oppoſite to the injured part of the head.

Some of the milder of theſe ſymptoms, as vertigo, ſtupefaction, and a temporary loſs of ſenſibility, are frequently induced by ſlight blows upon the head, but commonly ſoon diſappear, either by reſt alone, or by the means to be afterwards pointed out. But when any other ſymptoms enſue, ſuch as dilatation of the pupils, and eſpecially when much blood is diſcharged from the eyes, noſe, and ears, and that there is an involuntary diſcharge of fæces and urine, it may be reaſonably concluded that compreſſion of the brain is induced.

The cavity of the cranium, in the healthy and natural ſtate, is everywhere completely filled by the brain; whatever therefore diminiſhes that cavity, will produce a compreſſion of the brain.

184
Cauſes of theſe.

The cauſes producing ſuch a diminution may be of various kinds, as fracture and depreſſion of the bones of the cranium; the forcible introduction of any extraneous body into the cavity of the cranium; effuſion of blood, ſerum, pus, or any other matter; the thickneſs of the bones of the cranium in certain diſeaſes, as in lues venerea, rickets, or ſpina ventoſa; or water collected in hydrocephalous caſes. The firſt ſet of cauſes ſhall be conſidered in their order. The four laſt mentioned belong to the province of the phyſician, and have been conſidered in a former part of this Work.

Sect. I. *Of Fracture and Depreſſion of the Cranium producing Compreſſion of the Brain.*

Fractures of the cranium have been differently diſtinguiſhed by different authors; but it ſeems ſufficient to divide them into thoſe attended with depreſſion, and thoſe which are not ſo.

In fracture and depreſſion of the cranium, the treatment ought to be,—to diſcover the ſituation and extent of the fracture;—to obviate the effects of the injury done to the brain, by raiſing or removing all the depreſſed parts of the bone;—to endeavour to complete the cure by proper dreſſings, and attention to the after treatment.

185
Method of diſcovering the ſituation of fractures of the cranium.

When the teguments correſponding to the injury done to the bone are cut or lacerated, and, as is ſometimes the caſe, entirely removed, the ſtate of the fracture is immediately diſcovered; but when the integuments of the ſkull remain entire, even though the general ſymptoms of fracture be preſent, there is ſometimes much difficulty in aſcertaining it. When, however, any external injury appears, particularly a tumor from a recent contuſion, attended by the ſymptoms already deſcribed, there can be no doubt of the exiſtence of a fracture. But it ſometimes happens that compreſſion exiſts without the ſmalleſt appearance of tumor. In ſuch caſes, the whole head ought to be ſhaved when an inflammatory ſpot may frequently be obſerved. Sometimes the place of the fracture has been diſcovered by the patient applying the hand frequently on or near ſome particular part of the head.

When the ſymptoms of a compreſſed brain are evidently marked, no time ought to be loſt in ſetting about an examination of the ſtate of the cranium, wherever appearances point out, or even lead us to conjecture, in what part a fracture may be ſituated. For this purpoſe an inciſion is to be made upon the ſpot through the integuments to the ſurface of the bone, which muſt be ſufficiently expoſed to admit of a free examination.

Some authors have recommended a crucial inciſion; others one in form of the letter T; while many adviſe a conſiderable part of the integuments to be entirely removed. But as it is more agreeable to the preſent mode of practice to ſave as much of the ſkin as poſſible, a ſimple inciſion is generally preferred, unleſs the fracture run in different directions, and then the inciſion muſt vary accordingly. It will frequently happen, that a conſiderable part of the integuments muſt be ſeparated from the ſkull, in order to obtain a diſtinct view of the full extent of the fracture; but no part of the integuments is to be entirely removed.

When blood-veſſels of any conſiderable ſize are divided, either before or in time of the examination, they ought to be allowed to bleed freely, as in no caſe whatever is the loſs of blood attended with more advantage than the preſent. When, however, it appears that the patient has loſt a ſufficient quantity, the veſſels ought to be ſecured.

After the integuments have been divided, if the ſkull be found to be fractured and depreſſed, the nature of the caſe is rendered evident; but even where there is no external appearance of fracture, tumor, diſcoloration, or other injury, if the patient continue to labour under ſymptoms of a compreſſed brain, if the pericranium has been ſeparated from the bone, and eſpecially if the bone has loſt its natural appearance, and has acquired a pale white or duſky yellow hue, the trepan ought to be applied without heſitation at the place where theſe appearances mark the principal ſeat of the injury.

Again, although no mark either of fracture or of any diſeaſes underneath ſhould appear on the outer table of the bone, yet there is a poſſibility that the inner table may be fractured and depreſſed. This indeed is not a common occurrence, but it happens probably more frequently than ſurgeons have been aware of; and where it does happen, the injury done to the brain is as great, and attended with as much danger, as where the whole thickneſs of the bone is beat in. The application of the trepan is therefore neceſſary.

But if, after the application of the trepan, it happens that no mark of injury appears either in the outer or inner table in that part, or in the dura mater below it, and that the ſymptoms of a compreſſed brain ſtill continue, a fracture in ſome other part is to be ſuſpected; or that kind of fracture termed by practitioners *counter fiſſure*, where the ſkull is fractured and ſometimes depreſſed on the oppoſite ſide to, or at a diſtance from, the part where the injury was received. This is fortunately not a very frequent occurrence, and has even been doubted by ſome; but different inſtances of it have, beyond all queſtion, been found. If therefore the operation of the trepan has been performed, and no fracture is diſcovered, no extravaſation appears on the ſurface of the brain; and if blood-letting and other means uſually employed do not remove the ſymptoms of compreſſion, the operator is to ſearch for a fracture on ſome other part. The whole head ſhould again be examined with much accuracy; and, by preſſing deliberately but firmly over every part of it, if the ſmalleſt degree of ſenſibility remains, the patient will ſhow ſigns of pain, either by moans or by raiſing his hands, when preſſure is made over the fractured part. In this way fractures have been frequently detected, which might otherwiſe have been concealed.

186
Method of removing and elevating depreſſed portions of the cranium.

Having now conſidered every thing preparatory to the operation of the trepan, we ſhall next point out the means beſt adapted for the removal or elevation of a depreſſed portion of the bone.

The firſt thing to be done is, after ſhaving the head, to make an inciſion as deep as the bone, and directly upon the courſe of the fracture.

The patient ought to be laid on a table, with a mattreſs under him, while his head is placed upon a pillow, and ſecured by an aſſiſtant. When the extent of the fracture has been determined, and the bleeding from the inciſion ſtopped, the depreſſed bone is now to be elevated; but previous to this it is neceſſary to ſearch for detached pieces. Should any be found, they ought to be removed by a pair of forceps adapted to this purpoſe. By the ſame inſtrument any ſplinters of bone which may have been beaten in may be removed; but when a part of the bone is beaten in beyond the level of the reſt of the cranium, as much of the pericranium is then to be removed by a raſpatory, Plate CCCCLXXXVIII. fig. 21. as will allow the trephine, Plate CCCCLXXXVIII. fig. 22. to be applied; or, if the operator incline, for the ſake of diſpatch, he may uſe the trepan, Plate CCCCLXXXVIII. fig. 23. and 24.; or the operation may be begun and finiſhed with the trephine, while the trepan may perform the middle and principal part of the work. This part of the work is begun by making a hole with the perforator (fig. 24.), which is ſcrewed on to the lower end of fig. 23. deep enough to fix the central pin of the trephine, in order to prevent the ſaw from ſlipping out of its central courſe, till it has formed a groove ſufficiently deep to be worked ſteadily in; and then the pin is to be removed. If the bone be thick, the teeth of the ſaw muſt be cleaned now and then by the bruſh (fig. 25.) during the perforation, and dipped in oil as often as it is cleaned, which will conſiderably facilitate the motion, and render it more expeditious; making it at the ſame time much leſs diſagreeable to the patient, if he poſſeſs his ſenſes. That no time may be loſt, the operator ought to be provided with two inſtruments of the ſame ſize, or at leaſt to have two heads which can be readily fitted to the ſame handle.

After having made ſome progreſs in the operation, the groove ought to be frequently examined with a pick-tooth, or ſome ſuch inſtrument, in order to diſcover its depth; and if one ſide happen to be deeper than the other, the operator ought to preſs more on that ſide which is ſhalloweſt. Precautions are more particularly neceſſary when the operation is performed upon a part of the ſkull which is of an unequal thickneſs, eſpecially after the inſtrument has paſſed the diploe. And though it be ſaid by writers in general that the inſtrument may be worked boldly till it comes at the diploe (which is generally known by the appearance of blood), yet the operator ſhould be upon his guard in this point, examining from time to time if the piece be looſe, leſt thro' inadvertence the dura matter be wounded; for in ſome parts of the ſkull there is naturally very little diploe, and in old ſubjects ſcarcely any. It ought likewiſe to be remembered, that the ſkulls of children are very thin. When the piece begins to vacillate, it ought to be ſnapped off with the forceps (fig. 26), or levator (fig. 26. *a*); for the ſawing ought by no means to be continued till the bone be cut quite through, otherwiſe the inſtrument may plunge in upon the brain, or at leaſt injure the dura mater. If the inner edge of the perforation be left ragged, it is to be ſmoothed with the lenticular (fig. 28. *b*), to prevent it from irritating the dura mater. Particular care is to be taken in uſing the inſtrument, leſt it ſhould preſs too much upon the brain.

The next ſtep is to raiſe the depreſſed part of the bone with the levator, or to extract the fragments of the bone, grumous blood, or any extraneous body. After this, if there appear reaſon to apprehend that blood, lymph, or matter, is contained under the dura mater, it ought to be cautiouſly opened with a lancet, endeavouring to avoid the blood-veſſels running upon it, or lying immediately under it.

When the trepan is to be uſed on account of a fiſſure in which the bone will not yield, the inſtrument ſhould be applied ſo as to include part of it, if not directly over it, as it is moſt probable that the extravaſated fluid will be found directly under it. And when the fiſſure is of great extent, it may be proper to make a perforation at each end, if the whole can be conveniently brought into view; and in ſome caſes ſeveral perforations may become neceſſary.

When it is propoſed to make ſeveral perforations to remove depreſſed fragments of the bone which are firmly fixed, and having the internal ſurface larger than the external, or to raiſe them ſufficiently, it is neceſſary to apply the trepan as near the fractured parts as poſſible; making the perforations join each other, to prevent the trouble of cutting the intermediate ſpaces.

When the ſkull is injured over a ſuture, and it is not thought adviſable to uſe the trepan, a perforation ought to be made on each ſide of the ſuture, eſpecially in young ſubjects, in whom the dura mater adheres more ſtrongly than in adults; becauſe there cannot be a free communication between the one ſide and the other, on account of the attachment of that membrane to the ſuture.

187
Treatment of the patient after the operation.

After the elevation of the depreſſed pieces, or the removal of thoſe which are quite looſe, the extraction of extraneous bodies, and the evacuation of extravaſated fluids, &c. the ſore is to be dreſſed in the lighteſt and eaſieſt manner; all that is neceſſary being to apply a pledget of fine ſcraped lint, covered with ſimple ointment, to that part of the dura mater which is laid bare by the trepan, or otherwiſe; after which the edges of the ſcalp are to be brought together or nearly ſo, and another pledget laid along the whole courſe of the wound; a piece of fine ſoft linen is to be laid over all, and the dreſſings may be retained in their place by a common night-cap applied cloſe to the head, and properly fixed.

The patient is to be placed in as eaſy a poſition in bed as poſſible, with his head and ſhoulders elevated a little more than ordinary. If the operation be attended with ſucceſs, the patient will ſoon begin to ſhow favourable ſymptoms; he will ſoon ſhow ſigns of increaſing ſenſibility, and the original bad ſymptoms will gradually diſappear. After this he ought to be kept as quiet as poſſible; proper laxatives are to be adminiſtered, and ſuch as may be leaſt of a nauſeating nature. His food ought to be ſimple and eaſy of digeſtion, and his drink of the moſt diluent kind. If he complain of the wound being uneaſy, an emollient poultice ſhould be immediately applied, and renewed three or four times in the twenty-four hours. By theſe means there will commonly be a free ſuppuration from the whole ſurface of the ſore.

Every time the wound is dreſſed, the purulent matter ought to be wiped off from it with a fine warm ſponge; and if any degree of ſloughineſs take place on the dura mater or parts adjacent, it will then be completely ſeparated. Granulations will begin to form, which will continue to increaſe till the whole ariſe to a level with the ſurface of the cranium. The edges of the ſore are now to be dreſſed with cerate ſtraps, and the reſt of it covered with fine ſoft lint, kept gently preſſed on by the night-cap properly tied. In this way the cure will go on favourably; luxuriance of granulations will commonly be prevented; the parts will cicatrize kindly; and as all the ſkin has been preſerved in making the firſt inciſion, the cicatrix will be but little obſerved.

But things do not always proceed in this favourable manner. Sometimes in a few hours after the operation the patient is ſeized with a kind of reſtleſſneſs, toſſing his arms, and endeavouring to move himſelf in bed, while the ſymptoms of a compreſſed brain remain nearly the ſame as formerly. In this caſe, eſpecially if the pulſe be quick and ſtrong, the patient ought to be bled freely, as there will be reaſon to ſuſpect ſome tendency to inflammation in the brain. Sometimes, though the trepan has been properly applied, the ſymptoms are not relieved, on account of extravaſated fluids collected internally under the dura mater, or between the pia mater and brain, or in the cavity of the ventricles. The danger in theſe caſes will be in proportion to the depth of the collection. Particular attention therefore ought always to be paid to the ſtate of the dura mater after the perforation has been made. If blood be collected below the dura mater, this membrane will be found tenſe, dark coloured, elaſtic, and even livid; in which caſe, an opening becomes abſolutely neceſſary to diſcharge the extravaſated fluid. Gentle ſcratches are to be made with a ſcalpel, till a probe (fig. 27), or directory (fig. 28.), can be introduced; upon which the membrane is to be ſufficiently divided in a longitudinal, and ſometimes even in a crucial direction, till an outlet to the fluid be given.

After the dura mater has been cut in this manner, there is ſome danger of the brain protruding at the opening; but the danger from this is not equal to the bad effects ariſing from effuſed fluids compreſſing the brain.

188 Of fungi.

A troubleſome and an alarming appearance now and then follows the operation of the trepan; namely, the excreſcences called *fungi*, formerly ſuppoſed to grow immediately from the ſurface of the brain, but which in general, originate from the ſurface of the dura mater or cut edge of the bone granulating too luxuriantly.

It often happens that they poſſeſs little ſenſibility; and then the beſt method to prevent their riſing to any great height is to touch them frequently with lunar cauſtic: but ſome caſes occur where their ſenſibility is ſo great that they cannot be touched, unleſs they hang by a ſmall neck; and then a ligature may be put round them, and tightened from time to time till they drop off, which will commonly be in the courſe of a few days. It ſeldom happens, however, that there is any occaſion for applying ſuch means, for the removal of theſe tumors, for they generally fall off as the perforations of the bone fill up.

If they do not, as the connection between them and the brain will be then in a great meaſure intercepted, they may be with more ſafety removed, either by exciſion, by cauſtic, or by ligature.

The cure being thus far completed, only a ſmall cicatrix will remain, and in general the parts will be nearly as firm as at firſt: but when much of the integuments have been ſeparated or deſtroyed, as they are never regenerated, the bone will be left covered only by a thin cuticle, with ſome ſmall quantity of cellular ſubſtance. When this is the caſe, the perſon ought to wear a piece of lead or tin, properly fitted and lined with flannel, to protect it from the cold and other external injuries.

This is the method now commonly practiſed in caſes of compreſſion; but it frequently happens, that inſtead of compreſſion, ſuch a degree of concuſſion takes place that no aſſiſtance from the trepan can be attended with any advantage; for the effects of concuſſion are totally different from thoſe of compreſſion, and therefore to be removed in a different manner.

SECT. II *Of Concuſſion of the Brain.*

BY concuſſion of the brain is meant ſuch an injury, from external violence, as either obſtructs or deſtroys its functions, without leaving behind it ſuch marks as to allow its nature to be aſcertained by diſſection.

189 Symptoms of concuſſion of the brain.

Moſt of the ſymptoms attending compreſſion of the brain occur alſo in concuſſion; but in a compreſſed ſtate of the brain they are more permanent. There is no diſcharge of blood from the eyes, noſe, or ears, which frequently happens in compreſſion; and inſtead of that apoplectic ſtertor in breathing which accompanies compreſſion, the patient ſeems to be in a ſound and natural ſleep. The pulſe is irregular and ſlow in compreſſion, and grows ſtronger and fuller by blood-letting; but in concuſſion it is weaker, being ſoft and equal, and ſinks by blood-letting. There are beſides convulſions in compreſſions, which are not obſerved in a ſtate of concuſſion. The ſymptoms ariſing from concuſſion come on immediately after the injury is received. In the violent degrees of theſe the patient remains quite inſenſible; the pupils are much dilated, and do not contract though the eyes be expoſed to the ſtrongeſt light.

In more violent ſymptoms, eſpecially when the patient is rendered inſenſible, it is extremely difficult to diſtinguiſh between concuſſion and depreſſion; for ſymptoms which have been ſuppoſed to ariſe entirely from concuſſion have, after death, been found to be owing to extravaſation or undiſcovered fracture; and extravaſation has been blamed, when, on diſſection not the leaſt morbid appearance could be diſcovered.

190 Treatment.

In concuſſion the pulſe will frequently ſink and become feeble, even after the diſcharge of eight or ten ounces of blood: In doubtful caſes, therefore, blood-letting ſhould be practiſed with great caution. If the pulſe become fuller and ſtronger after diſcharging a moderate quantity, if the blood appear ſizy, and eſpecially if the patient become more ſenſible, it may be concluded that the ſymptoms depend upon extravaſation, depreſſion of the ſkull, or ſome degree of inflammation; and as long as advantage ſeems to be derived from blood-letting, we may repeat it: but if, upon drawing a few ounces of blood, the pulſe becomes feeble, and eſpecially if along with this the patient become more weakly, we ſhould immediately deſiſt from any farther evacuation of blood; and in place of it we ought to give ſuch remedies as may ſupport and ſtrengthen the patient: cordials ought to be given internally, and ſtimulants applied externally. Warm wine ſhould be given in proportion to the degree of debility induced; the patient, who is apt, in this caſe, to become cold, ſhould be kept warm by proper coverings; a bliſter ought to be put to all that part of the head in which the ſkin has not been injured; ſinapiſms ſhould be applied to the feet; gentle laxatives are uſeful, and ſhould be regularly given, ſo as to keep the body open. If the patient cannot ſwallow wine in ſufficient quantity, volatile alkali, ardent ſpirits, and other cordials of a ſtimulating kind, ſhould be given. In concuſſions of the brain, Mr Bromefield has recommended the uſe of opiates, and ſeveral other practitioners agree with him; though ſome conſider it as hurtful in the early ſtages of the diſorder, and are of opinion that even wine and other cordials ought to be given with ſome degree of caution. Iſſues, or the frequent repetition of bliſters to the different parts of the head and neck, by which an almoſt conſtant ſtimulus is preſerved, are much recommended. When patients are recovering from accidents of this kind, a liberal uſe of bark, ſteel, and mineral waters, &c. have ſometimes been of ſervice. When the ſtomach is loaded, gentle vomits become neceſſary; and white vitriol is reckoned the beſt in ſuch caſes. When much languor, inactivity, and loſs of memory continue, electricity long applied has been attended with advantage. This remedy, however, would be hurtful where any ſymptoms of compreſſion or inflammation of the brain are preſent.

SECT. III. *Of Inflammation of the Membranes of the Brain, or of the Brain itſelf, from external Violence.*

191 Symptoms of inflammation of the brain and its membranes.

INFLAMMATION of the brain and of its membranes is attended with ſymptoms which occur in inflammations affecting other parts of the body, and from ſimilar cauſes, and likewiſe with ſymptoms peculiar to the brain itſelf. This diſorder differs eſſentially from concuſſion in its not appearing immediately; ſeldom till ſeveral days after the accident, and ſometimes not till two, three, or more weeks, or even as many months, have elapſed; when the patient begins to feel an univerſal uneaſineſs over his head, attended with liſtleſſneſs, ſome degree of pain in the part upon which the injury was inflicted, though of this there was perhaps no previous ſenſation. Theſe ſymptoms gradually increaſe; the patient appears dull and ſtupid; there is now a ſenſation of fulneſs, as if the brain were girt or compreſſed; he complains of giddineſs and of nauſea, which ſometimes terminate in vomiting; he is hot, and extremely uneaſy; his ſleep is much diſturbed, neither natural ſleep nor that procured by opiates affording him relief; the pulſe is hard and quick; the face is fluſhed; the eyes inflamed and unable to bear an expoſure to much light. Sometimes, where a wound of the head accompanies theſe ſymptoms, its edges become hard and ſwelled, and an eryſipelatous inflammation ſpreads quickly over the whole head, and eſpecially towards the forehead and eyelids, which frequently ſwell to ſuch a degree as to ſhut up the eyes entirely. This ſwelling is ſoft and painful to the touch; it receives the impreſſion of the finger, and frequently originates merely from the external wound; on which account the attending ſymptoms are commonly eaſily removed by the means beſt ſuited to eryſipelas of the parts. In a few inſtances, however, this ſymptom is likewiſe connected with, and ſeems to originate from, ſome affection of the dura mater. Its tendency is then of the moſt dangerous kind, and therefore requires the greateſt attention. Soon after theſe ſymptoms become formidable, the part which received the blow begins to put on a diſeaſed appearance. If the bone has been expoſed by the accident, it now loſes its natural complexion, becomes pale, white, and dry, either over its whole ſurface or in particular ſpots: but when the bone has not been denuded, nor the ſofter parts divided, but merely contuſed, they now ſwell, become puffy, and painful to the touch; and when the head is ſhaved, the ſkin over the part affected is redder than the reſt of the ſcalp; and if the ſwelled part be laid open, the pericranium will probably be found to be detached from the ſkull, and a little bloody fetid ichor will be obſerved between this membrane and the bone, which will be found diſcoloured in nearly the ſame manner as if it had been laid bare from the beginning.

By the application of proper remedies theſe ſymptoms are frequently entirely removed; but when neglected, or when they do not yield to the means employed, they conſtantly become worſe. Delirium enſues; the patient becomes extremely hot; and is at times ſeized with ſlight ſhiverings, which continue to increaſe and are attended with ſome degree of coma or ſtupor. The former ſymptoms now in a great meaſure diſappear; palſy of one ſide is ſoon followed by deep coma; the pupils are dilated; the urine and fæces are paſſed involuntarily; ſubſultus tendinum and other convulſions enſue; and death certainly follows, if the patient be not ſpeedily relieved.

Of the above ſymptoms, the firſt ſet point out the inflammatory, the other the ſuppurative, ſtage of the diſeaſe. The remedies which are uſeful in the one are highly improper in the other. During the inflammatory ſtage, blood-letting is the principal remedy; but this is improper after the ſuppurative ſymptoms appear, for then the trepan is the only thing that can give relief.

192 Method of cure.

The indications of cure are; 1. To employ the moſt effectual means for preventing inflammation. 2. To endeavour to procure the reſolution of inflammation by general and topical remedies. 3. When the inflammation cannot be removed by reſolution, and when ſuppuration has taken place, to give a free vent to the matter. 4. If the affected parts be attacked with gangrene, to endeavour to remove it and obviate its effects.

193 Blood-letting proper at firſt,

To anſwer the firſt indication, when the contuſion is conſiderable, blood-letting, both general and topical, ought to be employed, and to a conſiderable extent; the bowels ought to be kept open by the uſe of laxatives; a watery ſolution of ſaccharum ſaturni ſhould be applied to the part affected, and a low diet, with a total abſtinence from exerciſe, ought to be enjoined: but if theſe means fail, or as frequently happens, the practitioner has not been called in ſoon enough for their proper application, and if inflammation have actually commenced, the ſecond indication ought then to be attended to. For this purpoſe, blood-letting, not from the feet according to the advice of old practitioners, but as near as poſſible to the part affected, is to be performed, by leeching, cupping, or ſcarifying with a lancet or ſcalpel.

When inſtead of this, general blood-letting is thought more adviſable, it is commonly reckoned beſt to open the external jugular vein, or the temporal artery; and the rule, with regard to the quantity to be evacuated, ought to be, to draw blood as long as the pulſe continues firm; ſo that in violent caſes taking away from 20 to 25 ounces at once will be found to anſwer the purpoſe better than to extract even a larger quantity, but at different intervals. A few hours afterwards, if the ſymptoms continue violent, it may be proper to diſcharge an additional quantity; but this muſt depend upon the ſtrength of the patient and the fulneſs of the pulſe.

194 And purgatives.

Along with the liberal uſe of blood-letting, briſk purgatives ſhould be given. The bowels ſhould not merely be kept open; but in order to receive full advantage from the practice, a ſmart purging ſhould be kept up by repeated doſes of calomel, jalap, or ſome other neutral ſalt. Where the patient cannot ſwallow in ſufficient quantity, ſtimulating injections ſhould be frequently exhibited.

A moiſt ſtate of the ſkin is uſeful in every caſe of inflammation, and ought therefore to be here particularly attended to. In general a mild perſpiration may be induced by applying warm fomentations to the feet and legs, and by laying the patient in blankets inſtead of linen. But when theſe means are inſufficient, diaphoretics or even ſudorifics may be given.

When much pain or reſtleſſneſs takes place, opiates ſhould be adminiſtered freely, which are now found to be attended with real advantage.

195 External treatment.

With reſpect to the external treatment of this diſorder, attention ſhould be paid to thoſe means which may moſt readily induce a free diſcharge of purulent matter from the ſeat of the injury. With this view, if the original accident be attended with a wound or diviſion of the integuments, as the lips of the ſore are commonly obſerved to be hard, painful, and dry, it ſhould be covered with pledgets ſpread with an emollient ointment, and warm emollient poultices laid over the whole; by which means, and eſpecially by a frequent renewal of the poultices, a free diſcharge of matter will commonly be induced, and the bad ſymptoms will generally be much mitigated, or entirely removed.

In caſes unattended with a diviſion of the integuments, as ſoon as it is ſuſpected that bad ſymptoms may ſupervene, the tumor ſhould be divided down to the pericranium; and if that membrane be found ſeparated from the bone, it ought likewiſe to be divided; and by inducing a ſuppuration in the way already mentioned, the inflammatory ſymptoms will probably be removed. As matter formed here is commonly of an acrid nature, and therefore apt to affect the bone, and by communication of veſſels the membranes under it, inſtead of waſting time till fluctuation be diſtinctly perceived, a free inciſion ſhould be made as ſoon as a tumor is obſervable. But this would be extremely improper in the treatment of tumors which immediately ſucceed to external injuries; for it often happens that ſuch tumors diſappear ſpontaneouſly, or by the uſe of aſtringent applications. It is only when a tumour attended with pain appears at a diſtant period upon the ſpot where the injury was received, that it ought to be opened as ſoon as perceived.

The next part of the practice regards the remedies to be uſed when the diſorder has either proceeded to ſuppuration, or when, on a removal of a portion of the cranium, the dura mater is obſerved to be ſloughy with a tendency to gangrene; and this includes the third and fourth indications of cure.

196 Treatment when ſuppuration has taken place.

The ſuppurative ſtate of the diſeaſe is known by the inflammatory ſymptoms, inſtead of yielding to the remedies already adviſed, increaſing in violence; and being ſucceeded by coma, dilatation of the pupils, a ſlow and full pulſe, involuntary diſcharge of fæces and urine, palſy, and irregular convulſive motions, and eſpecially when theſe ſymptoms are ſucceeded by fits of rigor and ſhivering.

The exiſtence of matter within the cranium being aſcertained, as no other remedy can be depended upon for removing it, the operation of the trepan ſhould be immediately employed, and as many perforations ought to be made as may be ſufficient for evacuating the matter. But if, after the ſkull is perforated, little or no matter appear between the bone and membranes; if the dura matter ſeem more tenſe than uſual; this membrane is likewiſe to be opened, ſo as to give a free diſcharge to any matter which may be between the brain and its membranes.

When it is perceived that the dura matter has already become ſloughy, with ſome tendency to grangrene, the greateſt danger is to be dreaded. If mortification has commenced, there will be much reaſon to think that death will ſoon follow; but different inſtances have occured of ſloughs forming upon the dura mater, and of cures being made after theſe have ſeparated. All that can be attempted is to keep the ſores clean, to give a free diſcharge to the matter, to apply nothing but light eaſy dreſſings, and to give bark in as great quantities as the ſtomach can bear. If there be ſtill ſome tendency to inflammation, the diet ſhould be low and cooling, the patient ſhould drink freely of whey or other diluent liquors, and the bowels ſhould be kept moderately open: But if, on the contrary, the ſyſtem be low and the pulſe feeble, wine is the moſt effectual cordial.

SECT. IV. *Of Fiſſures, or ſimple Fractures of the Skull.*

THE term is here meant to imply a mere diviſion of one or both the tables of the ſkull, with or without a wound of the integuments, not attended with depreſſion. Fractures of this kind are not dangerous as far as affects the ſkull only, for it frequently happens that extenſive fiſſures heal without producing bad ſymptoms. But as they are frequently attended with effuſions of blood or ſerum upon the brain or its membranes, or as they may tend to excite inflammation in theſe, they require particular attention.

When effuſions occur, ſymptoms of compreſſion immediately follow. The remedies beſt ſuited to this diſeaſe muſt then be applied; and the trepan is alone to be depended upon. The fiſſures ſhould be traced through their whole extent, and a perforation made on the moſt depending part of each of them. If this be unſucceſsful, the operation ſhould be repeated along the courſe of the fiſſures as long as ſymptoms of a compreſſed brain continue; and as the effuſed matter will commonly be found contiguous to the fiſſures, they ought to be included in each perforation.

197 Methods of diſtinguiſhing fiſſures.

If the fiſſure be ſo large as to produce an obvious ſeparation of the two ſides of the bone, the nature of the caſe will be at once rendered evident; but where it is extremely ſmall, there is difficulty in diſtinguiſhing it from the natural ſutures, or from ſutures ſurrounding ſmall bones, which ſometimes occur, and get the name of *oſſa triquetra*. But this may be known by the firmer adheſion which always exiſts between the pericranium and ſutures; whereas this membrane is always ſomewhat ſeparated from that part of the bone where a fiſſure is formed. When the pericranium is ſeparated by the accident for a conſiderable way from the ſurface of the bone, various means have been contrived for diſcovering the nature of the caſe; as pouring ink upon the part ſuſpected to be fractured, which in caſe of a fracture cannot be wiped entirely off; or making the patient hold a hair or piece of catgut between his teeth, while the other extremity of it is drawn tenſe, which, when ſtruck, is ſaid to produce a diſagreeable ſenſation in the fractured part. But ſuch teſts are little to be depended on; ink will penetrate the ſutures; and the others are ineffectual, unleſs the fracture be extenſive, and the pieces conſiderably ſeparated from each other. The oozing of the blood from a fiſſure is a better mark. The aſcertaining of this point, however, appears not very material; for unleſs alarming ſymptoms are preſent, although there ſhould be a fiſſure, no operation is neceſſary; and if ſuch ſymptoms occur, the bone ought to be perforated whether there be a fiſſure or not.

When a fiſſure is not attended with ſymptoms of a compreſſed brain, the trepan ought not to be applied, eſpecially as the operation itſelf tends in ſome degree to increaſe inflammation of the part. The fiſſure ſhould be treated merely as a cauſe which may induce inflammation. The patient ſhould be blooded according to his ſtrength; the bowels ſhould be kept lax, and the ſore treated with mild, eaſy dreſſing; and violent exertion ſhould be avoided as long as there is any danger of inflammation occuring.

CHAP. XIII. *Diſeaſes of the Eyes.*

SECT I. *Of Wounds of the Eyelids and Eyeball.*

198 Treatment of wounds of the eyelids.

IN caſes of ſuperficial wounds of the eyelids, it will be ſufficient to bring the edges of the wounds together and retain them in their place by ſlips of adheſive plaſter: but when a wound is deep, particularly when the tarſus is divided, it will be neceſſary to employ either the interrupted or the twiſted ſuture, care being taken that the ſutures be not carried through the inner membrane of the eyelid otherwiſe the eye would be irritated and inflamed. After ſuch an operation, the motion of both eyelids ſhould be prevented as much as poſſible, elſe no union of the divided parts can be obtained. After the ſutures are finiſhed, the eyelids ſhould be cloſed and covered with a pledget of emollient ointment, and over this ſhould be laid a compreſs of ſoft lint, and one of a ſimilar nature ought likewiſe to cover the ſound eye; then a napkin ſhould be made to preſs equally on both eyes, and be properly fixed. Inflammation ſhould be guarded againſt, or, if already preſent, it muſt be removed in the manner directed under the article *Ophthalmia*, (ſee MEDICINE.) The ſutures may be removed in about three days from their introduction, when the parts will commonly be found reunited.

When a portion of the eyelids is ſo much deſtroyed, or perhaps ſo completely removed, as to prevent the remaining parts from being brought together, without obſtructing the motion of the eye, the beſt method will be to treat them with light eaſy dreſſings, truſting to nature for ſupplying the deficiency.

199 Of wounds of the eye ball.

If the cornea be wounded, it will commonly be attended with partial or total blindneſs. If any of the other parts of the ball be wounded, the danger will generally by in proportion to the extent of the wound. The principal attention ought to be directed to the prevention or removal of inflammation. When pain occurs, it ought to be removed by opiates; and with theſe a ſtrict antiphlogiſtic courſe is to be enjoined.

When the wound is large, and the humours completely evacuated, blindneſs, with ſinking of the eyeball, will almoſt always be the conſequence; but in wounds of a ſmall extent, by proper treatment, a cure may be made and the ſight preſerved.

Sect. II. *Of Diſeaſes of the Eyelids.*

200 Tumors of the eyelids.

The eyelids are ſubject to be infeſted with tumors of different kinds, which frequently require the aſſiſtance of ſurgery. The firſt of theſe is the hordeolum or ſtye, which frequently grows on the edge of the eyelid, and is attended with heat, ſtiffneſs, and pain; and unleſs proper means be taken to prevent it, a ſuppuration is frequently the conſequence. It may be conſidered as a common abſceſs ſeated in an obſtructed ſebaceous duct or gland. It may generally be removed by diſcutient applications. Should theſe prove ineffectual, it ought to be brought to ſuppurate by a ſmall emollient poultice, when it will commonly heal of itſelf; but if it do not, it may be opened with the point of a lancet, that the matter may be diſcharged; and the part may be anointed afterwards with ſaturnine ſolution.

The eyelids are ſubject to encyſted tumors, ſteatoms, warts, &c. which are to be treated like the ſame tumors when ſeated in other parts of the body; only in extirpating theſe tumors, ſhould part of the eyelid be removed entirely, no dreſſings can be applied, as, however mild they may be, they would irritate and inflame the ball of the eye. All that can be done therefore, in ſuch caſes, is to lay the lips of the ſore as nearly together as poſſible, and frequently to remove any matter that may form on it.

201 Inverſion of the cilia or eye-laſhes.

The eye-laſhes are ſometimes ſo much inverted as to rub upon the eye and create much pain and inflammation. Various cauſes are aſſigned for this, ſuch as the hairs themſelves taking a wrong direction; inverſion of the tarſus or cartilage of the eyelid; ſome cicatrix formed upon the ſkin of this part after wounds or abſceſſes; tumors preſſing the hairs in upon the eye; and, finally, a relaxation of the external integuments.

The treatment of this diſorder muſt depend much upon a knowledge of the cauſe. When it is owing to a derangement of the cilia themſelves, if they have remained long in this ſtate, it will be extremely difficult to make them recover their proper direction. They ought therefore to be pulled out by a pair of forceps, and the part waſhed with ſome aſtringent lotion; and if the new hairs appear to take a ſimilar direction, which is very apt to happen, as ſoon as they are long enough they ought to be turned back upon the eyelid, and kept there for ſeveral days, or even weeks, by adheſive plaſter. When the diſeaſe proceeds from a contraction of the orbicular muſcles, the contracted part may be cut from the inner ſurface of the eyelid; in which place a cut commonly ſoon heals. If the cauſe proceed from a tumor or cicatrix, this muſt be removed before a cure can be expected; or if it be owing to relaxation of the ſkin, the parts ought to be bathed with ſome ſtrong aſtringent. If this fail, the relaxed ſkin ſhould be removed, and the part healed by the firſt intention. Sometimes the cilia of the upper eyelid are turned in on account of dropſical ſwelling in that place. When this happens, the water is to be evacuated by a few punctures with a lancet; but when ſuch means fail, and when the diſeaſe is quite local, if viſion be diſturbed, a ſufficient part of the ſkin ought to be removed with a ſcalpel, and a cure made by adheſive plaſter or the twiſted ſuture.

202 The gaping eye, or turning out of the eye-lids.

When the gaping eye takes place to any great degree, it is attended not only with much deformity and uneaſineſs, from a large portion of the lining of the eyelid being turned outwards, but likewiſe from too much of the eye being expoſed. This diſorder may ariſe from an enlargement of the eyeball, from dropſical ſwelling, or from the cicatrix of an old wound or abſceſs: hence it is frequently produced by the ſmall-pox, burns, or ſcrophula; but more frequently by a laxity of the part in old age.

When the diſorder is induced by an enlargement of the ball of the eye, nothing but a removal of this ſwelling can be effectual. If from dropſical ſwelling, when this is connected with general anaſarca, the affection of the ſyſtem muſt firſt be cured; but if it appear to be local, nothing anſwers ſo well as punctures. When it ariſes from a cicatrix, the ſkin ſhould be divided, and the effects of inflammation guarded againſt. If it be owing to inflammation, the antiphlogiſtic courſe muſt be uſed; when it ariſes from old age, the eyes ought to be daily bathed with cold water, or ſome aſtringent and ſtimulant ſolution.

203 Concretion of the eye-lids.

Concretion of the eyelids ſometimes ariſes from a high degree of opthalmia; in which caſe the eyelids are not only connected by their edges to each other, but now and then grow to the ſurface of the eyeball. A coheſion is ſometimes obſerved alſo in children at birth. When the adheſion is ſlight, it may in general be removed by the end of a blunt probe; but when it is conſiderable, a cure can only be effected by a cautious diſſection. If the eyelids on one ſide be ſound, they will ſerve as a guide to direct the inciſion. The tarſi are carefully to be divided from each other; after which, if there be no other adheſions, the eyelids may be readily opened: But if they adhere to the eye, the operator is gently to pull and ſeparate the eyelids, while the patient is deſired to move the eye in the oppoſite direction. When this is effected, nothing is further neceſſary than to drop a little oil upon the eye, and cover the eyelids with ſoft lint ſpread with ſome cooling emollient ointment. The oil and ointment are frequently to be repeated, and every precaution taken to prevent inflammation and irritation.

Sect. III. *Of Specks, Films, or Excreſcences on the Eye.*

204 Of ſpecks on the cornea.

Specks are ſometimes formed upon the white part of the eye, but more frequently upon the cornea. In the former caſe they are ſeldom attended with much inconvenience, but in the latter they are often the cauſe of partial or total blindneſs. They are almoſt univerſally the conſequence of inflammation, and ſeldom go much deeper than the tunica adnata. Two very different ſtates of the diſorder occur; the one from an effuſion immediately under the outer layer of the cornea, and in this caſe the cornea does not appear to be raiſed; the other takes place from one or more little ulcers, which breaking, leave as many opaque ſpots in the centre, which are more elevated than the reſt of the cornea: and the inconvenience attending either ſituation muſt always be in proportion to their extent and degree of opacity, or their vicinity to the pupil. When viſion is little affected by them, they need ſcarcely be conſidered as an object of ſurgery; but whenever viſion is materially impaired, remedies become neceſſary, and theſe ſhould be ſuch as are beſt ſuited for removing inflammation, promoting abſorption, and reſtoring tone to the veſſels. For the means adapted for removing inflammation, ſee Medicine, nº 175.

205 Treatment.

Veſſels running upon the ſurface of the eye into the ſpeck are to be divided, and the eye frequently bathed with ſome refrigerant collyrium. By theſe means the ſimpleſt kind of ſpecks, when recently formed, may generally be removed; but where they have been of long ſtanding, their removal is attended with great difficulty. Where the ſpeck is owing to an effuſion of fluids between the layers of the cornea, and where it is not attended with any prominence, local applications are of little advantage, as it

is

Specks, &c. on the Eye.

is impoſſible to remove the effuſed matter without injuring the cornea; but conſiderable ſervice is derived from the uſe of ſuch remedies as are moſt effectual for promoting abſorption; and with this view a gentle, long continued courſe of mercury, briſk purgatives occaſionally, and iſſues in the neck, are found to be the moſt effectual remedies.

In the management of ſpecks which are prominent upon the cornea, and where inflammation is removed and the opacity is conſiderable, if the cornea beneath be ſound, the removal of the diſeaſed part will leave it tranſparent and fit for viſion. The remedies proper for this purpoſe are eſcharotics or the knife. The former are applied in the form of a powder, an ointment, or a waſh; and theſe ought to be very finely prepared, otherwiſe they will be in danger of irritating and inflaming the eye; and they ought merely to be of ſuch ſtrength as the eye can eaſily bear.

The applications ſhould be long perſiſted in and frequently repeated; and to make them ſtill more uſeful, ſome of the powders or ointments may be applied evening and morning, and the ſolution two or three times through the courſe of the day. To the remedies already mentioned cauſtic is ſometimes preferred. With this the centre of the ſpeck is to be frequently touched, till the patient complain of conſiderable pain, when pure water is to be applied by a pencil, or by dipping the eye in water, with the eyelids open, till the pain occaſioned by the application of the cauſtic be removed. The eye is then to be covered with compreſſes moiſtened in ſome ſolution, and this frequently repeated. The cauſtic to be repeated every ſecond or third day, unleſs prevented by inflammation. When the ſurgeon chooſes to employ the knife, which frequently may be more effectual, the eye is to be fixed by a ſpeculum (fig. 29.), or levator (fig. 30); the tumor is then to be cautiouſly ſeparated by means of a ſmall knife, and every attention paid to prevent inflammation. Theſe are the methods moſt likely to be of ſervice; and when properly managed, they will frequently remove ſpecks, which otherwiſe would entirely deprive the patient of the uſe of the eye; though it is to be regretted that caſes frequently occur which baffle art.

206 Of the excreſcence called pterygium.

A membranous excreſcence, called *pterygium*, is frequently found upon the white part of the eye, which often ſpreads over the cornea ſo as entirely to deſtroy viſion. It is ſometimes owing to external injuries; at other times it ariſes from a general diſeaſe of the ſyſtem, as lues venerea or ſcrophula; but inflammation is always the more immediate cauſe.

207 Method of removing excreſcences.

By a proper application of the remedies abovementioned affections of this kind may generally be prevented from becoming formidable; but when the reverſe takes place, and excreſcences begin to ſpread over the cornea, other means muſt be uſed. When the diſeaſed part is only ſlightly attached, it may be freely removed by a cut of the knife; but when this cannot be done without difficulty, it is better to deſtroy the veſſels by the extenſion of which this ſubſtance is chiefly formed. The manner of performing the operation in general is this: The patient being properly ſeated, the eyelids opened, and the eye ſecured, the operator, with a ſmall knife, makes a ſcarification through the whole thickneſs of the excreſcence, entirely round, and at a little diſtance from the circumference, by which the ſource of nouriſhment will be cut off; and, after the blooding is abated, one or two inciſions more may be made, in a ſimilar manner, within the former. Some practitioners raiſe the excreſcence with a needle and ligature before the inciſion is made; and, in ſome caſes, this may be done with advantage, though not in others.

After the bleeding is over, the part is to be bathed two or three times a-day with a weak ſaturnine ſolution; and the operation may be repeated occaſionally till the excreſcence is removed. In this way the operation commonly proves effectual; but inſtances ſometimes occur where, inſtead of being uſeful, it increaſes the diſeaſe. Whenever this happens, a palliative courſe is the only thing to be tried; and although it will not remove the diſorder, it may commonly prevent the excreſcence from acquiring any additional ſize. With this intention it ought to be frequently bathed with the ſolution laſt mentioned, and afterwards covered with a cooling ointment. When the diſorder cannot even be palliated, when viſion is deſtroyed, and particularly when the pain attending it is ſevere, there is reaſon to ſuſpect cancer. In this caſe the eye ought to be extirpated, otherwiſe deeper parts may ſuffer, and the life of the patient be endangered. The method of performing this operation will be afterwards pointed out.

Abſceſſes in the Globe of the Eye.

Sect. IV. *Of Abſceſſes in the Globe of the Eye.*

Though inflammation of the eye generally terminates by reſolution, inſtances ſometimes occur in which an abſceſs enſues. This is owing either to improper treatment, or a bad habit of body which counteracts all remedies. The greateſt danger attending theſe complaints is when they are ſituated on the cornea, as the cicatrix left by them may deſtroy viſion. When deep ſeated, a purulent matter is ſometimes apt to be found in ſome of the chambers of the eye, the ball becomes enlarged, the humours are diſturbed, and neither the iris, pupil, nor lens can be diſtinguiſhed. In ſome rare caſes again, after theſe appearances have continued ſome time, the cornea burſts, part or whole of the humours are evacuated, and the iris protrudes in a thickened diſtended ſtate. This has now the appearance of an excreſcence, which is called *ſtaphyloma* from a kind of reſemblance to a grape. But under this term ſome authors include all collections like thoſe above deſcribed. In moſt inſtances the cornea protrudes, but in others the tunica ſclerotica or opaque part is affected with partial ſwellings or protruſions.

While the diſeaſe is forming, beſides the loſs of ſight, the patient commonly feels great diſtreſs in the eye and head, accompanied by ſymptoms of fever. When no other diſtreſs is experienced than the loſs of ſight, the ſwelling is but ſmall, and contains chiefly a watery fluid. In the treatment, as viſion is ſeldom preſerved, the principal thing is to abate the pain and remove deformity. There is another kind of abſceſs in the eye, termed *hypopyon*, where the matter is lodged in the ſubſtance of the coats. It is ſometimes produced by external injuries, but more frequently from puſtules of ſmall-pox. If this termination cannot be prevented by the remedies mentioned in the article Medicine, n° 175, the mater muſt be evacuated by an inciſion into the eye, not regarding the humours, as viſion previous to this time is entirely deſtroyed. The proper part is the cornea or the moſt prominent part of the tumor.

A variety of this diſorder ſometimes, though rarely, happens, where the humours are abſorbed; but ſtill the ſame external appearances are obſerved. In this caſe the tumor is formed by a thickening of the coats, eſpecially the iris. The only means of relief is extirpation of the prominent part by the uſe of the knife. After the contents of the eye have been diſcharged, the parts are to be covered with a compreſs moiſtened with a ſaturnine ſolution, and the antiphlogiſtic courſe followed, till a cure is perfected, or at leaſt inflammation removed. If the ulcers diſcharge a thin acrid matter, they may be waſhed two or three times a day with a ſolution of corroſive ſublimate, or of white vitriol, &c. Fungous excreſcences, ſometimes conſidered as a cancer of the eye, are apt to form in both theſe diſeaſes after the matter is evacuated; but they may be prevented from increaſing opſical ings the Eye.

creaſing to a conſiderable ſize by burnt alum finely powdered, or by touching them occaſionally with lunar cauſtic.

208 lcers of e eye.

Ulcers on the eye may ariſe from the ſame cauſes which produce ulcers on other parts of the body, as wounds, burns, &c; or they may ariſe from a general affection of the conſtitution, as lues or ſcrophula; but they are more immediately produced by inflammation In the treatment therefore of ſuch diſeaſes, blood-letting, bliſtering, laxative and cooling applications, as already deſcribed in the caſe of ophthalmia, are to be employed. When the inflammatory ſtate is removed, their management muſt be almoſt the ſame with that for ſimilar affections in other parts of the body. When the diſorder ariſes from an affection of the ſyſtem, the primary diſeaſe muſt be attended to before a cure can be performed. With reſpect to the ſores themſelves, if acrid matter be diſcharged, we muſt have recourſe to detergent ointments and waſhes before a cicatrix can be formed. When theſe have not the deſired effect, and when the ſore becomes ſoft and higher than the reſt of the eye, aſtringent applications are moſt efficacious. If excreſcences be preſent, theſe are to be removed by eſcharotics, or by the knife. In ſome rare inſtances excreſcences of a fungous nature are found to be connected with the interior parts of the eye, and become ſo prominent as even to reſt upon the cheek. When ſuch occur, nothing but the removal of the eye itſelf can effect a cure.

SECT. V. *Of Dropſical Swellings of the Eye.*

209 ymptoms f dropſy f the eye.

THE eye is ſometimes enlarged by an accumulation of the aqueous humour. The ſymptoms are, a ſenſe of fullneſs in the eyeball; by degrees the motions of the eyelids become impeded; viſion gradually becomes more and more imperfect, till at laſt the patient can only diſtinguiſh light from darkneſs. As the diſeaſe increaſes, the ball of the eye becomes greatly enlarged, and at this time the cornea begins to protrude; when, if a puncture be not made, the eye burſts and empties itſelf. This diſeaſe is apt to be confounded with ſtaphyloma. But in the dropſical ſwelling the patient is always ſenſible to the effects of light, and the pupil is obſerved to contract, which does not happen in ſtaphyloma. In the early ſtages of this diſeaſe viſion may

210 Treatment.

be preſerved by puncturing the under edge of the cornea, and allowing the aqueous humour to paſs out by the anterior chamber; or by puncturing the tunica ſclerotica a little behind the iris, by which the fluid will paſs out by the poſterior chamber. The puncture may be made either with a lancet, pointed knife, or with a very ſmall flat trocar. The eye ought afterwards to be dreſſed with a compreſs made moiſt with a ſaturnine ſolution, guarding againſt exceſſive inflammation. When the uſe of the eye is ſomewhat recovered, tone may be reſtored to the parts, and a return of the diſeaſe as much as poſſible prevented, by frequently bathing the eye in aſtringent lotions; but where the cornea is deſtroyed, the ſight cannot be reſtored: We can then only diminiſh the ſize of the eye, and render it ſomewhat more comfortable to the patient.

211 Blood effuſed into the eye.

Blood may be effuſed into the chambers of the eye from various cauſes, as in putrid diſeaſes, or in conſequence of inflammation, but moſt frequently from a rupture of the blood-veſſels induced by external injury. In whatever way it gets into the eye, it mixes with the aqueous humour, and renders it opaque. It is ſometimes taken up by the abſorbents; when it is otherwiſe, it ought to be diſcharged by a puncture.

A few inſtances have occurred where the blood has fallen to the under ſide of the eye, and remained there without mixing with the aqueous humour. In ſuch a ſituation it ought to be allowed to remain.

Protruſion of the Eyeball beyond its Socket.

When a puncture is neceſſary, it is to be made in the ſame manner as in caſes of dropſy of the eye; only the opening may require to be ſomewhat larger, otherwiſe the blood may not paſs readily out. After the operation, nothing is neceſſary but to apply a compreſs of ſoft lint, moiſtened with a weak ſaturnine ſolution.

SECT. VI. *Of the Portruſion of the Eyeball beyond its Socket.*

THE eye may protrude in conſequence of external violence, or from tumors forming behind it, or on account of ſome of the ulcers, excreſcences, or dropſical ſwellings, already mentioned. When the eye is forced out of its ſocket by external violence, if the eyeball be not entirely ſeparated from the neighbouring parts, it ought to be freed from any extraneous matter which may adhere to it, and immediately replaced; and if the optic nerve be not quite divided, the uſe of the eye may be recovered. With a view to prevent or moderate inflammation, every part of the antiphlogiſtic regimen ought to be ſtrictly adhered to. If the protruſion is occaſioned by a tumor, the cure muſt depend upon the removal of this; and if the diſeaſe has advanced ſo far that the bones are become carious, they muſt likewiſe be ſeparated. But more frequently, inſtead of the bones becoming carious, they aſſume a gelatinous or rather cartilaginous nature. In ſuch a ſituation an operation could be of little advantage. The beſt method to prevent the bones from being ſo affected is an early performance of the operation.

A few inſtances have happened of the eye being puſhed from its ſocket by an enlargement of the lachrymal gland. When this occurs, if the enlargement be conſiderable, the ſtructure of the eye will moſt probably be ſo much injured that viſion will be deſtroyed; but inſtances have occured of this gland, in the enlarged ſtate, having been removed without any injury being done to the eye.

SECT. VII. *Of Cancer of the Eye, and Extirpation of the Eyeball.*

212 Symptoms of cancer of the eye.

SCIRRHUS and cancer may ariſe from repeated inflammations of the eye, or from ſtaphyloma, or ſome of the other diſeaſes which frequently attack this organ. The ſymptoms are, an enlargement, hardneſs, and protruſion of the ball, with a red, fungous appearance, ſometimes diſcharging thick, yellow matter, but more frequently a thin acrid ichor. At firſt there is only a ſenſation of heat in the tumor; but this gradually increaſing, changes at laſt into darting pains, which likewiſe ſhoot through to the oppoſite ſide of the head. In this ſituation blood-letting, opiates, and emollient applications, may alleviate the pain. A hemlock poultice applied to the eye, and a waſh of lime-water, with a little opium diſſolved in it, and applied every time the poultice is renewed, gives ſome relief; but although the pain be moderated by theſe means, it does not prevent the diſeaſe from ſpreading, nor can any thing elſe but extripation produce a radical cure.

213 Method of extirpating the eye.

After the diſeaſe is diſcovered to be cancerous, the operation ſhould be performed without delay, to prevent the parts in the neighbourhood, as well as the conſtitution at large, from ſuffering. In performing the operation, the patient ſhould be placed in a proper light, and the head ſupported by an aſſiſtant. If the eyelids are diſeaſed, they muſt be ſeparated along with the tumor; but where they are ſound, they ought to be carefully preſerved; and for this purpoſe they may be kept out of the way by two levators held by aſſiſtants. When the eyeball protrudes conſiderably, the operator may lay hold of it with his fingers; but if this be impracticable, a broad ligature ſhould be introduced through the centre of it, that it may be the more readily removed from the orbit. Sometimes it will be neceſſary to enlarge the opening of the eyelids, by cutting the external angle to allow the eyeball to be more readily removed. The whole of the diſeaſed parts are now to be ſeparated by a knife bent ſo as to correſpond with the ſides of the orbit, guarding at the ſame time againſt wounding the perioſteum or the bones of the orbit, which are commonly extremely thin. The eye being in this manner extirpated, the hemorrhagy from the ocular arteries is to be ſuppreſſed by means of agaric, or by a bit of ſponge; then over this is to be laid ſoft lint, with a napkin to cover the whole. After ſuppuration takes place, the dreſſings are to be removed, when a little lint, applied with an emollient pledget over it, will be ſufficient as long as any matter is diſcharged. After the wound is healed, the deformity may be in ſome meaſure obviated by wearing an artificial eye; though it is chiefly in caſes where part of the humours of the eye have been evacuated that this can be uſed with much propriety; for when the orbit is empty the artificial eye ſinks too far into it.

Sect. VIII. *Of the Cataract.*

214 Symptoms of cataract.

The ancients, and ſome of the modern writers, had a confuſed idea of the ſeat of the cataract; different authors placing it in different parts of the eye. It conſiſts of an affection of the cryſtalline lens or of its capſule, by which the rays of light are prevented from falling upon the retina; and is therefore the ſame diſeaſe with the glaucoma of the ancients. It commonly begins with a dimneſs of ſight; and this generally continues a conſiderable time before any opacity can be obſerved in the lens. As the diſeaſe advances the opacity becomes ſenſible, and the patient imagines there are particles of duſt or motes upon the eye, or in the air. This opacity gradually increaſes till the perſon either becomes entirely blind, or can merely diſtinguiſh light from darkneſs. The diſeaſe commonly comes on rapidly, though ſometimes its progreſs is ſlow and gradual. The opacity of the lens is found to be nearly in proportion to the degree of blindneſs the patient is affected with; it gradually changes from a ſtate of tranſparency to a perfectly white, or light grey colour. In ſome very rare inſtances a black cataract is found. Sometimes the diſeaſe is confined to a particular ſpot of the lens, but generally the whole is affected. The conſiſtence alſo varies, being at one time hard, at another entirely diſſolved. When the eye is otherwiſe ſound, the pupil moves according to the degree of light in which it is placed. This diſeaſe is ſeldom attended with pain; ſometimes, however, every expoſure to light creates uneaſineſs, owing probably to inflammation in the bottom of the eye. The real cauſe of cataract is not yet well underſtood. Numbers of authors conſider it as proceeding from a preternatural contraction of the veſſels of the lens, ariſing ſometimes from external violence, though more commonly from ſome internal and occult cauſe. The diſeaſe is diſtinguiſhed from the gutta ſerena, by the pupils in the latter being never affected with light, and from no opacity being obſerved in the lens. It is diſtinguiſhed from hypopyon, ſtaphyloma, or any other diſeaſe in the fore part of the eye, by the evident marks which theſe affections produce, as well as by the pain attending their beginning. But it is difficult to determine when the opacity is in the lens or in its capſule. The lens is generally affected; when the capſule is the ſeat of the diſeaſe, it is termed the membranous cataract.

215 Methods of treatment.

With reſpect to the treatment: If the diſeaſe be in the incipient ſtate, mercury, particularly calomel in ſmall doſes, has been attended with ſome advantage. When any degree of inflammation is preſent, blood-letting and cooling regimen will ſometimes be neceſſary. Electricity, extract. hyoſcyami, flammula Jovis, &c. have likewiſe been extolled; but after theſe or other remedies have failed, the cure muſt depend upon a chirurgical operation. For this purpoſe two methods are in general uſe. The firſt of theſe, and which was practiſed for a long time before the other, is called *couching*. It is done with a view to allow the rays of light to fall upon the retina; and it conſiſts in removing the lens from its capſule, and lodging it in ſome part of the vitreous humour, where it may be entirely off the axis of the eye, and where it is ſuppoſed, in courſe of time, to diſſolve.

The other method is termed *extraction*, where, after an inciſion has been made in the cornea, the lens is puſhed through the pupil, and then entirely removed from the eye. Each of theſe methods has been much practiſed, and it is ſtill a matter of doubt to which we ought to give the preference. The next circumſtance deſerving attention is the time at which the operation for couching or extracting can with moſt propriety be performed. Formerly it was thought neceſſary to wait till the lens had a certain degree of conſiſtence, or was become ripe; but no certain marks of fluidity or firmneſs have been yet diſcovered; neither indeed is there any neceſſity for attending particularly to it, as the operation may be practiſed in every period of the diſeaſe, providing the retina be ſound, the iris have the power of contracting, and the cornea be tranſparent. The proper time for the operation is when the opacity of the lens is ſo conſiderable as to prevent the patient from following his ordinary occupation. When this is not the caſe, or when the patient has the uſe of one eye, it ought not to be performed, as it is always attended with ſome degree of danger.

216 Method of couching the cataract.

When the operation is to be performed, the following is the method of doing it: And firſt, *of couching the cataract*. To guard as much as poſſible againſt the effects of inflammation, the patient ſhould be confined, for ſeveral days previous to the operation, to a low regimen; and two or three doſes of ſome cooling laxative ſhould be given at proper intervals. After this he is to be ſeated with his face towards the light; but ſunſhine ought to be avoided. Some, however, prefer a ſide-light both on account of the operator and patient. One aſſiſtant is to ſupport the head, while others ſecure the arms. The operator is either to be ſeated with his elbow reſting upon a table; or, which is preferred by ſome, he ought to ſtand, reſting his arm upon the ſide of the patient. The eye being fixed by the ſpeculum (fig. 29.), or in ſuch a manner as to allow the whole of the cornea and a ſmall portion of the ſclerotic coat to protrude, a couching needle (fig. 31.) is to be held in the right hand, in the manner of a writing pen, if the left eye be the ſubject of operation; the ring and little fingers are to be ſupported upon the cheek or temple of the patient: The needle is to be entered in an horizontal direction through the ſclerotic coat, a little below the axis of the eye, and about one fourth of a line behind the edge of the cornea, ſo as to get entirely behind the iris. If the needle be of the flat form, the flat ſide ought to be oppoſed to the iris, to prevent that ſubſtance from being wounded. The point of the needle is to be carried forwards till it be diſcovered behind the pupil. The operator is now commonly directed to puſh the point into the lens, and depreſs it at once to the bottom of the eye; but in this way the lens either burſts through the capſule at an improper place, or it carries the capſule with it, tearing it from the parts to which it is connected. Inſtead of this, the needle ought firſt to be puſhed into the lens near its under edge, as Dr Taylor adviſes, and then carried ſome way down into the vitreous humour, ſo as to clear the way for the lens. It is then to be drawn a little back, and carried to the upper

217 reatment fterwards.

part of the capſule, when, by preſſing upon it, the lens, if, ſolid, is to be puſhed down by one, or, if fluid, by ſeveral movements, to the bottom of the vitreous humour. It ſhould then be puſhed downwards and outwards, as Mr Bell directs, ſo as to leave it in the under and outer ſide of the eye; where, in caſe it ſhould riſe, the paſſage of the light would be little obſtructed. The needle is then to be withdrawn, the ſpeculum removed, and the eyelids cloſed; and a compreſs ſoaked in a ſaturnine ſolution is to be applied over them. Mr Pellier's method is to cover each eye with a linen bag half filled with fine wool, applied dry and fixed to a circular bandage of linen paſſed round the forehead: the whole is retained by a triangular napkin. The patient is then to be laid in bed, upon his back, with his head very little raiſed; and to be kept in this ſituation for about a week in a dark room. Unleſs he be of a weakly habit, he ought to be bled at the neck, or leeched at the temple, a few hours after the operation. He ſhould be kept upon low diet, and get ſmall doſes of opiates frequently repeated. His belly ſhould be kept moderately open by gentle purgatives. The dreſſings ſhould not be removed till inflammation is at leaſt ſo far gone that no danger will ariſe from uncovering the eye, which may generally be about the eighth or tenth day. Sometimes the patient perceives light immediately on the dreſſings being removed, but more frequently not till ſome time after.

Upon removing the dreſſings, if the cataract has again got back to the axis of the eye, a repetition of the operation may become neceſſary. Some time, however, after the inflammatory ſymptoms are gone, ſhould be allowed to elapſe before any other operation is again attempted; for the cataract frequently diſſolves, providing the aqueous humour get free acceſs to it. Mr Pott ſometimes, when he found the cataract to be of the mixed kind, did not attempt depreſſion, but contented himſelf with a free laceration of the capſule; in which caſes the lens hardly ever failed of diſſolving ſo entirely as not to leave the ſmalleſt veſtige of a cataract. When the operation is to be performed upon the right eye, the ſtraight needle muſt either be uſed by the left hand, or the operator muſt place himſelf behind the patient. A needle (fig. 32.) has been contrived, however, with a large curve, by which the operation may be readily performed with the right hand, while the ſurgeon is placed before the patient; only the needle is entered towards the inner, inſtead of the outer, angle of the eye.

218 Method of extracting the cataract.

The firſt hint of extracting the lens ſeems to have been ſuggeſted by Mr Petit, who propoſed to open the cornea and extract the lens when it was forced into the anterior chamber of the eye either by external violence or accidentally in couching. At firſt it was conſidered as a dangerous operation, and was ſeldom practiſed till about the year 1737, when Mr Daviel propoſed and practiſed extraction in preference to couching. The operation is now performed in the following manner: The patient and operator being placed, and the eye fixed in the ſame manner as for couching, the ſpeculum, when the operation is to be done upon the left eye, is to be held in the left hand of the operator. It is neceſſary to make as much preſſure as will ſecure without hurting the eye. Neither ought the cornea to be preſſed too near the iris, leſt the latter be wounded. The operator now takes the knife (fig. 33.), and holds it in the ſame way as he does the needle for couching; he then enters the point of it with the edge undermoſt into the cornea about the diſtance of half a line from its connection with the ſclerotic coat, and as high as the centre of the pupil; he is then to paſs it acroſs the pupil to the inner angle in an horizontal direction, keeping the edge a little outwards to prevent the iris from being cut; the point is then to be puſhed through oppoſite to where it entered; the under half of the cornea is next to be cut, and at the ſame diſtance from the ſclerotics with the parts at which the point of the knife went into and came out from the eye.

In cutting the under half of the cornea the preſſure of the ſpeculum upon the eye ſhould be gradually leſſened; for if the eye be too much compreſſed, the aqueous humour, with the cataract and part of the vitreous humour, are apt to be forced ſuddenly out immediately after the inciſion is made. The operator then takes a flat probe, and raiſes the flap made in the cornea, while he paſſes the ſame inſtrument, or another probe (fig. 34.), rough at the extremity, cautiouſly through the pupil, to ſcratch an opening in the capſule of the lens. This being done, the eye ſhould be ſhaded till the lens be extracted, or the eyelids are to be ſhut to allow the pupil to be dilated as much as poſſible; and while in this ſituation, if a gentle preſſure be made upon the eyeball at either the upper or under edge of the orbit, the cataract will paſs through the pupil more readily than it would do when the eyelids are open.

If the lens cannot be eaſily puſhed through the opening of the cornea, no violent force ſhould be uſed, for this would tend much to increaſe the inflammation. The opening ſhould be enlarged, ſo as to allow the lens to paſs out more freely. When the cataract does not come out entire, or when it is found to adhere to the contiguous parts, the end of a ſmall flat probe, or a ſcoop (fig. 35.), is to be introduced, to remove any detached pieces or adheſions that may be preſent. The iris ſometimes either projects too much into the anterior chamber, or is puſhed out through the opening of the cornea. When this happens, it is to be returned to its natural ſituation by means of the probe already mentioned. Sometimes the opacity is not in the body of the lens, but entirely in the capſule which contains it. The extraction of the lens alone would here anſwer no uſeful purpoſe. Some practitioners attempt to extract, firſt the lens, and then the capſule by forceps; others, the lens and capſule entire. Thoſe who have had much practice in this branch of ſurgery, as Pellier, ſay they find ſuch a method practicable; but others think it better to truſt entirely to time and a cooling regimen for the cure, which, in ſome inſtances, has taken place. When the operation is to be performed on the right eye, the operator is either to uſe the left hand, to take his ſtation behind the patient, or to employ a crooked knife (fig. 36.)

219 Treatment after the operation.

After the operation is finiſhed, the eyelids are to be ſhut, and the ſame treatment obſerved as in couching. When the operation ſucceeds, the wound in the cornea is generally healed in little more than eight or ten days; but previous to this time, the eye ought not to be examined; and even then it ſhould only be done in a dull light, otherwiſe it may ſuffer conſiderably from the irritation which a ſtrong light might occaſion. When the eye is to be examined, if the eyelids be found adhering together, they ought to be waſhed with ſome gentle aſtringent. With this the eye ought alſo to be frequently waſhed afterwards, by which it will gradually recover ſtrength and ſight. About the end of the third week the dreſſing may be entirely removed, and a piece of green ſilk put over the eyes as a ſhade; and if every thing has ſucceeded, the patient may generally go out after a month from the time at which the operation was performed.

It ſometimes happens, that in extracting the lens a portion of the vitreous humour is evacuated. This does not in general prevent the ſucceſs of the operation. The eye ſoon begins to fill again, and in the courſe of two or three weeks it is for the moſt part as large as it was previous to the operation. Whether this be owing to a renewal of the vitreous humour, or merely an aqueous ſecretion, is not yet determined; though the latter circumſtance is generally ſuppoſed.

Chap. XIV. *Of Fiſtula Lachrymalis.*

By this diſeaſe is properly underſtood a ſinuous ulcer of the lachrymal ſac or duct with callous edges, though every obſtruction of this paſſage is commonly called *fiſtula lachrymalis*.

220 Symptoms of the diſeaſe in its moſt ſimple form.

The firſt and moſt ſimple ſtate of the diſeaſe is that termed a *dropſy of the lachrymal ſac*. The ſymptoms are, a tumor between the inner cornea of the eye and ſide of the noſe. This diſappears by preſſure, the tears mixed with mucus paſſing partly into the noſe, but chiefly back upon the eye and over the cheek.

This ſtate of the diſeaſe is what the French have called the *hernia*, or *hydrops ſacculi lachrymalis*. It is frequently met with in children who have been rickety, or are ſubject to glandular obſtructions: and in this ſtate it ſometimes remains for ſeveral years, ſubject to little alterations, as the health or habit ſhall happen to vary, the ſacculus being ſometimes more, ſometimes leſs full and troubleſome; the contents which are preſſed out are ſometimes more, ſometimes leſs cloudy; and now and then the diſeaſe is attended with a ſlight ophthalmy, or an inflammation of the eyelids, but which, by common care, is eaſily removed. If the ſacculus be not much dilated, the diſcharge ſmall, and produced only by preſſure, the chief inconveniences are the weeping eye, and the gumming together of the lids after ſleeping: but theſe, by being attended to, may be kept from being very troubleſome; and if the diſeaſe makes no further progreſs, may be ſo regulated as to render any more painful proceſs totally unneceſſary. If the dilatation be conſiderable, the ſwelling is more viſible, and the quantity of fluid is larger; it is alſo in this ſtate more frequently mixed and cloudy, and more troubleſome, from the more frequent neceſſity of emptying the bag; but if the patient be an adult, it may, even in this more dilated ſtate of it, be kept from being very inconvenient.

If an inflammation comes on, the tumor is thereby conſiderably increaſed, the diſcharge is larger, as well during ſleep as upon preſſure; the ſkin covering it loſes its natural whiteneſs and ſoftneſs, becomes hard, and acquires an inflamed redneſs, and with the tears a mixture of ſomething, which in colour reſembles matter, is diſcharged, eſpecially if the preſſure be made with any force, or continued for any time.

When the parts are in this ſtate, the contents of the bag have ſo much the appearance of purulent matter that they are now generally conſidered as ſuch, though Mr Pott and ſeveral others have been of a different opinion, conſidering the fluid as merely mucus under a different form; allowing, however, that pus is ſometimes diſcharged. If the puncta lachrymalia be naturally large and open, and the inflammation confined to the ſurface of the ſac, its contents will paſs off pretty freely, and the ſkin will remain entire.

221 In its advanced ſtate.

But when the ſkin covering the lachrymal bag has been for the time inflamed, or ſubject to frequently returning inflammations, it moſt commonly happens that the puncta lachrymalia are affected by it, and the fluid, not having an opportunity of paſſing off through them, diſtends the inflamed ſkin; ſo that at laſt it becomes ſloughy, burſts externally, and forms an opening in the moſt prominent part of the tumor, at which the tears and matter contained in it are diſcharged. When the opening thus formed is ſmall, it commonly heals again in a few days, but it burſts as ſoon as a conſiderable quantity of this fluid is collected; and it continues thus to collect and burſt alternately, till the opening becomes ſufficiently large to prevent any farther collection. This ſtate of the diſorder exhibits exactly the appearances of a ſinuous ulcer, with callous, and ſometimes with retorted edges; and this ſtage forms properly the real fiſtula lachrymalis. Tears, mucus, and purulent matter, are now abundantly diſcharged from the ſore. When the bone beneath is ſound, this diſcharge is ſeldom either acrid or offenſive to the ſmell, for the opening being in general in the under part of the tumor, the matter is readily evacuated; but when any of the contiguous bones are carious, they are not only found to be ſo by the introduction of a probe, but by the appearance, ſmell, and effects of the matter upon the neighbouring parts. In this caſe it is thin, fetid, and commonly ſo acrid as to fret and corrode the integuments moſt contiguous to the ulcer; and when the diſorder is connected with ſcrophula or with lues venerea, which is by no means an unfrequent occurrence, the diſcharge and appearance of the ſore will vary according as it happens to be combined with one or other of theſe diſeaſes.

222 The diſeaſe divided into four ſtages.

From what has been ſaid, we may divide this diſeaſe into four general heads or ſtates, under which all its more minute diſtinctions may be comprehended. The firſt conſiſts in a ſimple dilatation of the ſacculus and obſtruction of the naſal duct, diſcharging, upon preſſure, a fluid either quite clear or a little cloudy; the ſkin covering the bag being entire and perfectly free from inflammation. In the ſecond, the tumor is ſomewhat larger; the ſkin which covers it is in an inflamed ſtate, but entire; and the diſcharge made through the puncta lachrymalia is of a pale yellow or purulent colour. In the third, the ſkin covering the ſacculus is become ſloughy, and burſts; by which means the ſwelling is in ſome meaſure leſſened: but the matter which, while the ſkin was entire, uſed to be preſſed out through the puncta lachrymalia now diſcharges itſelf through the new aperture. The ductus ad nares, both in this and the preceding ſtate, are not otherwiſe diſeaſed than by the thickening of its lining. In the fourth, the paſſage from the ſacculus lachrymalis into the noſe is totally obliterated, the inſide of the former being either ulcerated or filled up with a fungus, and attended ſometimes with a caries of the bone underneath.

223 Treatment during the firſt ſtage.

In the firſt and moſt ſimple ſtate of the diſeaſe, viz. that of mere obſtruction without inflammation, much pains have been taken to reſtore the parts to their natural ſtate and uſe, without making any wound or diviſion at all. The introduction of a probe, the injection of aſtringent fluids, and a conſtant compreſſion made on the outſide of the ſacculus in the corner of the eye, are the principal means by which this has been attempted.

224 M. Anel's probe and ſyringe.

Several years ago, M. Anel made a probe (fig. 37.) of ſo ſmall a ſize as to be capable of paſſing from the eyelid into the noſe, being introduced at one of the puncta lachrymalia, and paſſing through the ſacculus and duct; with which probe he propoſed to break through any ſmall obſtruction which might be found in its paſſage. He alſo invented a ſyringe (fig. 38.), the pipe of which is ſmall enough to enter one of the puncta, and thus furniſhes an opportunity of injecting a liquor into the ſacculus and duct; and with theſe two inſtruments he pretended to be able to cure the diſeaſe whenever it conſiſted in obſtruction merely, and the diſcharge was not much diſcoloured. The firſt of theſe, viz. the paſſage of a ſmall probe through the puncta, has a plauſible appearance; but will, upon trial, be found very unequal to the taſk aſſigned: the very ſmall ſize of it, its neceſſary flexibility, and the very little reſiſtance it is capable of making, are manifeſt deficiencies in the inſtrument;

225 Of little uſe.

ment; the quick ſenſation in the lining of the ſac and duct, and its diſeaſed ſtate are great objections on the ſide of the parts, ſuppoſing it were capable of anſwering any valuable end, which it moſt certainly is not.

That the paſſing a fine probe from one of the puncta lachrymalia into the noſe is very practicable, is known from experience; but the pain it gives, and the inflammation it often excites, are much greater than any benefit which does or can ariſe from it. It is ſaid that the principal uſe of this probe is to clear the little ducts leading from the puncta into the ſacculus, and the obſtruction of thoſe ducts is often mentioned as a part of this diſeaſe. Hence one would be led to ſuppoſe that it was a circumſtance which frequently occurred; whereas it is ſeldom, if ever, met with. Nor, even if it did happen, could it ever produce the diſeaſe in queſtion; the principal characteriſtic of which is a diſcharge into the inner corner of the eye upon preſſure made in the angle.

The ſyringe, if uſed judiciouſly while the diſeaſe is recent, the ſac very little dilated, and the mucus perfectly clear, will ſometimes be found ſerviceable; it gives no pain; and a few trials render the uſe of it by no means troubleſome. There is very little occaſion, however, to take much trouble, or to put the patient to ſo much uneaſineſs; for if the ſac be emptied by compreſſion, if the liquor which was to have been injected be applied to the puncta, they will abſorb it as readily as the fluid which naturally paſſes through them.

226 Screw invented by Fabricius ab Aquapendente.

Fabricius ab Aquapendente invented an inſtrument, which was ſo contrived as by means of a ſcrew to make a preſſure externally on the lachrymal bag; from the uſe of which, he ſays, his patients received much benefit. This inſtrument has been conſiderably improved by late practitioners, and is ſtill recommended as very uſeful. See fig. 39.

All the good that can be obtained by compreſs and bandage, this ſcrew is capable of procuring; but it is alſo ſubject to all the ſame inconveniences, ariſing from the impoſſibility of determining exactly the due degree of preſſure: for if it be ſo great as to bring the ſides of the upper part of the ſac into contact, all communication between it and the puncta will be thereby ſtopped; if it be but ſlight, the accumulation will not be prevented; nor does it in either caſe contribute to the removal of the obſtruction in the naſal duct, the primary and original cauſe of the diſeaſe. If the curative intention was to procure an union of the ſides of the ſacculus, as in the caſe of parts ſeparated from each other by the formation of matter or ſloughs, and the preſſure could be made uniformly and conſtantly, poſſibly it might be ſo managed as to anſwer a valuable purpoſe; but as that is not the intention, the preſſure, whether made by an inſtrument or by a common roller and compreſs, contributes little or nothing toward a cure.

227 Treatment during the ſecond and third ſtages.

When the diſeaſe is only beginning to form, if the lachrymal ſac be frequently preſſed with the finger, the contents of it will be diſcharged before they become acrid, and the complaint, though ſeldom to be cured in this manner, may be ſometimes endured without any other aſſiſtance. But when the diſeaſe has advanced ſo far as to be in a ſtate of inflammation, conſiderable relief may be obtained from ſuch remedies as are found to be uſeful in inflammatory affections of other parts of the body, as blood-letting, laxatives, and low diet, together with ſaturnine applications to the parts affected. But when theſe fail, and it is found that the paſſage of the tears to the noſe is completely obſtructed, as the matter, if it does not burſt outwardly, may be in danger of corroding the bone underneath, a different practice is to be followed.

In this ſtate, an opening in the upper part of the ſacculus lachrymalis becomes in general abſolutely neceſſary; and as a wound made by a knife leaves a much leſs diſagreeable ſcar than that which neceſſarily follows the burſting of the ſkin, one being a mere ſimple diviſion, the other a loſs of ſubſtance; it will always be found beſt to anticipate the accident of burſting, by making the opening as ſoon as the integuments are in ſuch a ſtate as to threaten it.

For making this inciſion, authors have been very particular in their directions with regard to its place, manner, and form. But all that the ſurgeon need obſerve is, to take care to keep the knife at a proper diſtance from the juncture of the palpebræ, to begin the inciſion a very little above a line drawn from that juncture toward the noſe, and to continue it downward ſo as to lay the ſac completely open; and the beſt inſtrument to make it with is a ſcalpel of the common form, but of a ſmall ſize. If the ſacculus be already burſt, the place of opening is determined; and the orifice may be enlarged with a knife, or dilated.

The inciſion being made, the contents of the tumor ſhould be moderately preſſed out; after which, ſome practitioners adviſe that the naſal duct ſhould be ſearched for by means of a probe; and if found, that a piece of catgut, bougie, or lead, ſhould be introduced, and kept there, its edge being bent a little downwards till the ſides of the duct are ſkinned over and healed. In the mean time, the ſore is to be dreſſed with ſimple pledgets of wax and oil, which are to be retained by means of adheſive plaſter. As ſoon as the paſſage of the tears into the noſe is ſufficiently ſecured, the ſubſtance which has been left in it is to be withdrawn, and the wound healed.

228 During the laſt ſtage.

The laſt ſtate of this diſorder is that in which the natural paſſage from the ſacculus to the noſe is ſo diſeaſed as to be quite obliterated, or in which the bones are ſometimes found to be carious. The methods hitherto deſcribed have all been calculated to preſerve the natural paſſage, and to drive the lachrymal fluid again through it. In this attempt they are ſometimes ſucceſsful; but when every trial for diſcovering the naſal duct has been unſucceſsful, recourſe muſt be had to an artificial opening for the tears. 229 Method of making an artificial naſal duct. In performing this part of the operation, the patient ſhould be ſeated oppoſite to a window, with his head ſupported by an aſſiſtant. The ſurgeon is to place himſelf immediately before him, either in a ſitting or ſtanding poſture. The canula of the trocar (fig. 40.) is now to be introduced to the under and back part of the lachrymal ſac, and held with one hand, while the ſtilette is to be paſſed into it by the other, in a direction obliquely downwards and inwards, between the two ſpongy bones, till it reach the cavity of the noſe, which will be known by ſome bloody mucus paſſing out at the noſtril. As ſoon as the inſtrument has penetrated the noſe, the opening ſhould be made ſufficiently large; then the ſtilette ſhould be withdrawn, and a bit of catgut or bougie, or what is more cleanly and convenient, a leaden probe, is to be introduced, and the canula removed. One end of the probe ought to remain in the noſe, and the other bent in ſuch a way as to hang over the edge of the wound, and at the ſame time be in no danger of coming out. The ſore is now to be covered with a pledget of lint ſpread with emollient ointment, and the whole retained with adheſive plaſter. The probe muſt be removed every day or two, ſo as to allow it and the paſſage to be cleaned; and at each dreſſing ſome aſtringent injection ſhould be thrown in, when the parts are to be dreſſed as at firſt. Several weeks will commonly be neceſſary for rendering the paſſage perfectly callous; but this muſt depend much upon the ſtate of the parts, as well as the conſtitution of the patient.

After the paſſage is become ſufficiently callous, the dreſſings and probe are to be withdrawn, and the parts cleared from any mucus with which they may be ſtuffed. The ſides of the wound, now already ſufficiently contracted, are to be laid together, and covered with ſome adheſive plaſter. If this be ineffectual, the wound is to be touched with cauſtic, when the cure will generally be quickly completed. To give tone to the parts, moderate preſſure ſhould frequently be made upon the ſac, either by the patient's finger or by the machine already mentioned, and this ſhould be continued for a conſiderable time. Sometimes the diſeaſe returns after a cure has been made, owing to diſeaſes of the conſtitution, carious bone contiguous to the ſore, or ſometimes too ſmall an opening having been formed. In this caſe a canula of gold, ſilver, or lead, is ſometimes introduced into the artificial paſſage, and the ſkin healed over it; by which means the paſſage will afterwards remain completely open, and no diſeaſe of the conſtitution can ever affect it. We ſhall deſcribe Mr Pellier's method of performing this operation, who has made ſeveral improvements on it.

230 Mr Pellier's method of performing this operation.

The patient is to be ſeated, and his head properly ſupported by an aſſiſtant; then the ſac is to be laid freely open at its inferior part; the naſal duct is to be ſearched for with a firm probe, or with a conductor (fig. 41.) made for the purpoſe; and Pellier aſſerts that he never fails in finding it. As ſoon as this is diſcovered, a conical tube (fig. 42.) with a projection at the top, and another in the middle for ſecuring it in its place, muſt be put upon the conductor, previouſly furniſhed with a compreſſor (fig. 43.), and it ſhould be of ſuch a ſize that the conductor may fit it exactly. The point of the conductor is now to be paſſed into the lachrymal duct; and being puſhed in till it reaches the noſtril, which may be known either by inſerting a probe into it, or by a few drops of blood falling from the noſe, the conductor is to be withdrawn; leaving the compreſſor upon the brim of the canula, which muſt be firmly preſſed down with the left hand, while the conductor is removed with the other. This being done, the compreſſor muſt next be taken out; and to diſcover whether the canula be at a proper depth, a little milk or water ſhould be injected thro' it. If the injection paſs, it will ſhow that the canula is properly placed. If, on the contrary, any obſtruction occur, there will be reaſon to ſuſpect that it is already puſhed too far, and that it preſſes againſt the os ſpongioſum inferius; in which caſe the canula muſt be withdrawn, ſhortened, and reintroduced as before.

The ſore ought to be kept open for eight or ten days after the operation with ſoft lint ſpread with emollient ointment, and the whole covered with a compreſs of ſoft linen ſecured with a bandage. An injection of milk and water ſhould be daily paſſed through the canula; and as ſoon as the ſore looks clean and healthy, the dreſſings ſhould be entirely removed, and a piece of court plaſter laid over it. In this ſtate it is to be left to heal; but the plaſter muſt be renewed, if matter appear to form beneath it. By this method Mr Pellier finds, that fiſtula lachrymalis, not depending upon diſeaſes of the contiguous bones or of the conſtitution, may commonly be completely cured in two or three weeks, which, by the uſual practice, might require ſeveral months.

CHAP. XV. *Of Affections of the Noſe.*

SECT. I. *Of Hemorrhagies from the Noſe.*

WHEN the means mentioned for this complaint in the article MEDICINE have failed, recourſe muſt be had to compreſſion. Doſſils of lint introduced into the noſtrils are ſometimes effectual; or the gut of ſome ſmall animal, tied at one end, then introduced by a probe into the noſe as far as the pharinx, and filled with cold water, or that and vinegar, and ſecured by a ligature, by adapting itſelf to all the parts, and preſſing equally on them, has been attended with advantage. When theſe remedies likewiſe fail in their effect, a piece of catgut or wire may be introduced through the noſe into the throat, and brought out at the mouth; a piece of ſponge, or a bolſter of lint of a ſize ſufficient to fill the back-part of the noſtril, is then to be fixed to it; the ſponge is next to be drawn back and properly applied. Another is to be applied to the anterior part of the noſtril and ſecured. The ſame may be done to the other noſtril, if it be neceſſary; or the ſponge may be of ſuch a ſize as to fill the ends of both noſtrils at the ſame time. By this contrivance the blood not finding an outlet, will ſoon coagulate, and prevent any farther evacuation.

SECT. II. *Of Ozæna.*

BY this is underſtood an ulceration within the noſe, which may be occaſioned by external violence, by expoſure to cold, by irritating ſubſtances, or by whatever produces inflammation in the membrane lining the noſtrils. Sometimes it ariſes from venereal infection; and in this caſe the diſcharge becomes ſo acrid as to corrode, and produce caries in the bones of the noſe. When the diſeaſe is local, and not depending upon any conſtitutional affection, aſtringent ſolutions are found to be the moſt uſeful, ſuch as a decoction of bark or that mixed with alum. Doſſils of lint dipped in theſe are to be introduced into the noſtrils three or four times a-day, or ſome prefer the injection of ſuch fluids by means of a ſyringe as being more effectual. If ſtronger aſtringents be neceſſary, a ſolution of ſtyptic powder ought to be uſed. At bed-time an ointment prepared with zinc or with lapis calaminaris ought likewiſe to be applied. Upon ſome occaſions the application of a bliſter to the temple has cured the diſeaſe.

Inſtances, however, occur, where the diſcharge is occaſioned by a collection of matter within the antrum maxillare; and then it is apt to reſiſt every effort till a proper outlet be given to it.

When the complaint is owing to venereal infection, the primary diſeaſe is to be attended to, and mercurial preparations are to be applied to the part; but when the bones are carious, till theſe are removed we need neither expect that the diſcharge will ceaſe, nor the diſeaſe be otherwiſe completely cured.

SECT. III. *Of Imperforated Noſtrils.*

SOMETIMES the noſtrils are in part or entirely obliterated. This may be owing to burns; ſmall-pox; different kinds of ſores, eſpecially thoſe of a venereal nature; and ſometimes it is the effect of original conformation, for it has been obſerved in new-born children.

When any opening appears in the obſtructed noſtril, it may be readily dilated by the introduction of a furrowed probe, and then cutting upon it in the courſe of the adheſion: but when no paſſage appears, the operator muſt endeavour, by means of a ſcalpel, to diſcover one of the noſtrils; and when diſcovered, it muſt be enlarged by a director and biſtoury, as in the former caſe. The other noſtril is to be treated in the ſame manner. After the openings are formed, they might be preſerved of a proper ſize by the introduction of doſſils of lint, which ſhould be frequently cleaned or renewed; but metallic tubes anſwer the purpoſe better, and allow the patient to breathe freely through them till a cure be performed. Previous to their introduction, they ought to be covered with ſoft leather ſpread with emollient ointment, and retained till the ſores are completely healed.

Chap. XVI. *Of Affections of the Mouth and Throat.*

Sect. I. *Of the Diviſion of the Parotid Duct.*

When the parotid duct is divided, the ſaliva which it tranſmits paſſes over the cheek inſtead of going into the cavity of the mouth.

When the ſurgeon is called to a recent diviſion of the duct, he ought to lay the divided ends of it as exactly together as poſſible, and retain them in their ſituation till they are united, by adheſive plaſters, or by the twiſted ſuture if there be conſiderable retraction of the parts. But when the portion of the duct next the mouth is entirely obliterated, an artificial paſſage muſt be made into the mouth, and an union formed between the opening and that part of the duct which proceeds from the parotid gland. The artificial paſſage ought to be as much as poſſible in the direction of the natural duct. For this purpoſe a perforation of a proper ſize is to be made obliquely into the mouth with the torcar (fig 44.), from the ſide of the wound exactly oppoſite and contiguous to the under extremity of the upper portion of the duct; and then a piece of leaden probe of the ſize of the perforator ſhould be introduced by means of the canula, and be kept in the cheek till the ſides of the opening become callous; when the lead being withdrawn, the extremities of the artificial and natural ducts are to be brought into contact, and retained there by adheſive plaſter till the cure is completed. Another method has, in a few inſtances, been followed by Mr Latta (ſee his *Syſtem of Surgery*), of introducing one end of a bit of catgut into the artificial opening, and bringing it out at the mouth, while the other is introduced a little way into the extremity of the natural duct, and retained by adheſive plaſter till the wound is healed. Whichever way the operation is done, the patient ſhould live upon ſpoon-meat, and make as little motion as poſſible with his lips or jaws.

Sect. II. *Of the Hare-lip.*

The hare-lip is a fiſſure in the upper lip, very ſeldom in the under one. It is attended with want of ſubſtance, and has its name from a reſemblance to the lip of a hare. In general it is only a ſimple fiſſure, though ſometimes it is double; in which caſe it renders a cure more difficult to be executed. There are many lips where the want of ſubſtance is ſo great, that the edges of the fiſſure cannot be brought together, or at leaſt where they can but juſt touch, and then the attempt ſhould be forborne. It is likewiſe improper in infants, and ought not to be performed till ſeveral months after they have been weaned, when they will have acquired more ſtrength to undergo the operation, and will be leſs liable to be attacked with bowel complaints, which frequently make them cry at an earlier period of infancy.

231 Operation for the hare-lip. In proceeding to the operation, the patient, if a child, ſhould be ſecured upon a perſon's knee, or rather perhaps upon a table; but if an adult, he is to be ſeated upon a chair, in a proper light. The frænum connecting the gums to the upper lip is to be divided; if a fore-tooth project ſo much as to prevent the parts from being brought properly together, it is to be extracted; or when the fiſſure runs through the bones of the palate, if a ſmall portion of the bone project, this muſt be removed. Matters being ſo far adjuſted, the operator is to lay hold of one ſide of the fiſſure between the thumb and fore-finger, or between the forceps (fig. 45.), then a pair of ſharp and very ſtrong ſciſſars (fig 46.), or with a ſcalpel, to cut off a thin portion of the lip, and to repeat the ſame thing upon the other ſide of the fiſſure, ſo as to render the whole edges of the fiſſure completely raw; by which, if the operation be properly performed, a piece will be ſeparated in form like an inverted V. After the inciſions have been made, the veſſels ſhould be allowed to bleed freely to prevent inflammation; and when the bleeding has ceaſed, the ſides of the wound are to be brought accurately together, and kept in that ſtate by the twiſted ſuture. The firſt pin ought to be as near as poſſible to the under edge of the lip; another is to be inſerted near the upper angle; and if the patient be an adult, a third pin will generally be neceſſary, half way between the other two. In paſſing them, they ought to go rather deeper than half through the lip, that the edges of the wound may be kept properly in contact. An aſſiſtant now keeps the parts together, while the operator applies a firm waxed ligature firſt to the under pin; and having made three or four turns with it in the form of an eight figure (fig. 47.), it ſhould then be carried about the ſecond, and in a ſimilar way about the third, care being taken that the thread be drawn of a proper tightneſs. After the ligature is ſecured, a piece of lint, covered with ſome mucilage, ſhould be laid over the wound to protect it from the air; and this is commonly all the bandage neceſſary. When, however, from a great want of ſubſtance, the retraction has been conſiderable, ſome advantage is derived from the uſe of adheſive plaſters applied to the cheeks and tied between the pins. During the time of the cure the patient ſhould be fed upon ſpoon-meat, and prevented from making any exertion with the lips, otherwiſe the cure might be conſiderably retarded. At the end of five or ſix days the pins may be taken out, when the parts will commonly be found completely united.

In the caſe of a double hare-lip, the operation ſhould be firſt done upon one fiſſure; and when a cure is completed there, it may be done ſafely upon the other.

Sect. III. *Of Extirpation of Cancerous Lips.*

The under lip is much more frequently attacked with cancer than the upper, or indeed than any other part of the body: And as little dependence is to be placed upon external applications or internal remedies, recourſe muſt be had to the knife as the only certain method of cure.

When the diſeaſe has not attacked any conſiderable part of the lip, the diſeaſed part is to be cut out, and the wound cured by the twiſted ſuture. The operation ought therefore to be performed early, to allow the parts to be brought properly together. The general ſteps of the operation are nearly the ſame as in the operation for hare-lip, and therefore need not be repeated. It is only to be obſerved, that all the diſeaſed parts are to be removed, taking care to make the cut in ſuch a way as will moſt readily admit of the twiſted or hare-lip ſuture. When the parts can be brought together, the lip, will have nearly the ſame appearance as in the operation for hare-lip; but when the diſeaſe ſpreads over a conſiderable part of the lip, ſo as to prevent the ſound parts from being united after the diſeaſed parts have been removed, all that can be done is to remove the part affected, ſecure the bleeding veſſels, and dreſs the ſore like any other recent wound.

Sect. IV. *Of Affections of the Teeth.*

232 Dentition. In dentition the gums inflame and ſwell about the parts where the teeth are afterwards to appear; the child is continually rubbing the gums with its finger; the ſaliva is commonly increaſed in quantity, though ſometimes the contrary happens; ſometimes the bowels are remarkably coſtive though more frequently the reverſe: there is generally quick pulſe, with heat, and other ſymptoms of fever; and on ſome occaſions theſe ſymptoms are attended with convulſions. The means found to be moſt uſeful here are ſuch as

are moſt effectual in allaying irritation; as opiates, bliſters, and eſpecially warm-bathing. When theſe fail, cutting the gum by means of a fleme (fig. 48.), over the approaching tooth, is frequently found to remove every ſymptom; but this ought to be done earlier than it commonly is to have the full effect. Whenever the ſymptoms give reaſon to think that a tooth is approaching, the gums ſhould be cut freely over that part where the teeth may be firſt expected. When the ſymptoms recur, the operation ſhould be repeated. A crucial inciſion is attended with ſtill more effect; and the bleeding which afterwards takes place is of conſiderable ſervice. The inciſion ſhould always be carried as far as the tooth, which ought to be ſomewhat expoſed; and when properly done, is frequently followed with immediate relief. Sometimes the ſame kind of ſymptoms attend the cutting of the ſecond ſet particularly of the dentes ſapientiæ. When this is owing to the thickneſs of the gums, ſcarifying gives the greateſt relief; but ſometimes it is for want of room in the jaw, and then the tooth ſhould be drawn.

233 Derangement of the teeth.

Derangement of the teeth happens more frequently in the ſecond than in the firſt ſet, and more commonly in the fore than in the back teeth. This may be owing to the firſt ſet remaining in the jaw after the ſecond have appeared. Another cauſe is a waſte of ſpace in the jaw; and a third is a mal-conformation of the teeth, where they are too large in proportion to the jaw, and therefore overlope each other. The remedy is the ſame in each of theſe caſes, viz. to extract the teeth which ſtand in the way of the reſt, to allow thoſe which are out of their place to come into the row, and put on a more uniform appearance.

The uſual method of moving teeth which are out of the row is, by fixing them with a ligature to the neareſt teeth; or the ſame thing is done by metallic plates or pieces of wire. But theſe methods have not been found fully to anſwer the purpoſe intended, though in ſome caſes they may be uſeful. When one or more front teeth are accidentally drawn out of the jaw, they ought to be immediately replaced. When the teeth are broken over or otherwiſe injured, they may be ſupplied with others tranſplanted from the jaws of another perſon; but this can only be done when the ſockets have been newly emptied, for after inflammation comes on it is impracticable. In theſe caſes the inflammation muſt be allowed to ſubſide, and then artificial teeth can be readily adapted.

234 Of looſe teeth.

When the teeth are looſened by external violence, by falls and blows, or by improper uſe of inſtruments in pulling diſeaſed teeth in the neighbourhood of ſound ones, they may again be made tolerably faſt by preſſing them as firmly as poſſible into their ſockets, and preſerving them ſo with ligatures of catgut, Indian weed, or waxed ſilk, and keeping the patient upon ſpoon-meat till they are firm. When looſe teeth are owing to tartar, nothing will faſten them till the cauſe be removed; and this ought to be done early, otherwiſe it will have no effect. Frequently the teeth become looſe from a ſpongineſs in the gums, often, but improperly, attributed to ſcurvy. The beſt remedy is ſcarifying the gums deeply, and allowing them to bleed freely; this ſhould be repeated till they are fully faſtened. Mild aſtringents, as tincture of bark, are here attended with good effects, tho' thoſe of a ſtrong nature will certainly do harm. The mouth ſhould be frequently waſhed with cold water ſtrongly impregnated with theſe, and the patient ſhould not uſe the teeth which have been looſe till they become firm again. The looſening of the teeth in old age cannot be remedied, as it is owing to a waſting of their ſockets, from which the teeth loſe their ſupport.

235 Of cleaning the teeth.

The teeth ſometimes become yellow or black without any adventitious matter being obſerved in them; at other times they become foul, and give a taint to the breath, in conſequence of the natural mucus of the mouth, or part of the food remaining too long about them. The moſt frequent cauſe of foul teeth is the ſubſtance called *tartar*, which ſeems to be a depoſition from the ſaliva, and with which the teeth are often almoſt entirely incruſted. When this ſubſtance is allowed to remain, it inſinuates itſelf between the gums and the teeth, and then gets down upon the jaw in ſuch a manner as frequently to looſen the teeth. This indeed is by far the moſt common cauſe of looſe teeth, and when they have been long covered with this or with any other matter, it is ſeldom they can be cleaned without the aſſiſtance of inſtruments. But when once they are cleaned, they may generally be kept ſo by rubbing them with a thin piece of ſoft wood made into a kind of bruſh, and dipped into white-wine vinegar; after which the mouth is to be waſhed with common water.

Plate CCCCLXXXIX.

When the teeth are to be cleaned by inſtruments, the operator ought, with a linen cloth or with a glove, to preſs againſt the points of the teeth, ſo as to keep them firm in their ſockets, with the fingers of the one hand, while he cleans them with the neceſſary inſtruments, fig. 51. n° 1, 2, 3, 4, 5, held in the other; taking care not to ſcrape them ſo hard as to looſen them, or to rub off the enamel. This being done, the teeth ſhould be rubbed over with a ſmall bruſh, or a piece of ſponge dipped in a mixture of cream of tartar and Peruvian bark. The ſame application may be made to the teeth for a few days, after which they may be kept clean as already directed.

The teeth are ſometimes covered over with a thin dark coloured ſcurf, which has by ſome been miſtaken for a waſting of the enamel, but which is only an extraneous matter covering it. By perſeverance this may be cleaned off as completely as where the teeth are covered with tartar; but it is apt, after ſome time, to appear again. When this is obſerved, the ſame operation muſt be repeated.

For the purpoſe of applying powders or waſhes to the teeth, a bruſh or a ſponge is commonly employed; the latter is certainly preferable, as being leſs in danger of wearing down the enamel, or of ſeparating the teeth.

236 Of toothach.

The cauſes producing toothach may be, expoſure of the nerve of a tooth, by breaking or waſting of the enamel, inflammation in or about the tooth, or from ſympathy when diſtant parts are affected, as the eye, the ear, the ſtomach, or the uterus, as in time of geſtation. After toothach has once been produced and removed, it is apt to return by expoſure to cold, by taking hot liquids, by hard bodies preſſed againſt the nerve in the time of chewing, by the uſe of a pick-tooth, &c.

237 Method of cure.

With reſpect to the cure of the diſeaſe, no rule can be laid down which will anſwer with certainty upon all occaſions. No remedy has yet been diſcovered which will at all times even moderate the pain; relief, however, is frequently obtained from acrid ſubſtances applied to the tooth, ſo as to deſtroy the irritability of the nerves, ſuch as opium, ſpirit of wine, camphire, and eſſential aromatic oils. When theſe fail, bliſters behind the ear, or deſtroying the nerve by the cautious uſe of ſtrong acids, or by a red hot wire frequently applied to the part, have been attended with advantage.

When a black or mortified ſpot appears on a tooth, if it be quite ſuperficial, it may be removed; but if it go through the thickneſs of the enamel, it will be more adviſable to let it remain.

When a ſmall hole breaks out in a tooth, particular attention ſhould be paid to prevent the admiſſion of air. Tin, lead, or gold-leaf, commonly employed for this purpoſe, ſometimes give relief for many months, or even years; but at other times are of little advantage, and in ſome inſtances create great pain. Gum-maſtich or bees-wax are frequently employed, and can be made to fill the cavity of the tooth ſtill better than metalline ſubſtances. When ſtuffing is to be employed, it ought to be done in the intervals of the fits of toothach, otherwiſe it will give great uneaſineſs. When it is to be uſed, the whole cavity of the tooth ſhould be filled; and this is to be done with the inſtruments, fig. 52. nº 1, 2, 3.

238 Method of extracting the tooth.

When the remedies made uſe of for the removal of toothach have failed in their effect, and it is found that the complaint ſtill continues, it will be neceſſary to extract the tooth. In doing this, it may be obſerved, that all the teeth may be pulled to either ſide, excepting the dentes ſapientiæ of the lower jaw, which ought to be pulled outwards, otherwiſe the jaw may be ſplintered. As ſoon as the ſocket is cleared of blood, if the tooth be not much ſpoiled, it may be immediately replaced, when it will become as uſeful as before. It is difficult, however, to replace the large grinders, on account of their diverging roots. The more perpendicularly the teeth are pulled, the leſs contuſion and injury will be done to the jaws and alveoli. But as no inſtrument has been yet invented capable of effecting this properly, ſurgeons are obliged to be contented with an inſtrument which acts in a lateral direction. One of the beſt is that (fig. 53.) in form of a key, with a claw and fulcrum. Previous to the operation, this ſhould be covered with a linen rag, to prevent the gum from ſuffering. After dividing the gum, or ſeparating it from the tooth, the claw is to be fixed as deep between the teeth and gum as poſſible. Then the fulcrum is to be applied on the oppoſite ſide. The ſurgeon may now, with one turn of the handle of the inſtrument, pull the tooth out at once. But the turn ſhould not be effected by a ſudden jerk, but in the moſt cautious and ſlow manner. When it happens to be one of the great molares, whoſe roots diverge very much, and when they are firmly fixed, after only looſing it with the firſt pull, the claw of the inſtrument is to be applied to the other ſide of the tooth, and the turn given in a contrary direction to the firſt. After it has been ſufficiently looſened in this manner, it is to be laid hold of by a common teeth forceps (fig. 54.), and extracted in the eaſieſt manner. Upon extraction of the tooth, any detached ſplinters occurring are to be immediately removed. Should any conſiderable hemorrhagy take place, the patient may take ſome cold water, vinegar, or ſpirit of wine into his mouth, and doſſils of lint may be introduced into the ſocket. After all theſe fail, recourſe muſt be had to the actual cautery.

When ſtumps occur from caries, or when the teeth have broken in time of the extracting, the common key will ſometimes remove them; if that fail, the punch (fig. 55.) is to be uſed. The operator having this inſtrument in one hand, is to place the fore finger of the other, with a piece of cloth wrapped round it, upon the inſide of the jaw oppoſite to the ſtump, to protect the neighbouring parts.

239 Of tranſplanting teeth.

Teeth can never be tranſplanted with propriety in childhood or in old age. The conſtitution muſt be free from thoſe diſeaſes which affect the gums. The tooth to be tranſplanted muſt be taken from a perſon of a ſound conſtitution, otherwiſe it will convey infection. To guard as much as poſſible againſt infection, it ſhould be immerſed for a few minutes in lukewarm water, and then well dried and cleaned. It ought to fit the ſocket exactly; if it be too large, it may be filed down, avoiding the enamel as much as poſſible. The ſurface of it ſhould be at firſt on a level with the reſt, or rather a little more depreſſed, that it may be as ſecure as poſſible in its place. If the tooth fit the ſocket properly, there will be no occaſion for uſing a ligature to fix it; but if a ligature be found neceſſary, it may be made of threads of fine ſilk properly waxed. After the operation is finiſhed, the patient ought to avoid whatever may be in danger of ſhaking the tooth, and this is to be attended to till the tooth, is perfectly firm. He ſhould alſo guard againſt cold and moiſt air, and live upon ſpoon-meat.

Sect. V. *Of Boils and Excreſcences of the Gums.*

240 Of gum boils.

Gum boils may ariſe from cold or from external violence, &c. but moſt frequently they are the conſequence of toothach. The complaint begins with pain attending a tumor on the parts affected; by degrees the ſide of the face ſwells conſiderably; the tumor of the gum now begins to point; and if it be not opened, it burſts and gives the patient immediate relief. When the boil is owing merely to inflammation after the matter is evacuated, the complaint goes off; but when it proceeds from a caries of a tooth, it will continue as long as the cauſe remains; the tooth therefore ought to be extracted. After the abſceſs has burſt, if the matter continue to be diſcharged, it may ſometimes be dried up by injecting ſome aſtringent liquor; but the moſt effectual method is to lay the abſceſs fully open, and to heal it from the bottom by doſſils of lint. Sometimes abſceſſes occur of a more obſtinate nature, owing to a carious ſtate of the jaw. In that caſe ſuppuration ought to be promoted, and the part laid open as ſoon as matter is formed; keeping the paſſage open for the diſcharge, being the only means for effecting a cure.

214 Excreſcences in the gums.

Excreſcences of various degrees of firmneſs ſometimes grow upon the gums. Some are ſoft and fungous, while others are of a warty nature. In general they are not attended with pain. They frequently originate from caries of the teeth, or of their ſockets; in which caſe the removal of the ſpoiled teeth, and the ſubſequent exfoliation, of the carious part of the jaw, will often accompliſh a cure. But when this does not happen, the tumor ſhould be removed as ſoon as it becomes troubleſome, otherwiſe there may be danger of its ending in cancer. The removal may be effected by a ligature or knife, according as the tumor may have a narrow or broad baſis. It is ſometimes neceſſary to uſe a ſpeculum oris to keep the mouth open. After the tumor is extirpated, the wound ſhould be allowed to bleed freely, to prevent ſubſequent inflammation. When the hemorrhagy proceeds too far, it ſhould be reſtrained by the application of ſpirit of wine, or tincture of myrrh, or ſolution of alum, &c. and ſhould theſe prove unſucceſsful, the lunar cauſtic will ſeldom fail of having the deſired effect. No dreſſings can be applied; but for ſome days after the operation, the mouth ſhould be frequently waſhed with a warm emollient decoction; and the cure will be afterwards promoted by the application of ſome gently aſtringent liquor, as port wine, tincture of roſes, &c.

Sect. VI. *Of Abſceſſes, &c. in the Antrum Maxillare.*

This diſeaſe is known by a pain and uneaſineſs beginning in the cheek, and extending upwards to the eyes, noſe, and ears, together with a ſwelling, which in the latter ſtages of the diſeaſe tends to a point, moſt frequently in the cheek. Sometimes a diſcharge enſues between the roots of the back-teeth, when they happen to penetrate the antrum. Sometimes a diſcharge of matter from the noſtrils takes place, particularly when the patient lies on the ſide oppoſite to the tumor. The diſeaſe may ariſe from cold, or whatever produces inflammation in general; but the moſt common cauſes are violent fits of the toothach, occaſioning exceſſive pain and inflammation of the membranes of the noſe and antrum.

The cure is performed by giving a free diſcharge to the con-

Ranula.

Plate 488.

contents of the tumor: and this is done in two ways; either by extracting one of the two anterior great molares, which are ſituated under the antrum, and making a perforation with a round trocar (fig. 49.) through the bottom of the ſocket; if this has not been already perforated by the fangs of the tooth or eroded, in which caſe the matter will paſs out immediately after the extraction: or the perforation may be made by the inſtrument repreſented in fig. 50. through that part of the antrum which projects outwardly over the molares. As moſt people wiſh to avoid the pulling of a tooth, when it does not appear to be abſolutely neceſſary, the perforation is commonly made in the way laſt mentioned. Some authors, however, object to this, as not giving a ſufficiently depending opening to the matter. As ſoon as the matter is diſcharged, a plug may be introduced into the perforation, which may be removed frequently to allow the matter to paſs out, and to admit aſtringent ſolutions of bark, &c. to be occaſionally thrown into the cavity of the antrum. In this way a cure is obtained, if the bones be ſound; but if they are carious, it is impoſſible to expect a cure till the diſeaſed portions of the bone exfoliate and be removed. When clotted blood is formed in the antrum, it is to be removed in the ſame manner. Sometimes the tumor of the cheek is owing to a ſwelling of the bones, and no matter is found in the antrum: In that caſe the operation does harm. No external application has yet been diſcovered for removing ſuch a ſwelling, though a long continued courſe of mercury has been found to be of ſome ſervice.

Sect. VII. *Of Ranula.*

This is a tumor under the tongue, moſt frequently owing to an obſtruction in one of the ſalivary ducts. Sometimes it contains matter like the ſynovia of the joints, ſometimes a fatty matter, now and then ſtony concretions, but moſt commonly a fluid like ſaliva. It often acquires ſuch a ſize as to prevent ſucking in infants, or maſtication and ſpeech in adults. When the perſon attempts to ſpeak, he only makes a croaking noiſe: hence the name of the diſeaſe.

The beſt mode of treatment is to lay the tumour fully open by means of a ſcalpel or large lancet, to evacuate its contents completely, and then to waſh the cavity with any mild fluid, as milk and water. If the ſore be difficult to heal, tincture of bark or other aſtringents may be uſed. When the tumour is obſerved to be filled with a fatty or any other firm ſubſtance, it ought to be removed entirely. The only application neceſſary in the time of the cure, is the frequent injection of milk and water, or any other mild fluid, by means of a ſyringe.

Sect. VIII. *Ulcers within the Mouth.*

When ulcers of the mouth ariſe from a general affection of the ſyſtem, this muſt be removed before a cure can be expected. When they originate from ſharp points in the teeth, theſe are to be filed off, and ſome aſtringent ſolution taken occaſionally into the mouth. Notwithſtanding theſe and other remedies, the ſore ſometimes becomes worſe, diſcharging a thin fetid ſanies, attended with much pain, and putting on every appearance of cancer. In this ſituation, extirpation is the only thing that can effect a cure. If the ſore be only ſuperficial, it may pretty readily be extirpated; but when deep-ſeated, it may ſometimes be neceſſary to cut through the whole ſubſtance of the cheek, and heal the ſore by the hare-lip ſuture. When the tongue is the ſubject of operation, the operator ought to be ready to take up the bleeding veſſels by the tenaculum or the needle. Along with ligature, it may be neceſſary to uſe aſtringent gargles, or a mixture of vitriolic acid in water. If theſe fail, the potential or even actual cautery muſt be uſed.

Sect. IX. *Diviſion of Frænum Linguæ.*

Diviſion of Frænum Linguæ.

Sometimes the frænum linguæ extends to the point of the tongue, and tying it down; whereas, in the natural ſtate, it ends about one-fourth of an inch farther back. When this is the caſe, it is to be divided, guarding againſt wounding the neighbouring veſſels, or the ends of the ſalivary ducts. The diviſion may be made with a common ſcalpel, but ſtill better with a pair of very ſharp ſciſſars with blunt points.

The child being laid acroſs the nurſe's knee, the ſurgeon ſhould open the mouth, and raiſe the tongue with the two firſt fingers of the one hand, while with the other he introduces the ſciſſars, and divides the frænum in the middle, and as far back as is neceſſary.

Sect. X. *Of Enlargement of the Tonſils and Uvula.*

241 Enlargement of the tonſils.

The tonſils ſometimes grow ſo large and hard as to become incurable, and even to threaten ſuffocation. The tumors here have been commonly conſidered as to be of ſcirrhous nature; but they are neither attended with ſhooting pain, nor are they apt to degenerate into cancer; neither do ſwellings return after the tonſils have been extirpated: hence they ought not to be removed till by their ſize they impede deglutition or reſpiration; but whenever they do this, they may be removed with ſafety. The only proper method of removing them is that by ligatures, which are not only void of danger, but ſeldom fail to perform a cure. If the baſe of the tonſil be ſmaller than the top, the ligature is to be uſed as for polypi in the throat; but however broad the baſe of it may be, much difficulty will ſeldom occur in fixing it, for the ſwelling is always very prominent. In diſeaſes of this kind both tonſils are generally affected; but if the removal of one of them forms a ſufficient paſſage for the food, the other may be allowed to remain. When, however, it is neceſſary to extirpate them both, the inflammatory ſymptoms produced by the extirpation of the firſt ſhould be allowed to ſubſide before any attempt be made to remove the other.

When the form of the tonſils happens to be conical, ſo that the ligature would be apt to ſlip over their extremities, Mr Cheſelden has recommended a needle (fig. 56.), with an eye near the point: a double ligature being put into the eye, the inſtrument is to be puſhed through the centre of the baſe of the tumor, and the ligature being laid hold of by a hook and pulled forwards, the inſtrument is to be withdrawn; then it is to be divided, and ſo tied that each part may ſurround one half of the tumor. This method however is ſcarcely ever found to be neceſſary.

243 And of the uvula.

Enlargements of the uvula, from inflammation or from other cauſes, may generally be removed by the frequent uſe of aſtringent gargles, as of ſtrong infuſions of red roſe-leaves or of Peruvian bark. But when theſe fail, and the enlargement is ſo conſiderable as to give great uneaſineſs by impeding deglutition, irritating the throat, and ſo cauſing cough, retching, and vomiting, extirpation is the only thing upon which any dependence can be placed. Exciſion is the readiſt method when the uvula is only elongated; but when the ſize is conſiderable, dangerous hemorrhages ſometimes attend this method; on which account a ligature is preferable. The operation may be readily performed by thoſe of the common kind; ſome prefer the curved probe-pointed biſtoury.

244 Extirpation of the uvula.

In performing the operation, the ſpeculum oris (fig. 57.) is neceſſary to keep the mouth ſufficiently open, and the uvula ſhould be laid hold of by a pair of forceps or a ſmall hook, ſo as to keep it firm, and prevent it from falling into the throat. After the operation, if the bleeding be conſiderable, it may be checked by aſtringent gargles, or by touch-

Scarifying and fomenting the Throat.

touching the part with lunar cauſtic; but this will ſeldom be neceſſary.

When a ligature is to be employed, it may be readily done according to the method recommended in the extirpation of polypi. A double canula with a ligature may be paſſed through the noſe, or the ligature may be applied according to Cheſelden's method in extirpation of the tonſils.

Sect. XI. *Of ſcarifying and fomenting the Throat.*

In inflammatory affections of the throat, the means commonly employed are gargles, fomentations, ſcarification, or top-bleeding. Gargles are uſeful for cleaning the fauces from thick mucus or other ſordes; they may likewiſe be uſeful in caſes of ulceration. In relaxation of the parts, they are employed to advantage when made of aſtringent materials. Fomentations may be of ſome uſe when externally applied; but the ſteam of water, &c. drawn into the throat by means of Mudge's inhaler (fig. 58.), is preferable. Sometimes it is neceſſary to draw blood from the part affected. Here recourſe may be had to ſcarifying with a common lancet, the tongue being depreſſed with a ſpatula. It may be ſtill more readily done by the ſcarificator (fig. 59). After a ſufficient number of punctures have been made, the flow of blood may be promoted by the patient's frequently applying warm water to the punctures. When abſceſs forms, notwithſtanding the uſe of theſe remedies, the matter may be diſcharged with the ſcarificator already mentioned.

Chap. XVII. *Of Diſeaſes of the Ear, and Operations performed upon it.*

245 Imperforated meatus auditorius externus.

Sometimes a thin membrane is ſpread over the mouth of the external paſſage, while at other times a conſiderable part of the paſſage is filled up with a fleſhy looking ſubſtance, occaſioning deafneſs. When the firſt circumſtance occurs, the ſkin is eaſily divided by a ſimple inciſion, and the accretion of its ſides may be prevented by a doſſil of lint or a bit of bougie inſerted between the edges of the wound, and daily cleaned and returned till the part be rendered callous.

When the other cauſe is preſent, the inciſion muſt be continued conſiderably deeper, till the reſiſtance be removed, or till the inſtrument reach near to the membrane of the tympanum, when the operator ſhould deſiſt, leſt the membrane ſhould be wounded; then the ſame kind of treatment may be followed as in the former caſe. The proper time for performing the operation is when children uſually begin to ſpeak; for previous to this the patient may be too weakly to bear it, and after this ſpeech would be impeded.

Sometimes the meatus externus is entirely wanting in the temporal bone. For this an opening through the maſtoid proceſs has been propoſed; but the operation has not been performed, at leaſt in this country.

246 Extraneous bodies impacted in the ear.

Children ſometimes puſh hard bodies into their ear, or different kinds of inſects occaſionally creep into it, ſo as to cauſe conſiderable uneaſineſs. Subſtances lying near the outer end of the paſſage may generally be extracted by the ſmall forceps repreſented in (fig. 60.); but round, hard bodies ſituated deeper in the paſſage are more readily removed by a crooked probe. When inſects are deep-ſeated in the ear, they ought firſt to be killed, by filling the paſſage with oil, or any other fluid which proves noxious to them, without hurting the tympanum. They may then be waſhed out by injecting warm water frequently by means of a ſyringe.

Wax is one of the moſt frequent cauſes of deafneſs, and it may be readily detected by looking into the ear in a clear ſunſhine.

247 Of ſuperabundance of wax in the ear.

Various methods have been propoſed for removing wax from the ear; but one, not inferior to any, is to throw in frequently, by means of a ſyringe (fig. 61.), warm milk and water, or water in which a little ſoap has been diſſolved. Aſſiſtance may likewiſe be given here, by uſing along with the injection a blunt probe or fine hair pencil, by which the bottom of the paſſage may be cleared out. After the wax is removed, the patient ought to guard againſt the effects of cold by introducing a little wool for ſome time into the meatus.

248 Deficiency of wax.

When deafneſs is owing to a deficiency of wax in the ear, a little oil of almonds, or even oils of a hotter nature, or ſoap, or galbanum &c. have been of ſervice.

249 A diſcharge of matter from the ear.

Purulent matter is now and then formed in the ears of adults, but oftener in thoſe of children. Sometimes it is produced by ulcers ſituated in the lining of the meatus, or upon the membrane of the tympanum. It ſeems to be merely a local affection, and does not, as many have ſuppoſed, originate from morbid humours of the ſyſtem. The remedies beſt calculated for removing it are ſuch as are of a moderately aſtringent nature, as a weak ſolution of ſaccharum ſaturni. A little of this may be dropped in two or three times a-day, but it is ſtill better to uſe a ſyringe. If the diſcharge has continued long, it may be proper, in addition to the other applications, to keep open a ſmall bliſter for ſome time in the neck, arm, or wherever it may be thought moſt convenient.

It ſometimes happens, particularly in old people, that, from expoſure to a ſtream of cold air, the tympanum becomes affected, and a noiſe is heard by the patient like the ruſhing of water. In other caſes the patient is incapable of accurately diſtinguiſhing the words of ſome perſons ſpeaking in a loud tone of voice; or, in mixed companies, he hears only a confuſion of ſounds. Complaints of this kind frequently originate from a relaxation of the ſoft parts of the tympanum; and though a complete cure is not very frequently performed, yet conſiderable advantage is ſometimes derived from the uſe of hot ſtimulating oils, and from keeping the part warm at the ſame time with a little wool. When deafneſs ariſes from affections of this nature, ſome aſſiſtance may be derived from collecting the ſound, ſo as to make a ſtronger impreſſion upon the internal ear. A variety of inſtruments have been invented for this purpoſe. Some uſe a convoluted tube as is repreſented in fig 62, (ſee TRUMPET); others a ſort of cup, fig. 63. which is concealed under the hair, and fixed to the head with ſtraps.

In ſcrophulous habits, ſuppurations ſometimes occur in the neighbourhood of the ear, and penetrate into the external paſſage, or into the tympanum itſelf; after which it is not unuſual for the ſmall bones of the ear to loſe their connecting membrane, and to be diſcharged along with the matter, and for caries to enſue in the tympanum; in conſequence of which a high degree of deafneſs is produced, which can never be removed. In ſuch a ſituation little elſe can be attempted than to preſerve the parts clean and free from ſmell, which is readily done by injecting a little warm milk and water morning and evening by means of a ſyringe. If this be neglected, the matter from the carious bones is apt to become offenſive; and it commonly continues till the diſeaſed parts are either diſſolved and diſcharged, or probably during the life of the patient.

250 Affections of the Euſtachian tube.

Beſides the affections which may ariſe in the meatus externus, and may be the cauſe of deafneſs, others may occur in or about the meatus internus or euſtachian tube, which may have in part the ſame effect, though by no means in the ſame degree. Inflammation and its conſequences may originate in the cavity of the tube, or ſwellings or ulcers in the throat may affect it ſo as to cauſe ſome degree of deafneſs. When this is the caſe, it is practicable to introduce a pipe, fig. 64. crooked at the extremity, through the mouth or noſe, and then to inject into the mouth of the euſtachian tube any mild fluid which may be thought fitteſt for the purpoſe, though no great dependence is to be placed upon the attempt.

251 Of perforating the lobes of the ears.

Formerly piercing the lobes of the ears was ſometimes recommended in complaints of the head, and was conſidered as a chirurgical operation; but it is now never practiſed, unleſs for the ſake of ornament. As the ſubſtances ſuſpended at the ears are ſometimes ſo heavy as to tear down the parts, the perforation ſhould be made as high on the lobes as can be done with propriety, and care ſhould be taken that the perforations be made exactly in the correſponding parts of the ears. Previous to the perforation the lobes may be marked with ink; then the patient being ſeated, the lobe of the ear ſhould be ſtretched upon a piece of cork placed beneath it, and perforated with an inſtrument, fig. 65. The cork is then to be withdrawn with the point of the inſtrument ſticking in it: A ſmall piece of lead, or ſilver, or gold-wire, is now to be inſerted into that part of the inſtrument which remains in the ear, and on being drawn into the perforation, the wire is to be left in it. By rubbing it with oil, and moving it daily, the paſſage will ſoon become callous, and fit for receiving the ornament intended for it.

Chap. XVIII. *Of the Wry Neck.*

252 Cauſes of wry neck.

Wry neck may be owing to different cauſes; as contraction of the ſkin in conſequence of burns, or other kinds of ſores; relaxation of the muſcles of one ſide of the neck, particularly the maſtoid, while thoſe of the other ſide continue to act with vigour; preternatural contraction of the muſcles of one ſide of the neck, the others having their uſual power; or, a bend in the vertebræ of the neck.

253 Treatment.

When the diſeaſe is owing to a contraction of the ſkin, this is to be divided through the whole of the contracted part, guarding againſt cutting the external jugular vein. When the contraction of the maſtoid muſcle is the cauſe of the diſeaſe, the muſcle ſhould be divided by gentle ſtrokes, ſo as to run no riſk of wounding the great veſſels ſituated under it. When an inciſion is made either with a view to divide the muſcle or the ſkin, the head is afterwards, by means of a machine (fig. 66.), to be kept in a proper poſture during the cure until new granulations form and fill up the empty ſpace. When the diſeaſe is merely owing to a curve of the bones of the neck, the ſame kind of machinery may be uſeful with that recommended for cure in the other parts of the ſpine. But ſometimes the diſeaſe ariſes from an affection of the bones of a more ſerious nature. Here the diſeaſe in the vertebræ commonly begins with a ſlight pain, which gradually becomes worſe, and the head is turned over to the ſound ſide. As the diſeaſe becomes worſe, a fulneſs can be obſerved very painful to the touch; and moving the head becomes ſo diſtreſſing as to be almoſt impracticable. The only method which has been found to be effectual in this caſe, is the inſertion of a pea-iſſue on each ſide of the tumor, and retaining it till the pain and ſtiffneſs are entirely removed.

Chap. XIX. *Of Bronchotomy and Oeſophagotomy.*

254 Bronchotomy.

The operation of bronchotomy is an inciſion made in the trachea, to make way for air into the lungs, when reſpiration is obſtructed to ſuch a degree that life is in danger. If the patient's breathing be already ſtopped, the operation ought to be done with the greateſt expedition; uſing any inſtrument which will moſt readily make an opening in the trachea, as the delay of a few moments will often put a period to the perſon's exiſtence. Experience has ſhewn, indeed, that in by much the greater number of caſes, by a total ſtoppage of reſpiration for only five or ſix minutes, life is irrecoverably deſtroyed.

In performing the operation, where, from the nature of the caſe, ſufficient time is allowed, the patient is to be laid on his back upon a table, and properly ſecured by aſſiſtants. A longitudinal inciſion is to be made, about an inch and an half long, through the ſkin and cellular ſubſtance; beginning at the under edge of the thyroid cartilage; the ſterno hyoid and thyroid muſcles are then to be ſeparated; the thyroid gland is to be avoided as much as poſſible, on account of its vaſcularity. As ſoon as the trachea is laid bare, the bleeding-veſſels, to prevent coughing, are to be ſecured; then, with a common lancet, a puncture is to be made as high as may ſeem practicable between two rings of the trachea, of ſuch a ſize as to admit the introduction of a double canula (fig. 65.), large enough to allow the patient to breathe freely, and of ſuch a length as neither to be in danger of ſlipping out, nor of irritating the back part of the treachea. Such a canula has long been recommended by Doctor Monro in his courſe of ſurgery. Previous to the introduction the canula may be put through ſeveral plies of linen compreſs; or theſe may be firſt ſlit half way down, and applied ſo that any of them may be removed and replaced at pleaſure. This double canula is to be fixed by a ſtrap round the neck; and when mucus obſtructs the paſſage of the inſtrument, the inner tube can be withdrawn, cleared, and readily replaced; while the patient is, during this time, breathing through the outer one; and by means of a ſcrew the tubes can be regulated according to the motions of the trachea. After the canula is fixed, it ought to be covered with a piece of muſlin or crape, to prevent the admiſſion of duſt, inſects, &c. As ſoon as the cauſes inducing ſuffocation are removed, the canula is to be withdrawn, and the ſkin immediately brought over the orifice, and retained there by a ſlip of adheſive plaſter.

255 Oeſophagotomy.

By œſophagotomy is underſtood the cutting open the œſophagus, to allow ſubſtances ſticking in it, and which cannot be extracted otherwiſe, to be removed. It is only to be done, however, in caſes of the moſt extreme danger, as it is attended with much hazard; and there are only two inſtances yet on record of its having been performed with ſucceſs, though there are ſeveral inſtances of wounds in the œſophagus being healed. The operation may be rendered neceſſary, where obſtructions of the œſophagus become ſo complete as to prevent the paſſage of nouriſhment into the ſtomach, or of air into the lungs. But it is evident, that when the obſtructing cauſe is in the under end of the œſophagus, any inciſion becomes uſeleſs.

In performing the operation, the patient is to be ſecured in the ſame manner as for bronchotomy, and an inciſion made through the ſkin and cellular ſubſtance as directly oppoſite as poſſible to the part obſtructed. If it be done with a view to remove an obſtruction, the muſcles over the trachea are to be pulled to one ſide, and the trachea to the other, by means of a blunt hook; by which the œſophagus will be brought into view. If the obſtructed part now come in ſight, the inciſion is to be made directly upon the obſtructing body, which is to be extracted by a pair of ſmall forceps; but if the obſtruction happen to be farther down than we can with ſafety have acceſs to the œſophagus, the inciſion is to be enlarged as much as poſſible, that the forceps may be able to reach and extract it. When the operation is performed, the wound will be difficult to

heal,

Sore Nipples.

heal, as the ſides of it will be frequently ſeparated by the action of deglutition. On this account as great a degree of abſtinence as poſſible is to be adviſed; and nothing but nouriſhing liquids, in ſmall quantities, are to be allowed. The patient ſhould be prevented from moving his neck; and the wound is to be healed as ſoon as poſſible by the ſame methods which are uſed with wounds in other parts of the body. On the other hand, if the operation has been done for the purpoſe of conveying nouriſhment into the ſtomach, when the patient was diſtreſſed by a tumor either in the œſophagus itſelf or in ſome of the neighbouring parts, it will be neceſſary to keep the wound open during the continuance of the tumor, or the life of the patient.

CHAP. XX. *Of Sore Nipples.*

WOMEN are more generally affected with ſore nipples in ſuckling their firſt child than at any period afterwards. This may, in ſome meaſure, be owing to the ſmallneſs of the nipples; but very often it ariſes from their being unaccuſtomed to the irritation of ſucking. In ſome caſes, the nipples are ſo flat, and ſo much ſunk in the breaſt, as to render it difficult for the child to lay hold of them. Here aſſiſtance can ſometimes be given, by the mother preſſing back the prominent part of the breaſt, ſo as to make the nipple project between two of her fingers. Should this be inſufficient, the nipple may be made to project by applying to it a ſtout child ſeveral months old: but when this cannot be done, breaſt-glaſſes, ſuch as fig. 68. may anſwer the ſame purpoſe. By applying theſe to the nipple, and ſucking out the air, the child will commonly be enabled to lay hold of it.

The nipples at this time are liable to excoriations, cracks, or chops; which, though not attended with a formibable appearance, are frequently more diſtreſſing than large ulcers. Mild, aſtringent, and drying applications are moſt to be depended upon in ſuch complaints; as port wine, brandy properly diluted, or lime-water; all of which ought to be applied warm. After bathing the parts with any of theſe, the nipple ſhould be covered with unguentum nutritum, or Goulard's cerate; the firſt of which is conſidered as beſt. Even a little ſoft pomatum frequently rubbed upon the part, and covered with a ſoft linen rag, is ſometimes found to give conſiderable relief. But the nipple ſhould be perfectly cleared of theſe applications before the child is laid to the breaſt; and this may be done with a little port wine, or equal parts of brandy and vinegar. If proper attention be paid to theſe remedies, they will commonly be found to have the deſired effect; but if the contrary ſhould happen, another remains to be mentioned, which, in different inſtances, has given great relief: it conſiſts in the application of a thin ſkin to the nipple, as the neck and part of the body of a ſwine's bladder with an aperture in it; which, being properly moiſtened and fixed to the breaſt, will completely protect it in the time of ſucking. As long as the nipples remain any way affected, ſmall cups of glaſs or tin are uſeful for retaining the dreſſings, defending the nipples from the friction of the clothes, and receiving any milk which may fall from the breaſt.

CHAP. XXI. *Of Paracenteſis of the Thorax.*

256 Fluids collected in the thorax.

WHEN either the action of the heart or of the lungs is impeded by fluids collected in the cavity of the pleura, a diſcharge of theſe fluids by a perforation is the only chance the patient has for relief. The fluids which collect in the pleura are, ſerum, blood, air, or pus. A collection of water or ſerum is frequently found in the thorax, combined with dropſy in other parts of the body; but the affection is often local, and it is then chiefly that advantage is to be derived from an operation. Beſides, in the two great cavities of the thorax, collections of water are frequently met with in the pericardium, and are ſaid to be ſometimes diſcovered between the layers of the anterior mediaſtinum. The diſeaſe is marked by the following ſymptoms: There is a ſenſe of weight or oppreſſion in the thorax, and difficulty of breathing; the patient has frequently a more uneaſy ſenſation in one ſide than in the other; has ſudden ſtartings during ſleep, with a ſenſe of ſuffocation; is troubled with a frequent dry cough; the pulſe is ſmall and irregular; the ſkin dry, and the urine ſcanty.

Paracenteſis of the Thorax.

257 Symptoms of fluids being collected.

With theſe ſymptoms there are commonly other marks of dropſy; and the patient ſometimes, upon any ſudden motion, is ſenſible of an undulation within the cheſt; and when the quantity of water is conſiderable, the undulation will even be heard by the byſtanders, if the body be ſmartly agitated. For this purpoſe, the patient's body ſhould be uncovered while under examination; and the ſurgeon ſhould place his hand upon the breaſt near the ſternum; then an aſſiſtant ought to raiſe the patient ſuddenly from an horizontal to an erect poſture, or to ſtand behind the patient and make ſudden jerks; when, if water be preſent, the undulation will be felt; but it is neceſſary to guard againſt being deceived by the noiſe ſometimes made by the contents of the ſtomach.

When the water is collected in one ſide only, if the diſeaſe be of long ſtanding, for the moſt part that ſide is more prominent than the other. If the water be in the pericardium, the ſymptoms are nearly the ſame as thoſe above enumerated, with this difference, that the pain is generally felt behind, and to the left ſide of the ſternum; and the ſtroke of the heart is as if buried in water, while an undulatory motion has been ſaid to be felt oppoſite to the anterior extremities of the third, fourth, and fifth ribs.

258 Internal remedies of little advantage.

In the treatment of this diſeaſe, little advantage can be derived from internal remedies. Squills, cream of tartar mercury, and digitalis, are upon ſome occaſions attended with advantage; but the only method from which we can expect any degree of ſucceſs is the removing of the water by an operation, which ſhould be performed as ſoon as there is reaſon to expect that danger may ariſe from delaying it longer. The operation is done in the ſame way as ſhall be afterwards deſcribed in the caſe of empyema.

259 Blood collected in the thorax.

Blood collected in the thorax is always extravaſated thro' ſome wound or rupture of the veſſels of the lungs or thorax. The breathing becomes oppreſſed, the motion of the heart and arteries feeble and irregular, and all theſe ſymptoms are more diſtreſſing than collections of other fluids. As it frequently happens, in caſes of this kind, that ſome of the veſſels of the lungs are injured, part of the blood is thrown up by coughing; which, when conſiderable, gives a temporary relief to the lungs and heart; and while this is the caſe, no operation is neceſſary; but whenever the action of theſe parts becomes much impeded by a great accumulation of blood, a perforation ought to be made to diſcharge it. When the extravaſated blood is too firmly coagulated to paſs off by a perforation, the wound ought to be made conſiderably larger; and if this be inſufficient, injections of warm water ought to be thrown in, and allowed to remain for ſome time, to promote the diſſolution of the maſs, which is afterwards to be evacuated. If the extravaſation has been occaſioned by a wound in the lower part of the thorax, a new perforation will be unneceſſary; an enlargement of the wound will be quite ſufficient. But if it be ſituated in the upper part of the cavity, a perforation in the middle and lateral part of the thorax ought to be made, that the blood may be freely diſcharged. In caſe of a rib being fractured, or a veſſel ruptured, the inciſion ought to be made as near as poſſible to the part affected, to allow the blood to eſcape, and looſe pieces of bones to be removed.

260 Air collected in the thorax.

The diſcharge of air into the cavity of the thorax produces ſymptoms little leſs alarming than thoſe proceeding from the effuſion of blood. In general they are, oppreſſion in breathing; a tightneſs of the breaſt, attended with pain; inability to breathe in the recumbent poſture; a fluſhing and ſwelling of the face; a feeble, and at laſt an irregular pulſe: The extremities become cold, and cold ſweats break out on the forehead. With theſe ſymptoms there is frequently a ſwelling over the external parts of the body, by air getting from the ruptured lungs into the common cellular ſubſtance; and all theſe complaints increaſing, the patient, if not quickly relieved, ſoon dies; ſometimes in a few hours, with marks of ſuffocation.

Air may be produced in the cavity of the thorax by wounds in the lungs, by mortification generating air in any of thoracic viſcera, by eroſion of ulcers, by laceration in conſequence of fracture in any of the bones of the thorax.

We diſtinguiſh this from other collections by the ſudden oppreſſion in breathing, by the fluſhing of the face, by no blood being thrown up, and by the emphyſematous ſwelling of the cheſt and other parts, which has a crackling noiſe upon being preſſed.

The treatment of this complaint conſiſts in making ſmall punctures in the affected part of the ſkin, ſo as to allow the air to eſcape from the cellular ſubſtance; and if the air ſhall have ſpread to diſtant parts of the body, it will eſcape moſt readily by ſuch openings. But if this give no relief to the oppreſſed breathing, paracenteſis ought to be performed. In former times, patients labouring under ſuch ſymptoms were almoſt conſtantly left to their fate. Within theſe few years, however, ſome caſes have occurred where the patients have been completely relieved by an operation being performed. This is done in the ſame way as in the evacuation of other fluids.

261 Empyema or pus collected in the thorax.

Purulent matter is more frequently collected in the thorax than any other fluid: it is much more frequently formed, however, than confined there. As the matter is uſually ſpit up as faſt as it is generated, in the diſſections of thoſe who have died of this ſpecies of conſumption, much extravaſated pus is rarely found in the cavity of the thorax, though a great portion of the lungs be deſtroyed. Caſes not unfrequently occur, however, which require the operation; and theſe may be diſtinguiſhed by the following ſymptoms: The patient at firſt generally complains of a fixed pain in ſome part of the thorax, attended with heat, quick pulſe, and other ſymptoms of inflammation; reſpiration becomes oppreſſed; he is unable to lie on the ſound ſide; or, if both ſides be affected, can only lie on his back; has a conſtant tickling cough, clammy ſweats, frequent rigors or ſhiverings. If theſe ſymptoms be attended with an enlargement of the affected ſide, or with a ſoft œdematous fulneſs there, and, along with theſe, if there be a ſenſible undulation of a fluid, it may be concluded that a collection of matter is formed. The matter is commonly firſt formed in the ſubſtance of the lungs, and is afterwards diſcharged into the cavity of the pleura, though in many inſtances large quantities of purulent matter have been found to originate from an inflamed ſtate of the pleura.

The operation ought to be performed as ſoon as there is evidence of the collection being the cauſe of the oppreſſed breathing, and that there are no ſigns of this being relieved by expectoration. The operation ought to be done upon the part where the collection is ſuppoſed to be ſituated; and this may be known by the ſeat of the previous pain, and perhaps by the matter being diſtinguiſhed between two of the ribs. If no matter flow, it is probably ſeated in the ſubſtance of the lungs; but even in this caſe, ſuch an opening may be uſeful, by taking off the ſupport and giving the abſceſs an opportunity of burſting.

262 Method of performing the operation of diſcharging fluids from the thorax.

If the undulation of the fluid be general, the operation is to be performed in the following manner: The patient is to be laid in an horizontal poſture, with the affected ſide inclining a little over a table. An inciſion is then to be made with a ſcalpel, through the ſkin and cellular ſubſtance, between the ſixth and ſeventh ribs, and half way between the ſpine and ſternum, from one to two inches in length, and in the direction of the ribs. The muſcles are then to be cut through, keeping as near as poſſible to the upper edge of the inferior rib to avoid wounding the intercoſtal veſſels and nerves. As there is no occaſion for the bottom of the wound being of the ſame length with the external inciſion, it may be gradually contracted, ſo as at laſt to be only about the half. The pleura being now expoſed, is to be divided by ſlight ſcratches, taking the aſſiſtance of a furrowed probe to prevent the lungs from being injured, in caſe they ſhall be found adhering to the ribs. If the contrary takes place, the fluid will ruſh out immediately upon a ſmall opening being made into the cavity of the thorax; but if an adheſion appear, and if it be ſlight, which may be known by the introduction of a blunt probe, as much of it may probably be ſeparated as to allow the fluid to eſcape. In caſe it be conſiderable, the inciſion is either to be continued a little nearer to the ſternum, or an attempt made in ſome other part. After the fluid is obſerved to flow, it will be proper to introduce a ſilver canula, fig. 69. at the opening; by which means it will run more readily off, or can be more eaſily ſtopped in caſe the patient become faint. If the quantity of fluid be not conſiderable, it may generally be drawn off at once; but if it be great, partial evacuations ought to be made at different intervals, as circumſtances may direct.

The canula therefore ſhould be ſo formed, that by means of a ſtrap put round the body of the patient, it can be readily ſecured. Its mouth is to be ſhut by means of a cork. A pledget of emollient ointment is to be laid over the wound; and the whole being fixed by a napkin and ſcapulary bandage, the patient ſhould be laid to reſt. The remainder may be drawn off, probably in a day or two, or as ſoon as it is ſuppoſed the patient can bear it. After the fluid is carried off, the canula is to be withdrawn and the wound healed; or in caſe the operator be afraid of bad effects being produced upon the lungs by irritation from the canula, though of this there will be little danger, as the lungs will generally be out of its reach, the ſkin may be ſo drawn back before the firſt inciſion is made as afterwards to ſerve the purpoſe of a valve. And for ſome days after the operation, the inciſion in the integuments may be brought oppoſite to that in the pleura, to allow the matter to run off, or to produce a radical cure by exciting a certain degree of inflammation over the lungs and inſide of the thorax.

After the matter is evacuated, the wound ought to be kept open a conſiderable time for the purpoſe of diſcharging the matter as faſt as it is collected. If the wound be apt to heal up too ſoon, which will be known by the ſymptoms of oppreſſion being renewed, it will be proper to keep the paſſage open by tents, or to introduce a bougie or ſilver canula a few hours occaſionally, till the ſource of the matter be dried up; which, however, ſeldom happens for a conſiderable time, and frequently never. By attending to this circumſtance, the patient may enjoy good health; whereas, by the neglect of it, a repetition of the firſt operation would ſoon be neceſſary.

CHAP. XXII. *Of Paracenteſis of the Abdomen, or Tapping.*

THIS operation is an opening made into the abdomen, in order to empty any quantity of extravaſated water collected in that ſpecies of dropſy called the *aſcites*.

263 Symptoms of a fluid in the abdomen. A fluid in the cavity of the abdomen is diſcovered by the ſwelling which it produces; by a ſenſe of tightneſs in the part affected; by laborious and difficult breathing, eſpecially when in the horizontal poſture; but particularly by a ſenſe of fluctuation being communicated to the fingers placed on one ſide of the abdomen, while the ſwelling is forcibly ſtruck on the oppoſite ſide. There is beſides much thirſt, a dry ſkin, ſcantineſs of urine, &c. Whatever may be the influence of diuretics and other evacuations in the cure of general dropſical affections, they are rarely ſerviceable in local diſeaſes of this kind, and even the operation of tapping ſeldom cures the diſtemper; but it commonly gives the patient eaſe for the preſent time, and is attended with very little pain.

264 Manner of performing the operation of paracenteſis. Upon the ſuppoſition that nothing forbids the extraction of the water, the manner of operating is this: Having placed the patient in an horizontal ſituation, as beſt ſuited to prevent fainting, and to allow the water to run freely off, the part to be perforated ought to be marked with ink; and the moſt approved part for the operation ſeems to be at a point lying at nearly an equal diſtance between the umbilicus and the centre of the ſpine of the os ilium, this being moſt out of the way of any of the viſcera, and ſufficiently depending to allow the water to eſcape; and as the ſpleen is leſs frequently enlarged than the liver, the left ſide is generally preferred. Various means have been uſed for applying an equal preſſure in this operation. Some apply preſſure by the hands of aſſiſtants; others uſe a broad piece of flannel, or other kinds of cloth, ſlit a certain way from each end; then the ends are drawn by aſſiſtants till ſufficient preſſure is made. Broad belts are uſed by ſome practitioners; but one of the beſt contrivances for this purpoſe is the bandage invented by the late Dr Monro, (fig. 70.) Till very lately, a puncture was firſt made with a lancet, then a trocar of a round form (fig. 71.), and with a triangular point, was conſtantly uſed: but the entrance of this inſtrument being always attended with difficulty and pain, a flat trocar is now very frequently employed; and that invented by Mr Andree (fig. 72.) ſeems the beſt which has yet appeared. The bandage being now applied and drawn a little tight, the part to be punctured is to project a little over the edge of the bed. The operator fixes the head of the trocar in the palm, while the fore finger directs the point of the inſtrument. He is then to puſh it forwards till he is ſatisfied, by the want of reſiſtance, that the end of the canula has reached the cavity of the abdomen. The perforator is now to be withdrawn, and the water allowed to flow as long as any of it can be taken off, the bandage being from time to time pulled to favour the diſcharge. But if the patient become faint, a ſtop for a few minutes ſhould be put to the diſcharge every now and then, by placing the point of the finger upon the mouth of the canula. If any of the viſcera happen to ſtop the flow of the water before the ſwelling is much diminiſhed, a blunt probe is to be introduced, but bent at the end, leſt it ſlip into the cavity of the abdomen. When the ſerum is thick and gelatinous, it may ſometimes be neceſſary to introduce a larger trocar than the one firſt employed. When the water does not flow, becauſe it is collected into ciſts, the canula is to be withdrawn, and the wound covered with a pledget of ſimple ointment. The operation may then be renewed immediately, or on the following day, upon the oppoſite ſide of the abdomen, or in the moſt depending part of the tumor, in whatever part of the abdomen it may be placed.

Plate CCCCXC

During the operation it is neceſſary to keep up a preſſure on the abdomen, otherwiſe the patient will be apt to fall into faintings from the weight on the great veſſels of the abdomen being taken off, and the ſinking of the diaphragm ſucceeding, in conſequence of which more blood flows into the inferior veſſels than uſual, the ſuperior ones are left too empty, and thus the regular progreſs of the circulation is interrupted. To obviate this, the preſſure muſt not only be made during the operation, but be afterwards continued. As to the dreſſing, it has been already mentioned, that the wound may be covered with a pledget of ſimple ointment; but between the ſkin and the roller ſome recommend a piece of flannel dipped in brandy or ſpirit of wine to be applied. The bandaging in this manner may even have ſome effect in preventing a return of the diſorder. When the water again collects, the operation ſhould be repeated whenever the ſwelling has acquired a conſiderable ſize: and though this operation does not always effect an abſolute cure, yet it ſometimes preſerves life a great many years, and even a comfortable one, eſpecially if the waters have been long collected.

After the operation, practitioners adviſe the abdomen to be frequently rubbed with aſtringent ſpirituous applications. This cannot be done for the firſt two days after the operation, as it would then be improper to remove the bandages; but after that time, they may be removed daily, for about a quarter of an hour; and camphorated ſpirit of wine, or other applications which may have a ſimilar effect, may be applied with ſtrong friction over the abdomen, the body being kept, during this period, in the horizontal ſituation, and the bandage applied immediately after the friction is finiſhed.

265 Of Tympanites. Sometimes, inſtead of water, we find air contained in the abdomen; and the inflation is of two kinds: Firſt, that in which the air is contained in the inteſtines; in which caſe the patient has frequent exploſions of wind, with a ſwelling of the belly frequently unequal. Secondly, where the air is collected in the cavity of the abdomen; and here the ſwelling is more equal, without any conſiderable emiſſion of air. In both varieties of the diſeaſe the ſwelling is more tenſe than where water is contained, and the belly ſounds when ſtruck, and affords to the touch and preſſure nearly the ſame ſenſation as is received from a bladder filled with air. Of theſe two diſorders the former is by much the moſt common. Many extenſive practitioners have never met with an inſtance of true abdominal tympanites. A few well authenticated caſes, however, have occurred, where the air was collected between the containing and contained parts of the abdomen. In ſome of them the air was found to have eſcaped by a ſmall hole in the inteſtines, from which it has been ſuppoſed that the other caſes were of the ſame nature. When the ſymptoms become urgent, there is as much neceſſity for diſcharging the air as for drawing off the water in caſes of dropſy. The preſſure and perforation are to be made in the ſame manner as directed for aſcites, with this difference only, that a trocar of the very ſmalleſt ſize ought to be uſed, for by it the air can be as eaſily diſcharged, and the wound will heal more readily than when a large opening is made. After the air has been extracted, the treatment ought to be nearly the ſame as that recommended in caſes of aſcites.

CHAP. XXIII. *Of Herniæ.*

SECT. I. *Of Herniæ in general.*

266 Definition of a hernia.

THE name of *hernia* might with propriety be applied to every ſwelling occaſioned by the diſlodgment of parts from thoſe boundaries within which, in a ſtate of health, they are contained; but the general acceptation of the term implies a tumor produced by the protruſion of ſome part or parts from the cavity of the abdomen.

267 Situation and contents of herniæ.

The parts in which herniæ uſually appear are the groin, ſcrotum, labia pudendi, the upper and fore part of the thigh, the umbilicus, and different points between the interſtices of the abdominal muſcles. If the ſituation of ſuch tumors be various, the viſcera which produce them are ſtill more ſo; inſtances having occurred of the ſtomach, uterus, liver, ſpleen, and bladder, being found to form their contents. But a part of the inteſtinal canal, or a portion of the omentum, are from experience known to be the moſt frequent cauſe of their formation.

268 Their different names.

From theſe circumſtances of ſituation and contents, all the different appellations are derived by which herniæ are diſtinguiſhed. Thus they are termed *inguinal, ſcrotal, femoral, umbilical,* and *ventral;* from their appearing in the groin, ſcrotum, thigh, navel, or belly. When the tumor is confined to the groin, the hernia is ſaid to be incomplete, and is termed *bubonocele;* but when the ſwelling reaches down to the bottom of the ſcrotum, the rupture is then ſuppoſed to be complete, and the diſeaſe obtains the name of *ſcrotal rupture,* or *oſchiocele.*

Of theſe diſorders the inguinal hernia is by much the moſt frequent; next to that is the femoral. The umbilical is ſeldom obſerved in men, or even in women who have not born children.

269 Cauſes which produce them.

The cauſes which tend to the production of hernia in its more uſual form are theſe:

I. The containing parts of the abdomen we know to be elaſtic and compreſſible; whatever, therefore, tends to produce a diminution of capacity in the cavity of the abdomen, muſt occaſion a proportional degree of riſk of ſome of the contained parts being puſhed from their natural ſituations. Violent coughing, crying, laughter, or great bodily exertion, are attended with more or leſs contraction of the abdominal muſcles, and particularly of the diaphragm; and as the contraction of theſe muſcles muſt always diminiſh the abdominal cavity, theſe cauſes therefore are frequently found to be productive of hernia.

II. Falls, in conſequence of the derangement they produce in the abdominal viſcera, from the ſudden and violent ſhock with which they are often attended, are not unfrequently the immediate cauſes of hernia.

III. Perſons of a preternatural laxity of frame are very liable to herniæ. The containing parts of the abdomen, from the want of a ſufficient tone and firmneſs, are unable in ſuch people to reſiſt on all occaſions the weight of the different viſcera; and they are therefore more particularly expoſed to diſorders of this kind on the ſlighteſt application of any of the cauſes already mentioned.

IV. Sprains are apt to induce a laxity of the part injured; and have therefore a ſimilar influence in inducing herniæ with general laxity.

V. It has been obſerved that the people of thoſe countries where oil is much uſed as an article of diet, are particularly liable to herniæ.

In whatever parts the parietes of the abdomen happen to be weakeſt, theſe various cauſes will moſt readily operate in producing herniæ; and accordingly we find, that deſcents of the bowels uſually occur only in ſuch parts.

270 Of the hernial ſac.

In whatever ſituation a protruſion of any portion of the inteſtines occurs, except in the caſe of the hernia congenita, as all the viſcera are contained within the peritonæum, a portion of that membrane, it is evident, muſt be carried down together with the parts protruded; and in every ſuch inſtance, it is this portion of the peritonæum which goes down along with the gut, that is termed the *hernial ſac.* The ſize of this ſac is various in different ſubjects, and in different ſtages of the ſame diſorder. On the firſt appearance of the diſeaſe, it is commonly of no very conſiderable ſize, as ſuch ſwellings ſeldom acquire any great bulk at once: but by repeated deſcents of the bowels, it comes to be puſhed lower and lower, till in ſome inſtances its bulk becomes very conſiderable indeed; and when in this advanced period of the diſorder the ſac happens to be laid open, it is found to contain either large quantities of omentum or inteſtine, and frequently large portions of each. As the peritonæum has this property in common with many other parts of the body, of thickening according to the degree of any gradual extenſion applied to it, ſo in many inſtances the thickening and firmneſs of the hernial ſac are often really aſtoniſhing.

271 Cauſe of the bad ſymptoms which appear in hernia.

All the bad ſymptoms which are found to occur in herniæ, proceed, as may be readily ſuppoſed, either from obſtruction to the paſſage of the fæces when the inteſtinal canal forms the tumor, or from a ſtoppage of circulation occaſioned by ſtricture on the prolapſed parts: ſo that the attending ſymptoms, it is evident, will be always more or leſs hazardous according to the nature of the parts ſo protruded.

Thus, when omentum alone forms the ſubſtance of hernial ſwellings, as that organ does not appear to be ſo immediately neceſſary for life as many of the other viſcera, ſuch tumors accordingly are not ſo frequently productive of bad conſequences, at leaſt they are ſeldom in any degree ſo hazardous as when a part of the alimentary canal is either protruded by itſelf or along with omentum.

Although this, however, is in general the caſe, yet it does ſometimes happen, that even an omental rupture is productive of no ſmall degree of danger. When a ſtricture ſo complete upon it occurs as to occaſion a ſtoppage of circulation in the protruded part, mortification with all its bad conſequences muſt be the certain event: And beſides, the connection between the omentum, ſtomach, and other viſcera, is ſuch, that a ſudden deſcent of any conſiderable portion of the former ſometimes brings on vomiting, hickup, and other troubleſome ſymptoms: And laſtly, although a rupture containing omentum only might not of itſelf produce any thing bad; yet as the paſſage through which the omentum has ſlipped muſt of neceſſity continue open ſo long as that viſcus remains protruded, and as that circumſtance alone muſt, ſo long as it continues, render it more eaſy for a portion of gut likewiſe to get down, this of itſelf is a ſufficient reaſon for intitling even this ſpecies of hernia to the ſerious attention of practitioners.

But whatever the contents of ſuch ſwellings may be, as their remaining in ſome inſtances for a conſiderable length of time without being productive of any bad ſymptoms, muſt proceed entirely from the circulation continuing to go freely on, notwithſtanding the derangement of parts; ſo, whenever a ſtricture occurs up the protruded viſcera, ſufficient to produce either a ſtoppage of the circulation, or of the fæcal contents of the alimentary canal, when a portion of gut forms the diſeaſe, the following in general are the ſymptoms which accrue.

272 Enumeration of theſe ſymptoms.

An elaſtic colourleſs ſwelling is obſerved at the part affected; a ſlight pain is felt not only in the ſwelling itſelf, but, if part of the alimentary canal is down, an univerſal uneaſineſs is perceived over the whole abdomen; and this pain is always rendered worſe by coughing, ſneezing, ar any violent exertion. The patient complains of nauſea; frequent retching; can get no diſcharge by ſtool; becomes hot and reſtleſs; and the pulſe is commonly found quick and hard. When the ſwelling is formed entirely by a portion of gut, if no ſæces be contained in it, it has a ſmooth, equal ſurface; and is eaſily compreſſible, but inſtantly returns to its former ſize on the preſſure being removed: but in gut-ruptures of long ſtanding, where hard fæces have collected in the protruded bowels, conſiderable inequalities are detected. When again the tumor is compoſed both of gut and omentum, its appearance is always unequal, it feels ſoft and ſomewhat like dough, and of courſe is not ſo elaſtic as when part of the inteſtinal tube only is down; for although, like the other, it is compreſſible, it does not ſo readily regain its former dimenſions on the preſſure being taken off.

473
Never happen in omental hernia.

It will be readily ſuppoſed, that the ſymptoms we have deſcribed never can happen from the preſence of omentum *only:* For although ſtricture produced on a portion of omentum, even when no part of the inteſtinal tube is down, does now and then occaſion a good deal of diſtreſs, ſuch as pain in the part, ſickneſs, vomiting, and twitching pains through the whole belly; yet no obſtruction of the gut ever occurs from this, and of courſe none of the ſymptoms ever prove ſo alarming as when any part of gut is affected. If theſe ſymptoms we have deſcribed as being produced by a ſtrangulated gut, are not now obviated by a removal of the ſtricture which produced them, the nauſea and retching terminate in frequent vomitings, firſt of a bilious, and afterwards of a more fetid matter; the belly becomes tenſe; the pain turns more violent; a diſtreſſing convulſive hickup comes on; the fever, which before was not apparently of much conſequence, now becomes very formidable; and a total want of reſt, with a very diſagreeable ſtate of anxiety, continues through the whole courſe of the complaint.—Theſe ſymptoms having gone on with violence for ſome time, the patient is at laſt commonly relieved in a ſudden from all manner of pain; and then he flatters himſelf that all danger is over. But inſtead of that, the pulſe, from having been hard and frequent, becomes languid and interrupted; cold ſweat breaks out over the whole body, but eſpecially on the extremities; the eyes acquire a kind of languor; the tenſeneſs of the abdomen ſubſides, and the ſwelling of the part affected diſappears; the teguments covering the parts, which before were either of a natural appearance, or had ſomewhat of a reddiſh inflamed caſt, now acquire a livid hue, and a windy crepitous feel is diſtinguiſhable all over the courſe of the ſwelling. If the protruded parts have not of themſelves gone entirely up, their return is now in general eaſily effected by a ſmall degree of preſſure, and the patient then diſcharges freely by ſtool; but the cold ſweats increaſing, the hickup turns more violent, and death itſelf is at laſt uſhered in by its uſual forerunners, ſubſultus tendinum, and other convulſive twitchings.

274
Symptoms of mortification of the inteſtine.

Theſe are the ordinary ſymptoms of what is termed a *ſtrangulated* or *incarcerated gut-hernia:* that is, when the parts protruded become ſo affected by ſtricture as to produce pain; and do not either return to their natural ſituations on the patient's getting into a horizontal poſture, or cannot even be immediately replaced by the hands of a practitioner.

275
Cure.

In whatever ſituation a ſtrangulated hernia occurs, the only rational method of cure, it is evident, muſt conſiſt in the removal of that ſtricture which prevents the return of the protruded parts. It is that ſtricture which ought to be conſidered as the cauſe of all the miſchief; and unleſs it be removed, nothing effectual can be done for the relief of the patient.

Various methods have been attempted by practitioners for the removal of ſtricture in theſe diſorders; all of which may be comprehended under two general heads.

I. Such as effect a reduction of the protruded parts, without the interpoſition of inciſion or any chirurgical operation properly ſo called; and,

II. A diviſion of the parts producing the ſtricture, ſo as to admit of a replacement of the deranged viſcera, conſtituting what is termed the *operation for the hernia.*

The remedies to be employed for accompliſhing the firſt of theſe are, a proper poſture of the patient, with the manual aſſiſtance of a practitioner; blood-letting, ſtimulating clyſters, opiates, the warm bath, and proper applications to the tumor itſelf.—If theſe fail, there is then no other means of cure left but the operation of dividing the integuments, and replacing the viſcera.

276
Method of reducing the inteſtine.

As ſoon as the aſſiſtance of a practitioner is deſired for the removal of ſymptoms in caſes of hernia, the firſt circumſtance requiring his attention is the placing of his patient in ſuch a poſture as will moſt probably favour the return of the protruded parts. Placing the patient's feet over the ſhoulders of another perſon, while his body is allowed to hang downwards, and cauſing him to be a good deal jolted about, has on ſome occaſions anſwered when other means have failed.

The ſurgeon ſhould at the ſame time endeavour to aſſiſt the return of the bowels, by means of gentle preſſure with his hands and fingers. In the inguinal or ſcrotal hernia, this preſſure ſhould be made obliquely upwards and outwards to correſpond with the opening in the external oblique muſcle; in the femoral hernia it ought to be made directly upwards; in the umbilical and ventral hernia directly backwards.—The ſwelling ſhould be graſped with one hand at the bottom, while with the fingers of the other hand an attempt is made to puſh gently the contents of the tumor into their place, always obſerving that the parts laſt protruded be firſt reduced. This operation is by authors termed the *taxis.*

When the means now mentioned have failed, no remedy affords more relief than blood-letting. The quantity to be drawn ought chiefly to be determined by the ſtrength of the patient. There is ſcarcely any diſeaſe, however, where ſuch large quantities of blood can with propriety be taken from weak people. Blooding till the patient is in a ſtate of deliquium animi, is frequently known to produce a more effectual relaxation of the muſcles than can be done by any other means. On that account it is ſometimes adviſed in caſes of hernia, and the practice is now and then attended with advantage.

As an obſtinate coſtiveneſs is commonly one of the moſt alarming ſymptoms of hernia, it has been a common practice to exhibit a variety of ſtimulating purgatives both by the mouth and anus; but they are very ſeldom of much ſervice, and in that caſe almoſt univerſally do injury, by increaſing not only the ſickneſs at ſtomach, but the tenſion and pain of the tumor. When they are to be employed, they ought to be thrown up by the anus. For this purpoſe aloes and other ſtimulating ſubſtances, but particularly tobacco-ſmoke, are employed; and although this laſt remedy, which is to be thrown in by double bellows, &c. does not always act as a purgative, it may be uſefully employed as an anodyne. Where an evacuation by ſtool is wanted, it may in general be readily procured by the injection of warm water, in which a little Caſtile ſoap is diſſolved, in the proportion of a drachm or a drachm and a half of the latter to a pound of the former. Warm bathing is another remedy greatly extolled, either by general immerſion or local application, Herniæ in general.

by means of warm water put into ox-bladders covered with flannel, and laid acroſs the abdomen.

To diminiſh the ſize of the tumor, remedies of an oppoſite quality from theſe have been uſed; and though by ſome this practice has been conſidered as hazardous, yet by others, particularly by the late Dr Monro and Mr Benjamin Bell, more advantage has been found from cooling applications than from thoſe of a different nature. Snow, ice, or cloths dipped in a recent ſolution of ſal ammoniac in water and vinegar, or cold ſaturnine applications, or cold water and vinegar, have been employed with advantage. If, notwithſtanding theſe remedies, the diſeaſe becomes worſe, and no probability remains of ſucceſs, the diviſion of the parts producing the ſtricture can alone ſave the life of the patient.

277 When the operation for reducing the inteſtine ſhould be performed.

To determine the exact time at which to proceed to an operation, has been conſidered as one of the niceſt points in ſurgery. In general, when every attempt has failed, and no repetition of the former remedies is likely to ſucceed, the ſurgeon ought certainly to proceed to the operation. A few hours, even when aſſiſtance has been early applied, is perhaps all the time which ought ever to be conſumed in trials of this nature. But however neceſſary this operation may be when a patient's life is in danger, as it is always attended with ſome degree of hazard, it ought never to be practiſed where ſymptoms of ſtrangulation do not exiſt.

In this kind of hernia called *chronic*, the circulation of the part forming the hernia, as well as the periſtaltic motion of ſuch parts of the alimentary canal as have been protruded, go freely and regularly on. There are many inſtances of large herniæ falling down even to the bottom of the ſcrotum, and continuing there for many years, without producing any interruption to the uſual diſcharge by ſtool. All that can be done here is, to prevent any accumulation of fæces in the inteſtine, by preſcribing a proper diet, and the occaſional uſe of gentle laxatives; and obviating any inconvenience which might ariſe from the weight of the tumor, by the application of a proper truſs or ſuſpenſary bandage; to warn them of the riſk to which they are conſtantly liable, and to caution them againſt violent exerciſe, particularly leaping, and every ſudden exertion. The truſs ought to be fitted exactly to the part for which it is intended, for without the utmoſt nicety in this reſpect, it muſt always do more harm than good; for the ſole purpoſe of a bandage, in caſes of hernia, is to prevent effectually the falling down of ſuch parts as have been newly replaced. If therefore the pad or bolſter of the bandage does not bear properly againſt the opening upon which it is placed, a portion of gut may ſlip out, and be materially injured by the preſſure of the pad. Fig. 74. repreſents a truſs for an inguinal or femoral hernia of one ſide, fig. 75. a truſs for the ſame diſeaſe in both ſides, and fig. 76. a truſs for an umbilical hernia.

278 Method of performing it.

We ſhall now proceed to deſcribe the circumſtances to be attended to in performing the operation for hernia in general. A table of convenient ſize and height being placed in a proper light, the patient muſt be ſo laid on it as to relax the diſeaſed parts as much as poſſible, and then ſecured by proper aſſiſtance To leſſen the contents of the abdomen as much as poſſible, the bladder ought to be emptied previous to the operation. An inciſion is to be made with a common round edged ſcalpel through the ſkin and part of the cellular ſubſtance, long enough to allow the ſtricture to be fully expoſed. The reſt of the cellular ſubſtance is then to be divided with the greateſt attention. That part of the muſcle forming the ſtricture or ring muſt next be laid diſtinctly in view. A ſmall portion of the protruding ſac muſt alſo be expoſed; after which the directory (fig. 77.) is to be paſſed between the ring and the ſac. A ſtraight probe-pointed ſcalpel is now to be introduced into the groove of the directory, and by it the ring is to be dilated till the point of the finger can be introduced. The finger is here conſidered as the ſafeſt director; for it being inſinuated into the aperture in the tendon immediately above the protruded parts, the point of the knife is eaſily introduced upon it; and by keeping the end of the finger always a little before the knife, the opening may be enlarged to any neceſſary extent without riſk of wounding any of the contiguous parts.

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By the eaſe with which the finger is introduced, the operator will be enabled to judge when the ring is ſufficiently dilated; and if the ſtrangulation was entirely in the ring, it will now be evident that every obſtacle to the reduction muſt be removed, and of conſequence that the prolapſed parts may be returned with little difficulty. If the patient be young, or if the diſeaſe has continued a conſiderable time, ſuch a degree of inflammation frequently enſues in the neck of the ſac as to produce thickening and ſtraitneſs; ſo that, after the ſac and its contents have been entirely freed from the ſtricture of the ring, the inteſtines cannot be reduced. We judge this to be the caſe when, after the ſtricture of the ring has been removed, the parts prolapſed do not expand into their natural ſize, and farther, when they make reſiſtance when we attempt to return them. In this caſe, the neck of the ſac muſt be opened with the utmoſt caution, to avoid wounding the parts within it.

If the herniary ſac, under the ſtraitened place of its neck, be thin and tranſparent, and there is little or no reaſon to ſuſpect an adheſion of the bowels to the ſac, the beſt method, as Dr Monro, in his publication on the Burſæ Mucoſæ, obſerves, will be to make a ſmall hole in the ſac below the ſtricture, and then to introduce a ſmall furrowed probe, and to cut cautiouſly upon it. But if the ſac be thick and dark coloured, and there is likewiſe a ſuſpicion that the bowels may adhere to it, the eaſieſt and ſafeſt manner will be to make the hole in the peritoneum above the ſtricture; then to introduce a common probe, bent near its point into a ſemicircle, with its point directed downwards through the ſtricture into the ſac; and upon the point of it to make, with great caution, another ſmall hole; after which we may either cut upon the probe, or introduce a furrowed probe, and divide the neck of the ſac.

After this, the bowels are to be returned by preſſure upon the ſac, without opening it farther; and the ſides of the wound in the ſkin are to be brought together, and kept ſo by means of ſlips of adheſive plaſter, though ſtitches made at the diſtance of a finger-breadth from each other will exclude the air, and prevent the return of the bowels more effectually. Over theſe are to be laid ſeveral folds of charpee, and the whole is to be ſecured by a bandage adapted to the nature of the part.

279 Treatment afterwards.

The patient, upon being carried to bed, ſhould be ſo placed as to have the part upon which the operation was performed higher than the reſt of his body, or at leaſt as high as the ſituation of the part operated upon will allow, in order to prevent a return of the diſeaſe. After the operation, opiates are particularly uſeful, and ought to be repeated as circumſtances may require. It is likewiſe neceſſary that the patient be kept cool. In plethoric habits, blood-letting is proper, together with a rigid attention to low diet. A frequent uſe of clyſters and gentle laxatives, to keep the belly moderately open, ought not to be neglected. When the conſtitution has been previouſly much reduced, inſtead of blood-letting and a low diet, a nouriſhing regimen is neceſſary. The dreſſings ought not to be removed till the third or fourth day after the operation, when the ſides

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ſides of the wound will be found almoſt adhering together; and if attention be paid to the ſubſequent treatment, the ſore will be generally healed in two or three weeks. As ſoon as the wound is firmly cicatrized, a truſs ought to be properly fitted to the part, and ſhould never, in any future period of life, be laid aſide.

280 Method of performing the operation when adheſions or mortifications have taken place.

When the hernia is of long ſtanding, and when there is reaſon to think adheſions have taken place between the ſac and bowels, or that mortification has already begun, or that ſome filaments run acroſs the ſac and prevent the reduction, or that there is water in the ſac, or that the gut is in danger of being entangled from a part of the omentum being down, a different method of operating becomes neceſſary.

The patient is to be placed as already directed. The operator is to graſp the tumor with the one hand, ſo as to make the ſkin tenſe on the fore part of it, while with the ſcalpel in the other he divides the ſkin from one end of the tumor to the other. The cellular ſubſtance is by gentle ſtrokes to be divided, till not only the ring, but the whole length of the ſac, is laid bare. An opening is now, in the moſt cautious manner, to be made into the ſac by ſlight ſcratches, to avoid hurting any of its contents.

In making this perforation, which is conſidered as the niceſt part of the operation, conſiderable aſſiſtance is obtained from the uſe of the ſmall directory, upon the point of which the fibres of the ſac are to be ſucceſſively raiſed and divided till an opening is made. The opening is to be enlarged till it admit the fore-finger of the left hand which ſerves as a directory for conducting the ſtraight probe-pointed ſcalpel with which the ſac is to be divided through its whole length.

The ſac being laid fully open, the parts contained in it ought to be examined with the niceſt attention, to diſcover whether they are all ſound or not; and if, upon an attentive inſpection, it is found that they are not evidently in a gangrenous ſtate, even although they ſeem conſiderably inflamed, they ſhould be immediately returned into the abdomen. When adheſions take place between different parts of the protruded gut, the greateſt caution is neceſſary in ſeparating them. When one part of a gut adhears ſo firmly to another as not to be ſeparated but with difficulty, it is much better to return the whole, even in that ſtate, into the abdomen, than to run the riſk of hurting the inteſtine materially by uſing much force. When adheſions occur between the hernial ſac and the gut, or between the gut and omentum, if the filaments producing the connection cannot be otherwiſe removed, as there is no great hazard in wounding the omentum, and ſtill leſs in hurting the ſac, a very ſmall portion of theſe may be diſſected, and returned with the gut into the abdomen. When the bowels cannot be reduced with eaſe, the ring is to be dilated by the blunt-pointed ſcalpel in the manner already directed. After returning the contents of the ſac into the cavity of the abdomen, it has been propoſed by ſome authors to paſs a ligature round the neck of the ſac, with a view of procuring a reunion of its ſides, ſo as to prevent a future deſcent of the bowels; and various other methods, even actual and potential cauteries, have been propoſed; but as none of them yet attempted have been found ſufficiently to anſwer the purpoſe, the only thing that can be recommended is a well made truſs.

281 Treatment when the bowels are in a ſtate of gangrene.

When the bowels are actually in a ſtate of gangrene, as the returning of ſuch mortified parts might be attended with the very worſt conſequences, a great degree of caution is neceſſary. When the omentum is found in a mortified ſtate, as the exciſion of a portion of this ſubſtance is not attended with much riſk, it is the common practice to cut away the diſeaſed parts, and to obviate any inconvenience which might enſue from the hemorrhagy. We are adviſed to make a ligature on the ſound parts previous to the removal of thoſe which are mortified; whilſt the ends of the ligature being left hanging out of the wound, the ſurgeon has it in his power to remove them when circumſtances appear to render it proper. Theſe ligatures on the omentum, however, are frequently productive of bad conſequences. No hemorrhagy of any importance ever occurs from a diviſion of this membrane, even in a ſound umortified ſtate; ſuch parts as have become gangrenous may therefore be freely cut off, and the remaining ſound parts be afterwards, without the intervention of ligatures, ſafely introduced into the abdomen. If a veſſel of any ſize in the omentum has been divided, a ligature may be paſſed above the veſſel itſelf, and the ends left hanging out of the wound; the threads may be afterwards pulled away at pleaſure. When a rupture has been of long duration, it ſometimes happens, that from the preſſure made by the truſs, and other circumſtances, portions of the omentum are collected together into hard lumps. If theſe be ſmall, they may be returned into the abdomen without producing any inconvenience; but if from their bulk and hardneſs they are likely to do miſchief, they ought to be cut off. When part of the omentum is to be removed, it ought to be previouſly expanded and divided with ſciſſars, which will be more convenient than any other inſtrument. When again a ſmall portion of gut is found mortified, we are to endeavour, by means of a needle-ligature, to connect the ſound part of the gut immediately above the mortified ſpot to the wound in the abdomen already made. By this means, when the mortified part ſeparates, or perhaps what is better, when it has been immediately cut out, the fæces are diſcharged by the wound; and there are different inſtances where, after ſuch a diſcharge has continued for ſome time, the wound has entirely healed.

Herniæ in general.

But when the mortified portion of gut is of conſiderable extent, and includes the whole circumference of the inteſtine, all that can be done is to remove it, and to draw, by means of a ligature, the upper end of the gut towards the under, and afterwards connect them to the inner edges of the wound. This at leaſt affords a chance of the ends of the gut being brought to reunite; and if unfortunately that event ſhould not take place, a paſſage of the fæces will ſtill be ſecured. All ſuch mortified parts as are to be removed ought to be cut off, and the remaining ſound inteſtine retained, before the opening in the ring can be dilated with ſafety, leſt the gangrenous portion ſlip in together with the ſound. The parts forming a hernia being all completely replaced, when the ſac in which they were contained is found thick, hard, and much enlarged, as in ſuch a ſtate no good ſuppuration can take place, and as its preſervation cannot be in any degree uſeful, ſuch parts of it as can be cut away with propriety ought to be removed. All the lateral and fore parts of the ſac may be cut off with ſafety; but as it is commonly firmly connected with the ſpermatic veſſels behind, this part of it ought not to be touched.

Sect. II. *Of Bubonocele, or Inguinal and Scrotal Hernia.*

282 Symptoms of bubonocele.

This ſpecies of hernia is formed by a protruſion of ſome of the abdominal bowels through the rings of the external oblique muſcles. It is known by the general ſymptoms of hernia already enumerated, and by a ſoft and ſomewhat elaſtic ſwelling, beginning in the groin, and deſcending by degrees into the ſcrotum in men, and into the labia pudendi in women. When the hernia contains omentum only, the ſwelling is both more ſoft, compreſſible, and more unequal than when the gut alone is down; the ſcrotum becomes more oblong than in the inteſtinal hernia; and when the quantity of omentum is large it is alſo much more weighty than a gut rupture of the ſame ſize; but frequently the tu-

Bubonocele or Inguinal and Scrotal Hernia.

mor is compoſed of both gut and omentum, and then the diſtinguiſhing ſymptoms of each can never be ſo clearly marked.

283 How diſtinguiſhed from other diſeaſes.

Bubonocele may be confounded with certain other diſeaſes; but may be diſtinguiſhed by the following marks which are preſent in theſe diſorders, while the ſymptoms of hernia are abſent: From venereal bubo, by the preſence of that incompreſſible hardneſs with which all ſuch ſwellings are at firſt attended, and by the fluidity of matter which in the ſuppurative ſtate is always obſervable: From hernia humeralis, or ſwelling of the teſtes, by the abſence of the hardened and enlarged ſtate of the teſtis and epidydimus, and likewiſe of the pain, the tumor of the teſticle being remarkably heavy in porportion to the bulk, the ſpermatic proceſs being commonly free from the ſwelling. In the hernia humeralis alſo the inteſtines are unobſtructed, and the general ſymptoms of hernia are wanting. From the hydrocele of the tunica vaginalis teſtis, by the tumor generally feeling more ſmooth to the touch than in hernia, by the ſwelling here beginning in the under part of the ſcrotum and aſcending, by the ſpermatic cord being always free and diſtinct, and by a fluctuation being evident. From hydrocele of the ſpermatic cord, ſometimes with much difficulty, and therefore it requires here particular attention. In every caſe of tumor in the teſtes, where the moſt perfect certainty is not obtained, and when it is neceſſary to have recourſe to an operation, the ſurgeon ought to proceed as in a caſe of real hernia.

284 Treatment.

The treatment of bubonocele is the ſame with that already adviſed in the treatment of hernia in general, only making allowance for the ſituation of the diſeaſe. In attempting the reduction by means of the hand, the preſſure ſhould be obliquely upwards and outwards, correſponding with the ring of the abdominal muſcle. In performing the operation, the patient ſhould be laid on a table, with his head and body almoſt horizontal, whilſt at the ſame time his buttocks are ſomewhat elevated by pillows placed beneath them. The legs hanging over the edge of the table ought to be ſeparated, ſo as to admit the operator between them; and ſhould in that ſituation be firmly ſecured by an aſſiſtant on each ſide, who ſhould take care to keep the thighs ſo far raiſed as to relax all the abdominal muſcles. The parts being previouſly ſhaved, an inciſion muſt be made with a common round-edged ſcalpel through the ſkin and part of the cellular ſubſtance, beginning at leaſt an inch above the ſuperior end of the tumor, and continuing it down to between two and three inches below the ring.

Although in by much the greateſt proportion of hernial ſwellings the ſpermatic veſſels lie behind the protruded parts, yet on ſome occaſions they have been found on the anterior part of the tumor; ſo that in order to avoid the riſk of wounding them, as ſoon as the ſkin is divided, the remainder of the operation ought to be done in the moſt cautious manner, care being taken to avoid every large blood-veſſel which makes its appearance. The ring muſt now be laid diſtinctly in view; a ſmall portion of the protruding ſac muſt alſo be expoſed; after which the directory is to be introduced between the ring and the ſac, placing the point of the inſtrument obliquely upwards and outwards. A blunt pointed biſtoury is now to be introduced into the groove of the directory, and by it the ring is to be dilated till the point of the finger can be introduced. The directory is now to be laid aſide, and the finger uſed in place of it through the reſt of the operation. After the operation is finiſhed, the dreſſings are to be applied, and the whole ſecured by a T bandage, or ſuſpenſory bag, properly ſtuffed with ſoft lint.

The patient, on being carried to bed, ſhould have a pillow under the buttocks, to elevate them a little above the reſt of the body, and ſhould be treated in the manner which has been already directed. As ſoon as the wound is firmly cicatrized, a truſs ought to be properly fitted and uſed through the reſt of the perſon's life. Females are liable to this ſpecies of rupture as well as men; and as the opening in the external oblique muſcles is exceedingly ſimilar in both ſexes, the treatment of this ſpecies of hernia in females is very ſimilar to what is found to anſwer in men. When clyſters, blood-letting, and the other remedies formerly enumerated, fail, the ſame operation of enlarging the opening in the tendon of the oblique muſcle is here equally proper as in the other ſex.

As modeſt women are apt to conceal diſorders of this kind, they may frequently happen when the ſurgeon receives no information about them. Whenever, therefore, ſuch ſymptoms of colic occur as give reaſon to ſuſpect the exiſtence of hernia, a particular examination ought always to be made, in order, if poſſible, to detect the cauſe of the miſchief, from the removal of which alone a cure can be expected.

Hernia Congenita

Sect. III. *Of Hernia Congenita*

The teſtes in the fœtus are, till near the time of delivery, lodged in the cavity of the abdomen When they deſcend into the ſcrotum, they puſh before them a portion of the peritonæum, which afterwards forms the vaginal coat. The paſſages by which they deſcend are ſoon ſhut up; but ſometimes the contrary happens, and then a portion of ſome of the abdominal viſcera paſſing down, forms that ſpecies of hernia to which new-born infants are liable, termed by Haller the *hernia congenita*. The teſticle and protruded inteſtine being here in contact with one another, the tunica vaginalis teſtis forms the hernial ſac.

285 How hernia congenita is diſtinguiſhed from bubonocele.

It has been affirmed by ſome of the lateſt writers, that hernia congenita cannot be diſtinguiſhed from that contained in the common herniary ſac; and that though there was a diſtinction, it could be of no material uſe in practice. But Dr Monro obſerves, that a hernia congenita may be diſtinguiſhed in an adult by an evident external mark; which is, that the bowels puſh down between the ſac and the forepart and ſides of the teſticle, ſo as often in a great meaſure to conceal it; whereas, in the common hernia, every part of the teſticle can be felt diſtinctly: And that it is of material uſe to make the diſtinction; becauſe in whatever manner we operate in hernia congenita, unleſs we take the utmoſt care to exclude the air, there will be a more violent inflammation and greater diſtreſs than in common caſes, becauſe the teſticle will partake of the inflammation.

286 Treatment.

In the treatment of ruptures of the congenital kind, little difference occurs from the management of the common ſcrotal hernia; only a truſs ought never to be applied to infants, unleſs the teſticle can be felt in the ſcrotum, after the contents of the hernia have been reduced; as it would entirely prevent the deſcent of the teſticle, which yet remains in the abdomen. If any operation has been performed, the teſticle ſhould, immediately after the bowels are reduced, be covered with the vaginal coat, and at each dreſſing care ſhould be taken that the air be excluded. In every other reſpect the treatment of congenital hernia is the ſame with that of hernia in general.

Sect. IV. *Of Femoral or Crural Hernia.*

287 Situation of the protruded bowels in femoral hernia.

The ſeat of this ſpecies of hernia is upon the upper and fore part of the thigh; the protruded bowels paſſing out at the ſame opening through which the large blood-veſſels of the thigh are tranſmitted from the abdomen, and of conſequence under that part of the tendon at the under end of the abdomen known by the name of *Poupart's* or *Fallopius's ligament*. Sometimes the bowels which protrude are ſituated imme-

Femoral or Crural Hernia.

immediately over the femoral veſſels, ſometimes on the outſide of theſe, but more frequently they lie upon their inner ſide. The diſeaſe is more frequent in women than in men, on account of the width of the female pelvis, and of conſequence the length and laxity of the ligament. The femoral hernia is more in danger of being confounded with inguinal hernia than with any other; the tumor, however, is deeper, and the ring of the abdominal muſcles, which lies entirely above the tumor in femoral hernia, completely ſurrounds the parts in that of the inguinal kind.

288 Treatment.

In the treatment of femoral hernia, when ſymptoms of ſtrangulation occur, we muſt uſe all the remedies commonly practiſed for hernia in general; only that here, in attempting to reduce the parts by the hand, the preſſure ſhould be made directly upwards. An inciſion of ſufficient length is to be made through the integuments, ſo as to allow that part of the tendon which forms the ſtricture to be laid fairly in view; and after dividing the integuments, we are cautiouſly to cut the faſcia lata of the thigh, and ſeparate any glands which may come in the way till the ſtricture and part of the ſac diſtinctly appear. The ſtricture is then to be divided, by cutting fibre after fibre ſucceſſively. The ſpermatic veſſels in the male, or round ligament in the uterus in the female, may be avoided by cutting in a direction towards the umbilicus, carefully dividing the tendon tranſverſely. Some authors, from a ſenſe of the danger attending this part of the operation, have recommended merely to dilate the paſſage, inſtead of dividing the tendon; but in ſuch a ſituation, to attempt a farther dilatation without the aſſiſtance of the knife, would probably be ſeldom attended with any advantage. After the parts are reduced, the wound is to be dreſſed as directed in the treatment of hernia in general: a piece of thin leather ſpread with ſome adheſive plaſter retains the dreſſings better, and with much more eaſe, than any other bandage.

Sect. V. *Of other Species of Hernia.*

289 Exomphalos, or umbilical hernia

In umbilical hernia the parts protruded paſs out at the umbilicus, and are commonly the inteſtines, or omentum, or both; ſometimes part of the ſtomach, the liver, and even the ſpleen, have been found in the ſac. Here, as in other ruptures, the peritonæum forms the ſac, and in recent caſes it is generally very evident; but by the ſize of its contents, or a long continuance of the diſorder, it ſometimes becomes ſo connected with the ſurrounding parts, that by many its exiſtence has been doubted, and ſometimes the ſwelling has increaſed to ſuch a degree as to burſt even the ſkin itſelf. The diſeaſe occurs moſt frequently in infancy, ſoon after birth. In the adult ſtate corpulent people are more ſubject to it than thoſe of a contrary habit; and pregnant women are particularly ſubject to it, on account of the ſize of the uterus. The diagnoſis in this diſeaſe is readily made, as the diſorder can ſcarcely be confounded with any other. If the diſeaſe be attended to in due time, a bandage properly fitted will generally effect a cure; and in ſuch ſwellings as occur in pregnancy, delivery will commonly remove the diſorder; but even in caſes of pregnant women, a bandage early applied and properly uſed will give conſiderable relief, till a cure can be obtained by delivery. In this diſeaſe the omentum is more frequently puſhed out than any other viſcus; hence umbilical herniæ in general are not productive of ſuch bad ſymptoms as uſually occur in the other kinds of rupture. When, however, the inteſtines protrude, the uſual ſymptoms of a ſtrangulated hernia are apt to be induced; and when the means uſually employed for returning the gut into the abdomen do not ſucceed, a cure it is evident muſt depend entirely on a thorough removal of the ſtricture. In performing this operation, an inciſion through the integuments is the firſt ſtep to be taken, ſo as to expoſe the ſtricture of the tendon and the neck of the ſac. The ſtricture is to be removed in the manner already deſcribed; and as the tendon completely ſurrounds the neck of the ſac, the ſtricture may be cut wherever it can be moſt readily dilated. A radical cure ſimilar to that for the other ſpecies has been propoſed, but with as little probability of ſucceſs.

Other Species of Hernia.

290 Ventral hernia.

Ventral rupture is a protruſion of ſome of the bowels through the interſtices of the abdominal muſcles, and is moſt frequently obſerved in ſome of the parts moſt contiguous to the linea alba. The treatment of this ſpecies of diſeaſe is exactly the ſame with that of exomphalos.

291 Cyſtic hernia, or rupture of the urinary bladder.

Hernia of the bladder of urine, though leſs frequent than that of the omentum or inteſtines, is not very uncommon. The ſituation in which it occurs is in the groin, through the abdominal ring, in the fore part of the thigh, under Poupart's ligament, ſo as to form inguinal or crural hernia. Inſtances have likewiſe occurred of the bladder being puſhed into the perinæum. Sometimes it occurs by itſelf, without any complication; at other times it is accompanied with inteſtines and omentum, both in inguinal and femoral herniæ: when complicated with bubonocele, the protruded part of the bladder is ſituated between the inteſtine and ſpermatic cord.

292 Symptoms.

The uſual ſymptoms are a tumor, attended with fluctuation either in the groin, in the fore part of the thigh, or perinæum, which generally ſubſides when the patient voids urine. When the ſwelling is large, before water can be made with freedom, it is commonly neceſſary to have recourſe to preſſure, at the ſame time that the tumor, when in the groin or thigh, is as much elevated as poſſible; but when the ſwelling is ſmall, and eſpecially when no ſtricture is as yet produced, the patient generally makes water with great eaſe, and without any aſſiſtance from external preſſure. When the diſeaſe occurs without any complication, it is commonly owing to a ſuppreſſion of urine. In the diagnoſis care ought to be taken not to miſtake it for a hydrocele. In recent caſes, the part protruding may in general be eaſily reduced, eſpecially if we attend to the ſuppreſſion of urine, which probably gave riſe to the diſeaſe. A proper truſs ought afterwards to be worn for a conſiderable time. When the diſeaſe has been of long ſtanding, adheſion takes place between the bladder and cellular ſubſtance of the ſcrotum. In this caſe, therefore, as long as no ſymptoms occur to render the operation neceſſary, a ſuſpenſory bandage, ſo fitted as effectually to ſupport the prolapſed parts, is the only probable means of relief.

293 Hernia ginalis.

Sometimes the bladder, owing to a ſuppreſſion of urine, at other times part of the inteſtines, have been found to protrude through the vagina. In the former caſe a fluctuation of water is perceptible to the touch.

The reduction is made by laying the patient on her back with her loins ſomewhat raiſed, and preſſing with the forefinger from the vagina. Deſcents may in future be generally prevented, by evacuating the urine often, and by the uſe of a peſſary introduced into the vagina. Nearly the ſame means are employed in reducing the inteſtine when it is found to protrude.

Chap. XXIV. *Of Hydrocele.*

Every tumor formed by a collection of water might with propriety be named *hydrocele*, but the chirurgical acceptation of the term implies a watery ſwelling ſituated in the ſcrotum or ſpermatic cord. Hydrocele is either anaſarcous or encyſted. In the former, the ſerum is chiefly diffuſed in the cellular ſubſtance: In the latter, the water is collected in a diſtinct bag. The ſcrotum with its contents are liable to both varieties of the diſeaſe; ſo is the ſpermatic cord with its coverings.

Sect. I. *Anaſarcous Hydrocele of the Scrotum.*

294 Symptoms of this diſeaſe.

As ſoon as water has collected in any conſiderable quantity in the ſcrotum, a ſoft, inelaſtic, colourleſs tumor is obſerved over the whole of it; impreſſions are eaſily received and retained for ſome time; the ſkin at firſt preſerves its natural appearance, and the rugæ of the ſcrotum are not much altered; but as the ſwelling advances, they gradually diſappear, and are at laſt totally obliterated. The ſwelling, from being at firſt ſoft, and of a conſiſtence ſimilar to dough, by degrees turns more firm, and the ſkin at laſt acquires an unnatural white ſhining appearance. The tumor at length becomes large; and though originally confined to the ſcrotum, it at laſt ſpreads up the groin. The penis likewiſe becomes affected, and often ſo ſwelled and diſtorted as to excite much inconvenience and diſtreſs; and although the ſcrotum is compoſed of parts which readily admit of dilatation, the tumor ſometimes becomes ſo enormous that it burſts from one end to the other.

295 Treatment.

In the ſurgical treatment of this diſeaſe, punctures made with the point of a lancet are moſt adviſeable, as large ſcarifications, in anaſarcous habits, are ſometimes apt to produce inflammation and mortification; while ſimple punctures readily heal, and can be renewed with very little pain as frequently as may be neceſſary: and beſides, punctures are equally uſeful with the inciſions; for as the cells of the ſcrotum communicate freely, if the punctures be made fairly through the ſkin, the water drains off very readily, though not ſo ſoon as by ſcarification. Previous to the operation, beſmearing the part with ſome tough ointment of an innocent nature, and afterwards keeping it as dry as poſſible by a frequent renewal of dry ſoft linen cloths, in order to imbibe the moiſture, is here a neceſſary piece of attention. The want of this ſeems to be the cauſe of much of the miſchief which frequently enſues from operations of this kind. When ſcarifications or punctures go wrong by beginning to inflame and turn painful, &c. a cold ſolution of ſaccharum ſaturni, applied upon ſoft linen, proves moſt effectual in putting a ſtop to the farther progreſs of the inflammation, and affords moſt immediate relief to the patient in the preſent diſtreſs. Lime water, employed in the ſame manner, proves alſo a very uſeful application. When, however, the diſorder proceeds to gain ground by a real mortification coming on, we ſhould immediately have recourſe to bark and other medicines uſually employed in ſuch affections.

296 Sometimes owing to a local cauſe.

Although the anaſarcous hydrocele, for the moſt part, depends upon a general dropſical tendency, ſome inſtances occur of a local cauſe producing a mere local dropſy of the ſcrotum. Thus, it has been known to happen from ſwellings in the groin and in the abdomen obſtructing the paſſage of the lymphatics. When this is the caſe, if tumors producing ſuch obſtructions can be extirpated, no other means will afford ſuch effectual relief; but when they are ſo deeply ſeated as to render any attempt for removing them improper, the practice we have already pointed out of making punctures in the moſt depending part of the tumor muſt be employed with a view to palliate ſuch ſymptoms as occur. It ſometimes happens in ſuppreſſion of urine, whether ariſing from ſtrictures in the urethra or from ſtones impacted in it, that the urethra burſts, and the urine in this manner getting acceſs to the cellular texture of the ſcrotum, an anaſarcous ſwelling riſes immediately over the whole of it; nor does it commonly diminiſh till the cauſe by which it is produced is removed.

In order to prevent the formation of ſinuſes, which in ſuch circumſtances will otherwiſe be apt to occur, an inciſion ſhould be made into the tumor, and carried to ſuch a depth as is ſufficient for reaching the wound in the urethra. In this manner a free vent will not only be given to the urine already diffuſed, but the farther collection of it may probably be prevented. If a ſtone impacted in the urethra be found to be the cauſe of effuſion, it ſhould be cut out; and if the obſtruction be produced by ſtrictures in the urethra, they muſt be removed by a proper uſe of bougies. The cauſe being thus removed, if the habit of body of the patient is good, and untainted with any venereal or other general affection, by dreſſing the ſore properly with ſoft eaſy applications, the opening into the urethra will probably heal, and a complete cure will in this manner be obtained. But when theſe ailments are complicated with any general affection, particularly with old venereal complaints, it frequently happens that neither mercury nor any other medicine has much influence in removing them.

Sect. II. *Hydrocele of the Tunica Vaginalis Teſtis.*

In the healthy ſtate of the body, a ſmall quantity of aqueous fluid is exhaled for lubricating the ſurface of the teſticle, the ſuperfluous part of which is abſorbed by veſſels appointed for that purpoſe. When the ſecretion of this fluid is either morbidly increaſed, or its abſorption diminiſhed, a preternatural collection of water is formed in the cavity of the vaginal coat, and hydrocele of the vaginal coat produced.

297 Symptoms of this diſeaſe.

The ſymptoms are, a fulneſs at firſt obſerved about the inferior parts of the teſticle, and moſt remarkable when the patient is erect, becoming gradually more tenſe as the diſeaſe advances; the tumor by degrees changing from the globular to the pyramidical form; no degree of preſſure making the ſwelling diſappear at any period of the diſeaſe. In the early part of the diſeaſe therefore, if it be not combined with hernia, or with a hydrocele of the cord, the ſpermatic proceſs may be diſtinctly felt, becauſe the ſwelling does not extend beyond the ſcrotum. In its more advanced ſtate, it cannot be diſtinguiſhed: the weight of the tumor now drags the ſkin of the neighbouring parts ſo much as to cauſe the penis almoſt to diſappear; and in this ſtate of the diſeaſe the teſticle cannot be felt without much difficulty. On a minute examination, a hardneſs is always to be felt along that part of the ſcrotum where the teſticle is ſituated; and at this point preſſure excites ſome uneaſineſs. Fluctuation of a fluid may in general be diſtinguiſhed through the whole courſe of the diſeaſe. In late ſtages, however, the appearance of a fluid is not very evident.

The tranſparency of the tumor has been generally ſuppoſed to be the principal criterion of this ſpecies of the diſorder; but this muſt depend upon the nature of the contents, or thickneſs of the ſac; ſo that, though the tranſparency of the tumor is a certain ſign of the exiſtence of water, its opacity cannot upon any account be conſidered as an indication of its abſence. Through the whole courſe of the diſeaſe the tumor is not attended with pain, but ſome uneaſineſs is commonly felt in the back by the weight of the ſwelling of the ſpermatic cord. This is more particularly the caſe when a ſuſpenſory bandage is not uſed.

298 Cure.

In the radical cure of hydrocele, in whatever way it is attempted, ſome degree of fever and inflammation will take place. Under the circumſtances mentioned in the prognoſis, the operation, if properly performed, is generally attended with the moſt complete ſucceſs. But if the patient be very old, infirm, and diſeaſed, an operation may be attended with ſuch a degree of inflammation, and conſequent ſuppuration, as to be in danger of deſtroying a conſtitution already greatly impaired, and therefore ought not to be performed.

Various methods have been propoſed for the cure of hydrocele, all of which may be reduced to two general heads: Such as have in view only a temporary relief, and which is therefore termed the palliative cure; and ſuch as are meant to effect a radical cure. When the tumor has become ſo large as to be inconvenient from its ſize, an evacuation of the water by ſurgical means becomes neceſſary. In this caſe, if the patient either refuſes to ſubmit to the operation for a radical cure, or if his ſtate of health render that operation improper, the palliative treatment, or a mere evacuation of the water by puncture, is the only means which can be employed.

299 Method of operating for the palliative cure.

A lancet-pointed trocar was many years ago recommended for drawing off the water in this manner by the preſent Dr Monro; and ſince that time it has in an improved ſtate (fig. 77.), been recommended by Mr Andree; another (fig. 78.) has been propoſed by Mr Bell. With any of theſe an opening may be made into the tunica vaginalis with ſafety.

The operator with one hand ſhould graſp the tumor behind, to preſs the contained fluid to the anterior and under part of it. If a round trocar is to be uſed, a puncture with a lancet ſhould be made where the trocar is to enter; but where a flat trocar is to be employed, the aſſiſtance of the lancet is unneceſſary.

As ſoon as the inſtrument has pierced the vaginal coat, the ſtilette ſhould be withdrawn, and the canula left in the ciſt. The water will now run off; and if the tumor be not uncommonly large, it may be all drawn off at once; but as the ſudden diſcharge of it, by taking off the ſupport, might be in danger of rupturing ſome of the veſſels, it ſhould be diſcharged by ſlow degrees. When the whole is evacuated, a piece of adheſive plaſter ſhould be immediately applied to the orifice; and a compreſs of ſoft linen being laid over the ſcrotum, the whole ſhould be firmly ſupported with a ſuſpenſory bag (fig. 79.) or a T bandage. The patient in this ſtate being laid in bed, all kind of uneaſineſs is in a few minutes commonly gone, and he is able to follow his ordinary buſineſs without interruption.

300 For the radical cure.

The intention of every means now in uſe for the radical cure of this ſpecies of the diſeaſe, is to induce ſuch a degree of inflammation on the parts in which it is ſeated as may obliterate entirely the cavity of the tunica vaginalis, by making it adhere to the ſurface of the teſticle. The means at preſent generally employed for effecting a cure are, exciſion of the tunica vaginalis; the application of cauſtic; the uſe of a ſeton; a ſimple inciſion of the ſac; and the injecting of acrid liquors into the tunica vaginalis, after drawing off the fluid which it contained.

301 By exciſion of the tunica vaginalis.

The method of cure, by the removal of the vaginal coat, is, firſt to lay open the vaginal coat, and then to cut it away by different ſnips of a pair of ſciſſars. The ſac being removed, the parts are to be dreſſed and treated in the ſame manner as in the operation where ſimple inciſion is uſed.

302 By cauſtic.

The cure by cauſtic is attempted in the following manner: The ſcrotum being ſhaved, a piece of common paſte cauſtic, properly ſecured with adheſive plaſter, is applied, of about a finger's breadth, the whole length of the tumor; and if, on removing the cauſtic, it has not penetrated into the vaginal coat, an opening is made in it with a ſcalpel, ſo as to evacuate the contents, lay bare the teſticle, and admit of proper dreſſings. But Mr Elſe, one of the lateſt writers in favour of the method of cure by cauſtic, ſays, that there is no neceſſity for ſuch an extenſive application of cauſtic as many have recommended; that an eſchar of the ſize of a ſhilling is ſufficient; that this may be always fully obtained by the application of cauſtic paſte of the ſize of a ſixpence, which is to be laid on the anterior and under part of the ſcrotum, and to be properly ſecured by plaſter, in order to prevent it from ſpreading. The cauſtic commonly produces all its effects in five or ſix hours, and may then be removed. At this time digeſtives, or an emollient poultice, muſt be applied over the ſcrotum, and the whole ſuſpended with a bandage. Inflammation, Mr Elſe obſerves, is ſoon induced over the whole tunica vaginalis; and the febrile ſymptoms which ſucceed, he adviſes to be kept moderate by bloodletting, injections, emollient poultices, and a low regimen. In a few days the eſchar of the ſcrotum ſeparates, and comes away; and in a gradual manner, in the courſe of four, five, or ſix weeks, the whole tunica vaginalis comes off, when the wound for the moſt part ſoon heals, and a complete cure is obtained.

303 By a ſeton.

Where it is intended to treat hydrocele by means of a ſeton, it may be done in the following manner: An opening is made with a ſcalpel, or the ſharp-pointed biſtoury, in the ſuperior part of the tumor, large enough to admit with eaſe a thick cord of common white ſewing ſilk. A director, with an eye at one end, in which the cord is inſerted, is introduced at this opening; and its farther extremity being carried down to the moſt depending part of the tumor, an opening is there made, of about half an inch in length, by cutting upon the director with the biſtoury; the director being now drawn till a ſufficient quantity of ſilk is left hanging out below, the operation is in this manner finiſhed.

Another very ſimple method of introducing a ſeton is by means of a ſilver canula and perforator.

304 By inciſion.

In the operation for a radical cure by inciſion, the patient being laid upon a table of convenient height, and properly ſecured by aſſiſtants, with the ſcrotum lying nearly on the edge of the table, the operator with one hand ſhould graſp the tumor behind, ſo as to keep it firm and make it ſomewhat tenſe anteriorly: With a common round edged ſcalpel in the other hand, he ſhould now divide the external integuments by one continued inciſion from the upper to the under end of the tumor. An opening is next to be made in the vaginal coat with a large lancet, or a ſharp pointed biſtoury (fig. 80.), at the upper end of the firſt inciſion. This opening ſhould be of ſuch a ſize as freely to receive the finger of the operator, which is to conduct a blunt pointed biſtoury, ſo as to divide the ſac down to its bottom, which is conſidered as being of advantage, by preventing partial adheſions and the riſk of a return of the diſeaſe.

The inciſion being completed, the teſticle is now brought fully into view; and if the tunica vaginalis be ſound, the dreſſing may be finiſhed immediately. But if the ſac be diſeaſed, it is to be removed, which may be readily accompliſhed by a ſcalpel or biſtoury.

When the hydrocele, as ſometimes happens, affects both ſides at the ſame time, if, when the operation is done on one ſide, an opening be made into the vaginal coat of the oppoſite ſide, at the upper part, through the ſeptum ſcroti, and the inciſion carried down to the bottom of the tumor, the ciſt can be equally well laid open, the water as completely evacuated, and a return of the diſeaſe as much prevented, as when the operation is done in the uſual manner, and at different times.

In whichever way the inciſion is made, if the teſticle be ſound, the wound ought to be quickly dreſſed; for it is found, that on this much of the ſucceſs of the operation depends. For if the vaginal coat be merely applied to the teſticle, or united by ſutures, as ſome have adviſed, partial adheſions are apt to take place, before a degree of inflammation is produced over the whole ſufficient for making a

Hydrocele of the Tunica Vaginalis Teſtis.

complete cure. In this manner cavities are left, which either fill with pus during the cure, and require to be laid open, or they afterwards give riſe to collections of water, and thereby occaſion a return of the diſeaſe. The practice of ſtuffing the cavity of the ſore with dreſſings is alſo a frequent cauſe of miſchief, by exciting too great a degree of inflammation in the part. But when the dreſſings are properly managed, ſymptoms of violence almoſt never occur. The lateſt authors adviſe, that in dreſſing the parts after the operation, two pieces of lint or ſoft old linen are to be dipped in oil, or in a liniment of wax and oil, and then, by the help of a probe, are to be inſerted into the bottom of the ſac on each ſide of the teſticle, leaving a ſufficient quantity of the pledgets hanging out of the wound, ſo as to admit of being eaſily withdrawn at the firſt or ſecond dreſſing. The edges of the wound are next to be dreſſed with pledgets of cerate, and the ends of the oiled pledgets turned over on each ſide. Several pieces of ſoft lint are then to be laid over the wound, and theſe ſhould be more or leſs numerous in proportion to the heat of the ſeaſon. A compreſs of linen is now to be laid over the whole, and the dreſſings ſupported by a T bandage or ſuſpenſory bag properly fitted. The patient is then to be carried to bed; an anodyne ſhould be given, eſpecially if there be much pain; and he ought to be adviſed to lie as much as poſſible upon his back for a few days after the operation.

In the third or fourth day after the operation, all the dreſſings, except thoſe between the teſticle and tunica vaginalis, are to be removed; and if this cannot be done readily, as the parts are otherwiſe apt to become uneaſy, a ſponge dipped in warm water ſhould be applied. On ſome occaſions, at the firſt dreſſing, and always at the ſecond or third, the pledgets inſerted between the tunica vaginalis come away; and whenever this happens, they ſhould be renewed. It is alſo proper to renew them daily for the firſt fourteen or fifteen days after the operation; not however of the ſame depth as the firſt, for during the latter part of the cure they need only to be inſerted as far as to prevent the divided edges of the tunica vaginalis from adhering to the teſticle, before the adheſive proceſs has taken place in the parts more deeply ſeated. Particular attention however is neceſſary to this part of the treatment; for when the diſeaſe returns, it has been found to be chiefly owing to the edges of the vaginal coat being allowed to adhere to the teſticle, before adheſion had taken place between the deeper parts.

A complete adheſion of the two coats of the teſticle, the tunica vaginalis, and tunica albuginea, takes place moſt frequently about the third week after the operation. Previous to this time, inflammation continuing gradually to increaſe, the tumor becomes larger till it acquire ſomewhat of the ſize of a ſwelled teſticle from gonorrhœa; but after this period it gradually ſubſides, and the ſore produced by the inciſion, and now reduced to a line, heals in ſome time between the fourth and eighth week, according to the habit of body, age of the patient, and other circumſtances.

305 Comparative advantages of each of theſe methods.

Having thus given an account of the methods uſually employed in the cure of hydrocele, we ſhall now make a few obſervations on the comparative advantages of the three laſt. From the teſtimony of many authors of credit, it is evident, that any of theſe methods, in moſt inſtances, prove effectual; but every practitioner being apt to be prejudiced in favour of a particular method, he generally continues to follow that mode and no other; and finding it commonly ſucceed, he by degrees perſuades himſelf, that other methods of cure with which he has not had ſuch opportunities of becoming acquainted, are liable to objections, which thoſe who have practiſed them do not find to be the caſe. The reſult of Mr B. Bell's obſervation upon this ſubject is, that although all the three modes of operating, by cauſtic, the ſeton, and ſimple inciſion, are perhaps equally capable of producing a radical cure; yet, that of the three, the latter, viz. the mode by the ſimple inciſion, is liable to feweſt objections, and effects a cure, both with leaſt trouble to the operator, and leaſt riſk to the patient: and of the other two, the treatment by cauſtic appears to be the beſt. He has ſeen all the three produce troubleſome ſymptoms, ſuch as, pain and tenſion of the abdomen, inflammation, and fever; but heſitates not to ſay, that the ſeton is more frequently productive of theſe effects than any of the other methods.

306 Radical cure by injection.

Beſides the methods already mentioned, another has been lately revived, viz. the injecting of irritating liquors into the vaginal coat of the teſticle. This method is particularly deſcribed by a Monſieur Lambert of the laſt century, and may be of much older date for any thing which is known to the contrary. From ſome cauſe or other it ſeems to have been entirely laid aſide till about the middle of the preſent century, when it was practiſed by Mr Monro (afterwards a phyſician-general in the Weſt Indies), under the ſanction of the late Dr Monro, and favourably received and followed by ſome of the firſt ſurgeons of Edinburgh. But in general, though the cure appeared complete, the diſeaſe returned.

The preference is uſually given to wine, and commonly that is ſomewhat diluted; but where no pain is excited by the injection, the liquor ſhould be diſcharged, and a ſtronger one uſed. For where no pain takes place, a cure is not to be expected.

The following is the moſt approved method of performing the operation: The operator ſhould be provided with a flat trocar and canula, and with a bag of reſina elaſtica, fitted with a ſtop-cock and pipe, which ought exactly to ſuit the canula. See fig. 81.

The patient being laid in an horizontal poſture, either upon a bed or a table, the water ſhould be drawn entirely off from the tumor by a flat trocar paſſed into the under and fore part of it. The operator ſecuring the canula with the one hand, is with the other to paſs the tube of the injection-bag fairly through it, and with gentle preſſure to force in as much of the liquid as may reach the whole ſurface of the vaginal coat, as well as the whole ſurface of the teſticle. The bag ſhould now be removed, leaving the tube within the canula of the trocar, ſo that by turning the ſtop-cock the injection may be retained in the cavity of the tumor. The canula of the trocar ought ſtill to be kept fixed, otherwiſe it might recede, by which the liquid would inſinuate into the cellular ſubſtance of the ſcrotum. The liquor ſhould likewiſe be brought into contact with every part of the cavity; and after remaining about four, or at the moſt five, minutes in the ſac, it ſhould be entirely diſcharged through the canula of the trocar, after withdrawing the tube of the elaſtic bag.

Sometimes intenſe pain is felt immediately after the liquor is thrown in. When this is the caſe, it ſhould be diſcharged as ſoon as it has paſſed over the different parts of the tunica vaginalis. Some recommend a repetition of the ſame kind of injection immediately after the firſt has been diſcharged and to be retained for the ſame period, though this is not commonly practiſed.

The whole of the injection ſhould be completely diſcharged, after which the ſcrotum ſhould be covered with a pledget of cerate, a compreſs being applied over it, and retained with a ſuſpenſory bag. The patient ought to be in bed for ſeveral days, and ſupport the ſcrotum in the bandage by means of a ſmall pillow.

Though it is difficult to aſcertain the proportion of thoſe who

Hydrocele of the Spermatic Cord. who are cured by the method of injections, and though it is to be regretted that hitherto the diſeaſe is found to return in a great proportion of thoſe upon whom this operation has been performed; yet, on account of the facility with which it can be done, the comparatively ſmall pain with which it is attended, the quickneſs of the cure, and chiefly becauſe it does not, in caſe of a return of the diſeaſe, preclude the future operation of inciſion, it appears a method which, in all probability, will be more and more adopted into practice.

Sect. III. *Of Hydrocele of the Spermatic Cord.*

307 Anaſarcous hydrocele of the ſpermatic cord. Anasarcous hydrocele of the ſpermatic cord ſometimes accompanies aſcites, and at other times it is found to be confined to the cellular ſubſtance in or about the ſpermatic cord. The cauſes of this diſeaſe may be, obſtructions in the lymphatics leading from the part in conſequence of ſchirhous affections of the abdominal viſcera, or the preſſure of a truſs applied for the cure of hernia.

308 Symptoms. When the affection is connected with anaſarca in other parts, it is then ſo evident as to require no deſcription. When it is local, it is attended with a colourleſs tumour in the courſe of the ſpermatic cord, ſoft and inelaſtic to the touch, and unaccompanied with fluctuation. In an erect poſition of the body it is of an oblong figure; but when the body is recumbent, it is flatter and ſomewhat round. Generally it is no longer than that part of the cord which lies in the groin, though ſometimes it extends as far as the teſticle, and even ſtretches the ſcrotum to an uncommon ſize; an inſtance of which is related by Mr Pott, who from a ſwelling of this kind diſcharged 11 Engliſh pints at once. By preſſure a great part of the ſwelling can always be made to recede into the abdomen. It inſtantly, however, returns to its former ſituation on the preſſure being withdrawn.

When the tumor is connected with general anaſarca of the ſyſtem, it can only be cured along with the reſt of the diſeaſe; but when the ſwelling is local, the remedy is alſo to be locally applied. An inciſion is to be made of ſuch a ſize it may be ſufficient for diſcharging the whole of the water; in the performance of which, attention is neceſſary to guard againſt hurting the ſpermatic veſſels. The contents of the tumour being diſcharged, the ſore is to be treated like any other ſimple wound.

309 Of encyſted hydrocele of the ſpermatic cord. Encyſted hydrocele of the ſpermatic cord ſometimes begins in the upper, but generally at the lower part of the ſpermatic cord. On its firſt appearance it is ſo ſmall as to give little or no trouble; hence it is ſeldom particularly attended to till it has acquired a conſiderable ſize. By degrees it extends as far as the abdominal muſcles, and ſometimes reaches to the bottom of the ſcrotum; and to a perſon unacquainted with the appearance of the diſorder may be miſtaken for a hydrocele of the tunica vaginalis. But here the tumor is always above the teſticle, which is diſtinctly felt below; and even in the advanced ſtate of the diſeaſe the teſticle is found in the back part of it perfectly unconnected with the ſwelling; 310 Symptoms. whereas, in the advanced ſtages of hydrocele in the vaginal coat, although ſome hardneſs is diſcovered where the tunica vaginalis adheres to the teſticle, yet when the ſwelling is great the teſticle cannot be diſtinctly felt. In the encyſted hydrocele of the cord, the figure and ſize of the penis is little altered; whereas, in caſes of common hydrocele, the penis frequently diſappears almoſt entirely. In other reſpects the two diſeaſes are nearly ſimilar. It ſometimes happens that the water is contained in two diſtinct cells. In that caſe the tumour is ſomewhat puckered up, or diminiſhed in its diameter. A ſimilar appearance alſo occurs, when this variety of the diſeaſe is connected with hydrocele of the tunica vaginalis, which ſometimes takes place.

The only other tumors with which this one may be confounded are, the anaſarcous hydrocele of the ſpermatic cord, and a real hernia. But in neither of theſe is the fluctuation of a fluid perceptible, and to the touch they are both ſoft and inelaſtic; whereas, in this variety of hydrocele, the tumor has a ſpringy feel, and a fluctuation is ſenſible to the touch; and in both the one and the other the ſwelling recedes ſomewhat upon preſſure, which it never does here.

From hernia it is chiefly diſtinguiſhed by the tumor beginning ſome way down the cord. In hernia the tumor turns leſs when the patient is in an horizontal poſture, and is conſiderably affected by coughing and ſneezing; but this kind of hydrocele is not altered in ſize by any ſuch circumſtances, nor has it the common ſymptoms which attend a hernia.

Infants are frequently ſubject to this diſeaſe, as well as to an anaſarcous ſwelling of the cord, and an œdematous tumor of the ſcrotum. But here the complaint is ſeldom permanent; for in moſt inſtances it readily yields to gentle friction, with any ſtimulating or aſtringent application, as a ſtrong ſolution of ſal ammoniac in vinegar, &c. But in adults, the ciſt, in every variety of encyſted hydrocele, becomes ſo firm as not to be affected by external applications; ſo that when the tumor becomes large, it is neceſſary to uſe means for producing either a palliative or radical cure, in the ſame manner as is done for a hydrocele in the vaginal coat.

Sect. IV. *Of Hæmatocele Scroti.*

Hæmatocele Scroti. We ſhall mention in this place the diſeaſe called *hæmatocele ſcroti*, which is occaſioned by blood extravaſated in the inner ſubſtance of the ſcrotum, in the tunica vaginalis, or in the ſpermatic cord; but the uſual ſituation is in the tunica vaginalis teſtis.

Tumours of this kind may be produced by any thing which ruptures the blood-veſſels of the part, but they are commonly the conſequence of external violence. In the tunica vaginalis this diſorder may be produced by the point of a trocar or of a lancet in tapping for hydrocele. In ſuch a caſe, we are commonly informed of the accident by blood being diſcharged along with the water; though ſometimes it does not appear till the whole of the water is evacuated, and then a tumor of a conſiderable ſize ſuddenly takes place. Sometimes it happens where the quantity of water has been ſo uncommonly great that the ſudden diſcharge of it, by taking away the ſupport which the veſſels have been accuſtomed to receive, has been the cauſe of their rupture; and it ſeems certain, that whenever a tumor is produced either in the ſcrotum or cord ſuddenly after the water of a hydrocele has been evacuated by tapping, that it is entirely owing to an extravaſation of blood.

In the ſpermatic cord injuries of the ſame kind will be attended with a ſimilar effect upon the veſſels of the ſac containing the water. The diſtinction between blood and water in the ſubſtance of the ſcrotum is readily made by the colour; for where the diſeaſe is produced by blood, it forms a real eſchymoſis. The tumor feels heavier in the tunica vaginalis when filled with blood than where it is filled merely with water; the treatment is nearly the ſame with that in hydrocele. In the commencement of the anaſarcous or diffuſed hæmatocele, when produced from ſlight external violence, the application of ſtimulating or aſtringent fluids will ſometimes diſcuſs it; but if this prove ineffectual, the tumor is to be laid open, and treated exactly as was directed for hydrocele; only if a ruptured veſſel be diſcovered, it muſt be ſecured by ligature. In like manner, all collections

Varicocele, Circocele, Spermatocele, and Pneumatocele.

of blood either in the vaginal coat or ſpermatic cord are to be laid open, and treated as in hydrocele. If bleeding veſſels appear, they are to be ſecured. Sometimes however theſe cannot be detected; an oozing takes place which it is difficult to reſtrain, even by the uſe of bark, vitriolic acid, and other means generally employed in ſuch caſes. It has been uniformly found, that local remedies prove chiefly uſeful here, particularly the application of ardent ſpirits, æther, or tincture of myrrh, to the ſurface of the ſore. Pledgets of ſoft lint, ſoaked in one or other of theſe, not only ſerve to check the diſcharge of blood, but in general tend to promote the formation of good matter.

Chap. XXV. *Of Varicocele, Circocele, Spermatocele, and Pneumatocele.*

311 Varicocele. VARICOCELE is a preternatural diſtenſion of the veins of the ſcrotum, which in this ſtate form a tumor of hard, knotty inequalities, ſeldom painful, and generally attended with no inconvenience excepting what ariſes from its bulk. 312 Circocele. Circocele is ſimilar in its nature to the former, but ſituated in the ſpermatic cord, extending from the abdominal ring to the ſuperior part of the ſcrotum, and produced by a varicoſe ſtate of the ſpermatic vein. Both of theſe diſorders are occaſionally produced by obſtruction in the veins; but are moſt frequently owing to a relaxed ſtate of theſe vaſſels; to which we may add, that on account of the ſmallneſs of the correſponding artery, they are not ſufficiently affected by its influence. The tumor produced by theſe diſorders is ſometimes ſo large as to appear like a hernia or hydrocele; but we diſtinguiſh it from theſe by the touch, for varicoſe veins are like worms filled with elaſtic matter. We have another mark upon which we can ſtill more depend: The tumor in the erect poſture of the body is much increaſed, while in the horizontal ſituation it almoſt entirely diſappears.

313 Of collections of blood within the tunica albuginea. Another diſorder is obſerved by late authors, where a collection of blood is ſometimes found within the tunica albuginea teſtis, and is ſuppoſed to be a kind of hæmatocele, or more probably varicocele. Sometimes the collection is ſo conſiderable, that a fluctuation reſembling that of an hydrocele of the vaginal coat of the teſticle is obſervable. When this is miſtaken for hydrocele, and an opening is made into it with a trocar, a diſcharge is produced of a duſky-coloured blood, ſomewhat reſembling thin chocolate: But though the tumor may be diminiſhed by the evacuation thus obtained, yet the alteration is inconſiderable; nor is the patient ever relieved, but on the contrary made worſe by ſuch an operation. Caſtration, after this, becomes neceſſary; but even this has been found ineffectual: ſo that the patient had better be adviſed to truſt to nature, aſſiſted by a proper ſuſpenſory bandage, than to ſuffer the attempt of a radical cure; for it has been obſerved, that in ſome inſtances they have remained ſtationary for many years, whereas they never fail to become much worſe by any attempt to evacuate the fluid.

When tumors, or the preſſure of a truſs, has been the cauſe of ſuch complaints, a proper attention to theſe ought to be the firſt attempt towards a cure. But when a relaxed ſtate of the veins is ſuſpected, we ought to recommend a ſuſpenſory bandage, an horizontal poſture, the cold bath, and the application of a ſolution of alum and other aſtringents. By a proper exhibition of theſe, the diſeaſe may at leaſt be prevented from increaſing, ſo as to render any operation unneceſſary.

314 Spermatocele. By ſpermatocele is underſtood a morbid diſtenſion of the vas deferens and epidydimis. The diſeaſe may ariſe from tumors, ſtricture, or inflammation about the vas deferens, or its termination in the penis; but more probably from inflammation there. When an inflammatory diſpoſition is diſcovered, general and topical blood-letting, gentle laxatives, a low cooling diet, and reſt of body, will commonly be found the beſt remedies. When tumors are found to preſs upon the vas deferens, they ought either to be brought to a ſtate of ſuppuration, or entirely extirpated, if that can be properly effected. If the diſeaſe proceed from a venereal cauſe, nothing can be ſo uſeful as a courſe of mercury properly directed.

Sarcocele, or Scirrhous Teſticle.

315 Pneumatocele. By pneumatocele is underſtood a diſtenſion of the ſcrotum from a collection of air.

The principal cauſe of this diſeaſe, which rarely happens, is wounds in the lungs, by which air paſſes through the common cellular ſubſtance into the ſcrotum; but from whatever cauſe the tumor is produced, the diſeaſe is to be treated by making ſmall punctures with the point of a lancet, as in the caſe of anaſarcous ſwellings formed by water.

Chap. XXVI. *Of Sarcocele, or Scirrhous Teſticle.*

SARCOCELE implies a fleſhy, enlarged ſtate of the teſticle, much firmer and harder to the touch than is obſerved in hernia humeralis or inflamed teſticle.

The ſymptoms vary exceedingly in different patients; but the following are the moſt general: The firſt ſymptom is commonly a ſmall enlargement, without much pain, and no diſcolouration of the part. The tumor becomes gradually larger, and the hardneſs increaſes; but for a conſiderable time the ſurface remains ſmooth; and when the conſtitution is otherwiſe good, the diſorder will ſometimes remain in this ſituation for a conſiderable number of years; and in a few rare inſtances, by a moderate diet, keeping the belly open, ſuſpending the tumor properly, and avoiding violent exerciſe, or any thing which may conſiderably increaſe the impetus of the blood, the diſorder has not only been prevented from increaſing, but has in a gradual manner diſappeared entirely. More commonly, however, the tumor increaſes in ſize, and becomes ragged and unequal on its ſurface. Smart and ſevere ſhooting pains are frequently felt through its ſubſtance. Sometimes ſerum is extravaſated in the vaginal coat, or matter is collected in different parts of the tumor. The ſcrotum, now much diſtended burſts, and thin, fetid, bloody matter diſcharging, the diſeaſe terminates in an ulcerated cancer of the worſt kind.

The ſpermatic cord is commonly unaffected till the tumor has acquired a conſiderable ſize, and generally not till collections of matter have been formed. After this, from being at firſt only ſlightly ſwelled, it gradually increaſes in hardneſs and bulk; after which it becomes very painful, knotty, or unequal through its whole extent. The diſcharge from the ſcrotum ſtill continues; but although the matter increaſes in quantity, the ſize of the tumor is not thereby diminiſhed, but, on the contrary, continually increaſes; the edges of the ſore become hard, livid, and retorted, and fungous excreſcences puſh out from every part of it; the health of the patient becomes entirely deſtroyed, and he is at laſt carried off in great miſery.

Hernia humeralis produced by venereal infection has been conſidered, by ſome authors, as a frequent cauſe of the worſt kind of ſcirrhous teſticle; but the fact is very much otherwiſe; and ſuch an idea has this bad tendency, that it prevents the perſeverance in the uſe of ſuch remedies as might have removed the diſeaſe without the neceſſity of extirpation.

Another cauſe mentioned by authors as producing ſcirrhus of the teſticle, is the hydrocele of the vaginal coat; but though ſarcocele is frequently combined with this diſeaſe, there is every reaſon to think that the primary diſorder was in the teſticle itſelf, and that the water is only a conſequence of the other complaint. When the hydrocele happens to be the original diſeaſe, the teſticle is alſo found frequently altered in its appearance. It is here paler than in its natural ſtate. It is ſometimes diminiſhed, but more frequently enlarged. The enlargement however is ſoft, harmleſs, and free from pain; and in ſuch a ſituation ſhould never be extirpated. To this point particular attention ought to be paid, otherwiſe we run the riſk of committing a miſtake, into which practitioners have been too frequently led—the extirpation of a teſticle which ought to have been ſaved. To keep free of this error, we ought to attend to the following circumſtances.

316 In what caſes the teſticle may be extirpated.

When the diſeaſe begins in the teſticle itſelf, eſpecially in the body or glandular part, or when it becomes hard and enlarged previous to any collection of water in the vaginal coat, it is to be conſidered as of a different nature from that in which an enlargement of the part ſucceeds to a collection of water; or if, upon evacuating the water, the teſticle be found hardened, enlarged, and attended with pain and other marks of ſcirrhus, eſpecially if the ſurface be unequal or ulcerated, extirpation ought certainly to be performed. The ſymptoms abovementioned ſometimes, though rarely, begin in the epidydimis. In ſuch caſes, however, extirpation will ſeldom be adviſable, as there is here always a ſuſpicion of a venereal affection; and then we ought by all means to try the remedies commonly uſed in ſuch diſeaſes. In the prognoſis, we attend to the age and habit of the body, as well as to the ſtate of the diſeaſe and length of time it has continued.

When the patient is young and the conſtitution unbroken, we may always hope for a cure, although the ſymptoms ſhould be very conſiderable; whereas, in old infirm people, and in habits attended with an emaciated look, with indigeſtion, and other ſymptoms of obſtructed viſcera, whatever ſtate the diſeaſe may be in, there will be but a ſmall chance of ſucceſs.

If the diſeaſe has ſubſiſted for a long time without conſiderably increaſing in ſize, we may reaſonably think it is of a milder nature than where it has made a rapid progreſs. As long as the teſticle is only hard and free from the formation of matter, we may expect a favourable event; but where collections of matter have already formed, either in the ſubſtance or upon the ſurface of the teſticle, there is no other chance of ſaving the patient than by means of extirpation. Previous to this, however, we are to attend to the ſtate of the ſpermatic cord; for were any of it left in a diſeaſed ſtate, little advantage could be derived from extirpation; nor ought the operation ever to be performed but where we can reach the whole of the diſeaſed parts. We are not to be prevented from performing it though the cord ſhould be conſiderably enlarged, providing it do not evidently partake of the diſeaſe of the teſticle; for the cord is generally ſomewhat enlarged in the diſeaſed ſtate of the teſticle; but this enlargement is for the moſt part merely either a varicoſe ſtate of the veins, or a watery diſpoſition of the cellular ſubſtance.

317 Method of performing the operation.

But ſuppoſing no obſtacle to the operation, the method of doing it may be this. The parts being previouſly ſhaved, the patient is to be laid upon a ſquare table of about three feet four inches high, letting his legs hang down; which, as well as the reſt of his body, muſt be held firm by aſſiſtants; or, he may be laid acroſs a bed in the ſame manner. Then with a knife the inciſion is to be begun above the rings of the abdominal muſcles, that there may be room afterwards to ſecure the veſſels; then carrying it through the membrana adipoſa, it muſt be continued downward to the bottom of the ſcrotum. A firm, waxed, flat ligature, compoſed of ſmall threads, is next, by means of a curved needle, to be paſſed round the ſpermatic cord, at leaſt an inch above the diſeaſed part, or as near the abdominal ring as poſſible; after which the veſſels are to be ſecured by a running knot, and divided about a quarter or half an inch below the ligature. The cord and teſticle are then to be removed from the ſurrounding parts by diſſecting from above downwards, and no inſtrument is better for this purpoſe than the common ſcalpel. After the diſeaſed parts are removed, the knot upon the cord muſt be ſlackened to diſcover the ſpermatic arteries and veins; both of which, by means of the tenaculum or a common forceps, are to be taken up. The ligature upon the ſpermatic cord is now to be left looſe, ſo as to act as a tourniquet if a hemorrhagy ſhould enſue; nor is there more occaſion for leaving the ligature tied than for leaving a tourniquet firmly applied to one of the extremities after amputation; beſides, where patients have ſuffered ſuch pain as is ſometimes mentioned by authors, it has been found to be owing to the tightneſs of the ligature rather than to any other cauſe. In dividing the ligatures of the blood-veſſels at the extremities of the cord, they muſt be left of ſuch a length without the wound as to be readily removed, however much the cord may retract in the time of the cure.

In ſeparating the teſticle, a conſiderable hemorrhagy ſometimes enſues from the diviſion of the ſcrotal arteries. In ſuch a caſe, they ought always to be fixed with ligatures before proceeding in the operation. The parts being removed, and the blood-veſſels ſecured, the wound is to be cured, if poſſible, by the firſt intention; and for this purpoſe the ſides of the ſcrotum are to be brought together in the moſt accurate manner, beginning at the under end, and ſecuring the parts by adheſive plaſter as we proceed upwards, and in ſuch a way that the ſides of the ſore may be kept properly together. About two inches of the ligatures of the cord are to be left out, and this part of the wound treated in the ſame manner as the reſt; the whole to be ſecured by a compreſs of linen and a T bandage.

318 Treatment after the operation.

The patient ſhould now be laid to reſt, and an opiate adminiſtered; and if, upon the ſecond or third day, any inflammatory ſymptoms enſue, they are to be removed by methods commonly employed upon theſe occaſions; as topical blood-letting, gentle laxatives, and keeping the part conſtantly moiſt with a ſolution of ſugar of lead. The dreſſings ought not to be allowed to ſhift, elſe the cure will be greatly retarded. They are to be examined about four or five days after the operation; and if nothing material has happened, they may be allowed to remain two or three days longer, by which time generally the ligature can be readily removed; and the wound will be healed by the firſt intention, excepting ſome ſmall opening in the ſkin, more eſpecially where the ligatures were placed. Theſe are to be drawn together by adheſive ſtraps, and dreſſed in the ſame manner as formerly. In this way, if the patient be otherwiſe healthy, a cure may be expected in little more than a fortnight.

The method of dreſſing moſt frequently practiſed is to apply a quantity of ſoft lint to the ſore, and then a compreſs of linen over it, and to ſecure the whole with a T bandage or a ſuſpenſory bag. The patient is then laid to reſt, and an opiate given. The ſore is not to be touched till a free ſuppuration takes place, which will commonly be about the fifth or ſixth day, and then the dreſſings are to be removed, and renewed from time to time; once every two days, or oftener, as the quantity of matter may render it neceſſary. Sometimes after the operation the patient complains of pain in the ſore, and of tenſion and uneaſineſs in the belly. In ſuch a caſe, warm fomentations ſhould be applied to the abdomen, and the ſore covered with an emollient poultice, and this repeated as often as may be neceſſary.

Chap. XXVII. *Of the Stone.*

Sect. I. *Of Stone in the Bladder.*

319 Caſes of the formation of calculi.

A variety of cauſes have been aſſigned as tending to the formation of calculi in the bladder of urine; as, a decompoſition of a ſuperabundant quantity of earthy matter from the blood, on account of a ſedentary life; certain articles of diet or drink, containing a greater quantity of earthy matter than others; a continued uſe of ſolid food without a ſufficient quantity of drink; the peculiar action of abſorbent veſſels; the particular ſtructure of the kidney; the nature of the different excretory veſſels; the time the urine may remain in the kidney; the habit of retaining the water in the bladder; particles of blood getting into the kidney or bladder, and attracting the ſtony matter ſo as to form a nucleus. A certain change of the veſſels of the kidney forming the urine has by ſome been conſidered as a more probable cauſe than any of the former. The formation of calculus ſometimes begins in the kidneys, at other times in the bladder.

After a calculus has begun to be formed, it ſometimes acquires a great ſize in a few months from the firſt obvious ſymptoms; but ſometimes it remains in the bladder for many years without arriving at any conſiderable ſize.

320 Symptoms of calculus.

The ſymptoms commonly come on gradually, and bear ſome kind of proportion to the ſize and inequalities of the ſtone. One of the firſt commonly taken notice of is an uneaſy ſenſation at the point of the urethra, which for ſome time is perceptible only upon making water, or upon uſing violent or jolting exerciſe. This ſenſation gradually increaſes; and there is along with it a frequent deſire to make water, which is commonly voided in ſmall quantities, and ſometimes only in drops. When running in a full ſtream, it often ſuddenly ſtops, though the patient is conſcious that a conſiderable quantity ſtill remains, and feels a ſtrong inclination to void it. If the ſtone be large the patient has a conſtant dull pain about the neck of the bladder, and frequent deſire of going to ſtool. The urine is generally of a limpid colour; but it is frequently thick, depoſiting a mucous ſediment, and when the diſeaſe is violent it is often tinged with blood. All theſe complaints are greatly increaſed by exerciſe, eſpecially by riding on horſeback; and from a long continuance of pain, the patient's health by degrees becomes much impaired, and unleſs effectual means are employed for removing the cauſe of the diſorder, death alone puts an end to his miſery.

We are rendered certain of the exiſtence of calculus when ſmall pieces of ſtone are frequently paſſed along with the urine. When this does not occur, we cannot be certain that the ſymptoms do not ariſe from an ulcer or tumor in the body or neck of the bladder, or from the preſſure of tumors in the neighbouring parts. In doubtful caſes, however, we have one mark by which we can judge with certainty, and that is by means of ſounding.

321 Method of ſounding.

This is performed by introducing an inſtrument called a *ſound* (fig. 82.), formed of ſteel finely poliſhed, and having the natural curvature of the urethra. The patient is to be laid upon a table or acroſs a bed, with his ſhoulders raiſed upon a pillow, to bring the ſtone to the neck of the bladder, and his thighs a little elevated and ſeparated from each other. A ſound adapted to the ſize of the urethra is to be choſen; and previous to the introduction it is to be laid in warm water till it be of the heat of the body, and then wiped and rubbed over with bland oil, butter, or axunge. The ſurgeon lays hold of the penis with his left hand, while with his right he introduces the ſound with its concave ſide towards the abdomen. He is now with his left hand to draw the penis gently forward upon the inſtrument, which is to be gradually puſhed into the bladder. If any difficulty occur about the neck of the bladder, this may be obviated by introducing the finger into the anus, and raiſing the point of the inſtrument; or the ſame purpoſe is more readily anſwered by depreſſing the handle of the ſound. If ſtill it does not paſs with eaſe, much force ought by no means to be uſed, leſt the inſtrument perforate the membranous part of the urethra.

As ſoon as the inſtrument enters the bladder, if it happen at once to touch the ſtone, a tremulous motion will be communicated to the fingers of the operator, and the buſineſs of ſounding is then accompliſhed, the nature of the diſeaſe being now aſcertained. Great care, however, is here always neceſſary, as a few particles of ſand, or a hardened ſtate of the bladder, have ſometimes communicated the ſame ſenſation. If the ſtone be not ſoon diſcovered, the inſtrument is to be moved in all directions; and ſhould the operator be ſtill unſucceſsful, one of the fingers of the left hand is to be introduced into the rectum, ſo as to raiſe that part of the bladder in which a ſtone may probably be concealed. If even this attempt prove ineffectual, the body of the patient is to be put into different poſitions, and perhaps one of the beſt is depreſſing the ſhoulders and raiſing the pelvis. By this mean a ſtone may generally be felt, providing it is not contained in a cyſt, which very rarely happens. If after all theſe different attempts the ſurgeon ſhould fail in diſcovering the ſtone, the inſtrument is to be withdrawn; and if ſymptoms of ſtone be ſtrongly marked, and it appear that neither ſcirrhus nor inflammation, which might give riſe to theſe ſymptoms, do exiſt, a ſecond or even a third trial is to be made on the following days.

322 Of lithontriptics.

Various lithontriptics have been recommended for diſſolving the ſtone in the bladder; ſuch as lime-water, cauſtic alkali, ſoap, &c. but none of them can be conveyed in ſuch a ſtate into the bladder as to be much depended upon, as they undergo the greateſt change in the courſe of the circulation. To obviate theſe changes, it has been recommended to inject certain fluids of this claſs through the urethra into the bladder; but this has not been attended with any material advantages, and has generally been found to do injury to the bladder. The only effectual method of removing ſtones from the bladder is by means of a chirurgical operation; the ſucceſs of which depends much upon the dexterity of the ſurgeon, as well as on the conſtitution of the patient.

323 Symptoms forbidding lithotomy.

When the conſtitution has been ſo much impaired that the patient complains greatly of ſickneſs and oppreſſion at ſtomach, with nauſea and an inclination to vomit, eſpecially upon taking food; when he has likewiſe a conſtant thirſt, and the pulſe is as high as a hundred ſtrokes in the minute—an operation is improper till theſe ſymptoms are removed. The operation is improper alſo when the patient labours under a ſevere fit of the ſtone; for then inflammation of the bladder is apt to enſue to ſuch a degree as to produce ſuppuration. By frequent attacks and continuance of theſe fits, the coats of the bladder are apt to be thickened and greatly contracted. This laſt circumſtance may be known by the introduction of the ſound; for then it will ſtop after

ter getting paſt the ſphincter of the bladder, and cannot be puſhed farther without conſiderable force, and at the ſame time giving the patient the moſt exquiſite pain. Nor ought the operation to be performed when the bladder is ulcerated, eſpecially where the patient is old and much debilitated, and where the diſcharge of matter is great.

Children more readily recover from the operation of lithotomy than adults; and old people from the age of 55 to that of 70, whoſe conſtitutions have not been broken, are in leſs danger than thoſe in the full vigour of life, probably owing to inflammatory ſymptoms being more apt to proceed to a dangerous length in the extremes of ages than at the middle period of life. When the conſtitution, however, is not much impaired by the continuance of the diſeaſe, the operation may be undertaken with a probable degree of ſucceſs almoſt at any period of the patient's life.

Several methods have been recommended for performing this operation; but there are only two which can be practiſed with any propriety. One is, where the operation is to be performed immediately above the pubes, in that part of the bladder which is not covered with peritonæum: the other, where it is done in the perinæum, by laying open the neck and lateral part of the bladder, ſo as to allow of the extraction of the ſtone.

324 High operation.

Franco, a French ſurgeon, finding a ſtone in a child of two years of age too large to be extracted through an opening in perinæo (the place where the operation was then performed), was induced to make an inciſion into the bladder above the pubes; but though the ſtone was extracted and the child recovered, Franco, who publiſhed the caſe in 1561, never attempted the operation again, and even diſſuades others from doing it. It does not appear indeed to have been much practiſed anywhere till ſome time after the commencement of the preſent century, about the year 1720, when it was adopted and frequently performed in Britain and other parts of Europe for the ſpace of about 12 or 15 years. The lateral operation came then to be more generally known, and ſince this period the high operation has been ſeldom practiſed.

325 Method of performing it.

In performing the high operation, the bladder muſt be in a diſtended ſtate, ſo as to make it riſe above the oſſa pubis, to allow an inciſion to be made into that part of it which is uncovered by the peritonæum, and thereby to prevent the abdomen from being opened or its contents expoſed. Some days, or even weeks, previous to the operation, the patient ought to be deſired to retain his urine as long as he can, ſo as to diſtend the bladder till it can hold at leaſt a pound and a half, when the perſon is an adult and of an ordinary ſize; or the penis may be tied up to allow the urine to collect. As theſe methods may be attended with great diſtreſs, ſome prefer diſtending the bladder by injecting warm water by ſlow degrees till the bladder is ſufficiently full, which may be eaſily known by relaxing the abdominal muſcles and feeling above the pubes.

When the operation is to be performed, the patient is to be laid upon a table of convenient height, with the pelvis higher than the ſhoulders, that the parts may be fully on the ſtretch, and to prevent the bowels from preſſing upon the bladder. The legs and arms are to be properly held by aſſiſtants. An inciſion is to be made through the ſkin, in the very middle of the under and fore part of the abdomen, from ſome way under the umbilicus to the ſymphyſis pubes. The cellular ſubſtance, the tendon of the oblique muſcles, the muſculi recti and pyramidales, are now to be ſeparated; and it is better to make this ſeparation from the pubes upwards, ſo as to be in no danger of cutting into the abdomen. The ſurface of the bladder will now appear uncovered by the peritonæum. Then the operator, with a common ſcalpel, or an abſceſs lancet, or, what is better, with a concave ſharp pointed knife, makes a perforation into the moſt prominent part of the bladder, till the fore-finger of the left hand can be introduced. The ligature is now to be removed from the penis; then with a probe-pointed biſtoury, making the finger ſerve as a conductor, the wound is to be made ſufficiently large for the extraction of the calculus, taking particular care, however, not to carry the inciſion ſo high as to cut the peritonæum. This part of the operation being finiſhed, the ſtone is to be extracted with the finger; or if that be impracticable, the forceps are to be employed. Should it unfortunately happen that the ſtone is broken in the extraction, the pieces are to be removed entirely by the fingers rather than by ſcoops, which were ſometimes uſed. The edges of the wound in the integuments are now to be drawn together by means of the twiſted ſuture, leaving about an inch and a half immediately above the pubes for the diſcharge of any urine which may be there evacuated. The patient is to be laid in bed, with the pelvis ſtill kept higher than the ſhoulders. Gentle laxatives are to be occaſionally given, and the antiphlogiſtic plan ſtrictly adhered to.

326 Advantages and diſadvantages of this operation.

The advantages of this method are, that larger ſtones can be extracted by this than by the lateral operation, and that fiſtulous ſores are leſs apt to enſue. The diſadvantages are, the danger of opening or wounding the peritonæum, and thereby expoſing the abdominal bowels; the frequent occurrence of inflammation about the beginning of the urethra, ſo as to occaſion the urine to be diffuſed in the cellular ſubſtance on the outſide of the bladder, and thereby producing ſinuſes difficult to cure; the extreme difficulty of healing the wound, eſpecially in bad conſtitutions; and, laſtly, the ſmall number of patients, after the age of thirty, who have been found to recover from this operation.

327 Lateral operation.

Frere Jacques, a French prieſt, was the inventor of the lateral operation. He firſt appeared at Paris in 1697, and afterwards operated in a great number of caſes.

328 Frere Jacques's method of performing lithotomy.

He introduced a ſound through the urethra into the bladder with a ſtraight biſtoury, cut upon the ſtaff, and carried his inciſion along the ſtaff into the bladder. He then introduced the fore-finger of the left hand into the bladder, ſearched for the ſtone, which, having withdrawn the ſound, he extracted by means of forceps. The patient was now carried to bed, and the after treatment left to the attendants.

329 Improved by Profeſſor Rau.

Profeſſor Rau of Holland improved upon this method, by making a groove in the ſtaff, which enabled him, with greater certainty, to continue his inciſion into the bladder: but inſtead of dividing the urethra and proſtate gland, the latter of which he was afraid of wounding, he diſſected by the ſide of the gland, till the convex part of the ſtaff was felt in the bladder, where he made his inciſion, and extracted the ſtone; but this method was too difficult to perform, and attended with too many inconveniencies and dangers ever to be generally received. It ſuggeſted, however, to the celebrated Cheſelden the lateral method of cutting, as it is now with a few alterations very generally practiſed. We ſhall attempt to deſcribe the different ſteps of this operation in its preſent improved ſtate.

330 Suggeſted the lateral operation.

331 Manner of preparing the patient.

The manner of preparing the patient depends upon a variety of circumſtances. If he be plethoric, a few ounces of blood ſhould be taken away, and at proper intervals the bowels ought to be emptied by any gentle laxative which will not gripe. The diet ſhould conſiſt of light food for ſome time previous to the operation. If the pain be violent, opium is neceſſary. Sometimes it is relieved by keeping the patient in bed with the pelvis raiſed, ſo as to remove the ſtone from the neck of the bladder. He ought not to

Stone in the Bladder.

ſit up, or take any exerciſe, in the time of preparation. The warm bath ought to be uſed two or three times, and the patient ſhould remain in it half an hour at each time. A laxative ought to be given on the day preceding the operation, and an injection a few hours before it is performed. The patient ought to drink plentifully of ſome diluent liquor, and to retain the urine ſeveral hours previous to the operation. If this cannot be readily effected, a ſlight compreſſion, by means of a ligature, may be made upon the penis, ſo as to have the bladder ſufficiently diſtended, that there may be no danger of the poſterior ſurface being hurt by the end of the gorget. The perinæum and parts about the anus ſhould be well ſhaved.

332
Manner of performing the operation.

A table ſomewhat more than three feet in height, and of ſufficient ſtrength, is now to be firmly placed, and properly covered with blankets, pillows, &c. Upon this the patient is to be laid and properly ſecured; and for this purpoſe there ought to be two pieces of broad firm tape, each about five feet in length, which are to be doubled, and a nooſe formed upon them. A nooſe is then to be put upon each wriſt, and the patient deſired to lay hold of the middle of his foot upon the outſide. One end of the ligature is to go round the hand and foot, and the other round the ankle and hand, and croſs again, ſo as to repeat the turns in the reverſe way. A running knot is then to be tied, by which the hand and foot will be properly ſecured. The buttocks are then to be made to project an inch or two over the table, and to be raiſed conſiderably higher than the ſhoulders by a couple or more pillows, and one ought to be put under his head.

The operator is now to introduce a grooved ſtaff (fig. 83.) of proportionable ſize, and open to the very end, through the urethra into the bladder; and having again fully ſatisfied himſelf of the exiſtence of a ſtone, he inclines the ſtaff, if the ſurgeon be right-handed, obliquely over the right groin, ſo that the convex part of the ſtaff may be felt in the perinæum on the left ſide of the raphe. He then fixes it, and delivers it to his aſſiſtant, who is to hold it with his right hand, deſiring him to preſs it gently, in order to make the ſulcus of the ſtaff project in the direction in which he received it. With his left hand the ſame aſſiſtant is to raiſe and ſupport the ſcrotum.

The thighs of the patient being ſufficiently ſeparated by the aſſiſtants, and the ſurgeon being ſeated upon a chair of a proper height, and in a convenient light, he makes an inciſion with a common convex edged ſcalpel through the ſkin and cellular ſubſtance, immediately below the ſymphyſis of the oſſa pubis, which is a little below the ſcrotum, and where the crus penis and bulb of the urethra meet, and on the left ſide of the raphe, and continues it in a ſlanting direction downwards and outwards to the ſpace between the anus and tuberoſity of the iſchium, ending ſomewhat lower than the baſis of that proceſs, by which a cut will be made of three or four inches in length. This inciſion ought not to be ſhorter than is here directed, otherwiſe there will not be room for the reſt of the operation. As ſoon as the integuments are thus divided, he ought to introduce two of the fingers of the left hand. With one he keeps back the lip of the wound next the raphe, and with the other he preſſes down the rectum. He ought likewiſe particularly to guard againſt cutting the crures of the penis, which he can readily feel, and ſeparate at their under part with one of the fingers. He next makes a ſecond inciſion almoſt in the ſame direction with the firſt, but rather nearer to the raphe and anus, by which he preſerves the trunk of the arteria pudica. By this inciſion he divides the tranſverſalis penis, and as much of the levator ani and cellular ſubſtance within theſe as will make the proſtate gland perceptible to the finger. If any conſiderable veſſel be cut, it is immediately to be ſecured, though this is ſeldom neceſſary. After this he will have a view of the membranous part of the urethra, which is diſtinguiſhed from that covered by the bulb by being very thin. He is now to ſearch for the groove of the ſtaff with the fore finger of his left hand, the point of which he preſſes along from the bulb of the urethra to the proſtate gland, which ſurrounds the neck of the bladder. He keeps it there; and turning the edge of the knife upwards, he cuts upon the groove of the ſtaff, and freely divides the membranous part of the urethra, from the proſtate gland to the bulb of the urethra, till the ſtaff can be felt perfectly bare, and that there is room to admit the point of the finger; and as the finger aſſiſts in keeping the parts ſtretched, and effectually prevents the rectum from being hurt, the inciſion into the urethra may be made with perfect eaſe and ſafety.

Stone in the Bladder.

The next part of the operation, viz. dividing the proſtate gland and neck of the bladder, might, by a dexterous operator, be ſafely performed with a common ſcalpel, with the edge turned the oppoſite way. But to guard againſt accidents, a more convenient inſtrument, called the *cutting gorget* (fig. 84.), is now in general uſe. It was originally invented by Mr Hawkins of London, and ſince his time has undergone various alterations. Fig. 85. is a double gorget invented by Dr Monro. The inner plate, which is blunt, is made to ſlip forwards to protect the back part of the bladder. The membranous part of the urethra being now divided, and the fore-finger ſtill retained in its place, the point of the gorget, previouſly fitted to the groove, is to be directed along the nail of the finger, which will ſerve to conduct it into the groove of the ſtaff; and as this is one of the niceſt parts of the operation, the moſt particular attention is here required that the point of the gorget be diſtinctly heard to rub in the bare groove, and that nothing is interpoſed.

In the introduction of the gorget into the bladder, if the aſſiſtant could be depended upon, the ſtaff might be allowed to remain in his hand: the operator, however, generally chooſes to manage it himſelf. He now riſes from his ſeat, takes the ſtaff from the aſſiſtant, raiſes it to near a right angle, and preſſes the concave part againſt the ſymphyſis of the oſſa pubes; ſatisfies himſelf again that the point or beak is in the groove, and then puſhes on the gorget, following the direction of the groove till the beak ſlip from the point of the ſtaff into the bladder. The gorget is not to be puſhed farther than this, otherwiſe it may wound the oppoſite ſide of the bladder, &c.

The gorget having now entered the bladder, which is readily known by the diſcharge of urine from the wound, the ſtaff is to be withdrawn, and the finger introduced along the gorget to ſearch for the ſtone, which, when felt, will point out the direction to be given to the forceps; at any rate, the introduction of the finger ſerves to dilate the wound in the bladder; and this being done, a pair of forceps (fig. 86.) of a proper ſize, and with their blades as nearly together as their form will allow, are to be introduced, and the gorget withdrawn ſlowly, and in the ſame direction in which it entered, ſo as to prevent it from injuring the parts in its return. After the forceps are introduced, and paſſed till they meet with a gentle reſiſtance, but no farther, the handles ought to be depreſſed till they are ſomewhat in an horizontal direction, as this will moſt correſpond with the fundus of the bladder. One blade of the forceps is to be turned towards the ſymphyſis of the pubes to defend the ſoft parts there, the other of conſequence will guard the return. After they have diſtinctly touched the ſtone, by moving them a little in various directions, they are then to be opened, and the ſtone laid hold of, which may generally

rally be done with conſiderable eaſe. It frequently happens, however, that when the ſtone is ſmall, it is not readily felt with the forceps; and inſtances may happen where the under and back part of the bladder may be ſo depreſſed as to conceal the ſtone. In ſuch a ſituation, nothing will more readily bring it in the way of the forceps than to introduce the finger into the rectum, and elevate this part of the bladder. Straight forceps are generally uſed; crooked ones, in ſome very rare caſes, however, may be neceſſary, and therefore the ſurgeon ought to be provided with them.

After the forceps has laid hold of the ſtone, if it be ſmall and properly placed, it may readily be extracted; but if, on the contrary, the handles of the forceps are now obſerved to be greatly expanded, it is certain the ſtone is improperly fixed, or that it is remarkably large: in either caſe it ſhould not be held faſt, but allowed to move into the moſt favourable ſituation; or the finger is then to be introduced ſo as to place it properly for extraction. If this cannot be done with the finger, it ought to be allowed to ſlip out of the forceps, in order to get it more properly fixed; and as the moſt common form of the ſtone is flat and oval, or ſomewhat like a flattened egg, the forceps ſhould have hold of the ſmalleſt diameter, while an end preſents to the neck of the inſtrument. The ſtone ſhould be graſped with no greater firmneſs than is merely ſufficient to bring it fairly out. It ſhould be extracted in a ſlow and gradual manner.

When a ſtone is broken in the bladder, all the larger pieces are to be extracted by the forceps, which are to be introduced by means of the finger ſerving as a director. The ſmaller parts are to be removed by means of a ſcoop (fig. 87.), or probably the finger may be more convenient; and as the leaſt particle allowed to remain, or which is not waſhed off by the urine, may ſerve as the nucleus of another ſtone, a large quantity of water, properly warmed, is to be injected by a bag and pipe, or by a ſyringe; and for this purpoſe the body of the patient ſhould approach at leaſt to an upright poſture; and to give the particles of ſtone an opportunity of collecting near the inciſion of the bladder, the wound may be ſtopped for a little after the injection is thrown in.

When a ſtone is extracted of a regular, firm, and rough ſurface, it ſeldom happens that any others remain in the bladder. On the contrary, when it is of an irregular ſhape, and ſmooth and poliſhed, particularly in certain places, with impreſſions formed upon it, there is the greateſt probability of others remaining. There are exceptions, however, to theſe rules; and therefore the operator, inſtead of truſting to them, ſhould introduce his finger, which will anſwer the purpoſe without any other ſearcher.

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Treatment after the operation.

If, after the operation, any conſiderable artery bleeds much, it is to be taken up with a ligature; but if this be impracticable, the hemorrhagy ought to be ſtopped by means of preſſure, and for this purpoſe a firm roller introduced at the wound anſwers ſufficiently: and to prevent any ſtoppage to the diſcharge of urine, a ſilver canula, covered with caddis, and duſted over with ſtyptic powder, may be introduced into the wound with advantage.

Sometimes it happens that a conſiderable quantity of blood, inſtead of paſſing off by the wound, is collected in the cavity of the bladder, and may produce very dangerous ſymptoms. To prevent this as much as poſſible, immediately upon the operation being finiſhed, the patient's pelvis ſhould be made conſiderably lower than the reſt of his body; by which means the wound will be kept in a depending poſture, and the blood will eſcape more readily by the wound. But if it be found that blood is ſtill lodged in the cavity of the bladder, it muſt be immediately extracted.

As ſoon as the blooding is ſtopped, the patient is to be untied, a piece of dry ſoft charpee put between the lips of the wound, and often renewed, and the thighs brought together. He is then to be laid in a bed, in ſuch a way that the pelvis may be conſiderably lower than the reſt of the body, to give a favourable direction to any blood which may afterwards flow from the wound. A conſiderable doſe of laudanum is now to be given. From 30 to 50 drops for an adult will commonly be neceſſary. From this period, unleſs the ſtone has been large and difficult to extract, the patient commonly falls aſleep, or at leaſt lies quiet for a few hours; but afterwards generally begins to complain of pain in the under part of the abdomen. Anodynes are now to be given both by the mouth and anus, and warm fomentations, by means of flannels or bladders filled with warm water, are to be applied to the region of the bladder, as the affection ſeems to be of the ſpaſmodic kind.

If by a continuance of theſe remedies the pain abates, no anxiety needs be entertained concerning it; but if it increaſe, and eſpecially if the abdomen become hard and ſwelled, and the pulſe full and quick, and theſe ſymptoms become gradually worſe, great danger is to be apprehended, as they moſt commonly take place in conſequence of inflammation. In this ſituation, as much blood ought to be taken as the patient can bear. A large injection of warm water and oil, or linſeed tea, ſhould be given every ſix or ſeven hours, and the fomentations continued at the abdomen. If the ſymptoms continue to grow worſe, the patient ſhould be immediately put into the ſemicupium or half bath.

By a proper continuance of theſe means, with a low diet and plenty of diluent drink, the above ſymptoms may frequently be removed. The reverſe, however, is ſometimes the caſe. The wound becomes ſloughy and ill-conditioned; all the ſymptoms, in ſpite of every effort continued to increaſe, and ſoon terminate in death.

But where matters end favourably, the wound by degrees puts on a better appearance; the urine paſſes almoſt from the beginning by the urethra (moſt frequently, however, it is diſcharged by the wound for the firſt two or three weeks); the pain in the abdomen gradually abates, the feveriſh ſymptoms are ſoon removed, a complete cicatrix is formed, and the wound is ſometimes cured in a month; though upon other occaſions three will be neceſſary. But it muſt depend greatly on the nature of the conſtitution.

Excoriation of the buttocks may be prevented by placing a ſheet under them ſeveral times doubled, the breadth to be 18 or 20 inches, and to be all rolled up, except the part which is to be laid under the patient, the reſt of the roll to be by his ſide, which is to be unrolled as the nurſe draws the wet part from under him. If, after the uſe of this, excoriations ſhould ſtill happen, the part may be waſhed with cold water; or the parts round the wound, after being well dried, may be rubbed with any tough ſimple ointment.

In patients of a debilitated conſtitution incontinence of urine frequently occurs after this operation. In general, this is removed as the patient acquires ſtrength. Nouriſhing diet, cold bath, the bark, and other tonics, are of much ſervice here; but where theſe are afterwards found ineffectual, inſtruments for compreſſing the penis, or others for receiving the urine, have been found uſeful, and are now made in ſuch a convenient way as to allow them to be conſtantly uſed ſo long as they may be found neceſſary.

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Lithotomy in females.

An operation for ſtone in the bladder is much ſeldomer required in women than in men, on account of the ſhortneſs of the urethra in the former allowing a readier paſſage for the ſmall calculi which get into, or are formed in, the bladder. It is likewiſe in women more ſimple, and of courſe more readily performed. It might be done in the ſame manner as in the male, but there would be the greateſt probability of wounding the vagina. In a few caſes the operation has been performed from the vagina itſelf; but it is by no means adviſable, as ſtones would not only be extracted with greater difficulty, but, on account of the thinneſs of the parts, the urine would moſt probably form a fiſtulous opening, and a communication be maintained between the bladder and vagina; or cicatrices here might be attended with great inconvenience in child-labour.

In the method commonly practiſed, the patient being placed and ſecured in the ſame manner as in the operation upon the male, the operator introduces a ſhort grooved ſtaff, ſlightly curved (fig. 88.), into the bladder; then by means of the common gorget already mentioned, with its point paſſed along the groove of the ſtaff, he lays open the whole of the urethra and the neck of the bladder. The ſtaff is now to be removed, the finger introduced upon the gorget, and to feel for the ſtone, which is to be removed as already directed for the operation on the male ſubject. Where incontinence of urine occurs after the wound is healed, a peſſary is to be uſed within the vagina, or a ſponge applied, or a tin machine to receive the urine.

Sect. II. *Of Stones in the Kidneys.*

The ſymptoms of ſtone in the kidneys are, pain in the region of the kidneys, ſickneſs, and vomiting, the urine ſometimes mixed with blood, at other times with mucus or even purulent matter; but the ſame ſymptoms are often induced by other cauſes, eſpecially from inflammation and ſuppuration of the kidney. Nephritic complaints have frequently ſubſiſted for a long time, where ſtones have been blamed as being the cauſe of them; and yet upon diſſection purulent matter alone has been detected. From this circumſtance, as well as from the great depth of the parts and the large ſize of the blood-veſſels of the kidney, the operation of nephrotomy could not be performed, but with the greateſt uncertainty and moſt imminent danger, and is therefore never attempted. A few caſes indeed have appeared where inflammation induced by a ſtone in the kidney terminated in abſceſs, and the ſtones were taken out; but it was not till they had worked their way out of the kidneys into the cellular ſubſtance, ſo that it only remained to open the abſceſs and extract them; but otherwiſe the operation is never to be thought of.

Sect. III. *Of Stones in the Urethra.*

335 Symptoms of ſtones in the urethra.

Those who are troubled with calculous complaints frequently paſs ſmall ſtones along with their urine; and when theſe are angular or of conſiderable ſize, they ſometimes ſtick, and give much uneaſineſs. The ſymptoms are at firſt pain, then inflammation and ſwelling, attended with a partial, or total ſuppreſſion of urine, which, if long neglected, is apt to terminate in a rupture of the urethra, when the urine will be diſcharged into the neighbouring parts. The greateſt attention is therefore neceſſary to get the ſtone extracted as ſoon as poſſible.

336 Method of extracting them.

When a ſtone is in the urethra, unleſs it be of a large ſize, or has been long impacted, and the inflammation great, attempts ought to be made with the fingers to puſh it out; but previous to this, the penis ſhould be relaxed as much as poſſible, ſo as to remove a certain degree of ſpaſm which the preſence of ſtone here probably creates. Blood ought to be drawn by general or local means, according as the patient may be of a plethoric or emaciated habit. He ſhould be immerſed in a warm bath, and get a full doſe of laudanum, and warm oil ought alſo to be thrown into the urethra. After theſe remedies have relaxed the parts as much as may be, the extraction is to be attempted.

For this purpoſe certain inſtruments have been contrived, particularly a tube containing a pair of elaſtic forceps (fig. 89.), to be introduced into the urethra ſo as to lay hold of the ſtone. In ſome caſes they certainly might anſwer the purpoſe, but they have not been found very uſeful; and as they may increaſe the irritation already preſent in the urethra, they are ſeldom, if ever, employed. Inſtead of them, the ſurgeon uſes gentle preſſure on the penis to puſh the ſtone outwards; and as calculi larger than a field bean have ſometimes been paſſed by the urethra, an operation ought not to be performed till gentler means have been perſiſted in for ſome time. When theſe means have failed, an inciſion ought to be made immediately upon the ſtone, which is then to be removed by a probe, or with a pair of ſmall forceps. When a ſtone is lodged near the neck of the bladder, after the patient has been placed and ſecured in the ſame manner as for the lateral operation, while an aſſiſtant ſupports the ſcrotum and penis, the operator introduces a finger oiled into the anus, to ſupport the ſtone in its place, and prevent it from ſlipping into the bladder. An inciſion is then to be made, and the ſtone turned out. The after treatment will be nearly the ſame as that after the operation of lithotomy.

When, again, a ſtone has advanced further in the urethra, the beſt method is to draw the ſkin ſtrongly forwards or backwards, and then to cut upon it and turn it out, when the ſkin will ſlide back ſo as to cover the wound, and prevent the urine from paſſing through it; and by this means it will generally heal by the firſt intention. If part of the urine paſs through the wound, and inſinuate into the cellular ſubſtance, an attempt is to be made with the hand to preſs it back. If that prove inſufficient, a cut is to be made through the ſkin oppoſite to the inciſion of the urethra; but this will ſeldom be found neceſſary. If a ſtone is fixed near the point of the urethra, it may be removed with a pair of forceps; or, if this fail, the urethra is to be dilated with a ſcalpel; and if this alſo be inſufficient, an inciſion is to be made as above directed. When the cure is nearly completed, a tube formed of ſilver or elaſtic gum, or a hollow bougie, may be uſed to keep the urethra of a proper ſize.

The worſt part of the urethra for a ſtone to ſtick in is that immediately behind the ſcrotum; for then the urine is apt to paſs by the inciſion into the cellular ſubſtances of the ſcrotum, ſo as to occaſion large ſwellings there. To prevent this, a ſtone ſo ſituated ought, if poſſible, to be puſhed forwards with the fingers; or if this be impracticable, it ſhould be puſhed back into the perinæum by means of a ſtaff. If both methods fail, a cut is to be made at the under part of the ſcrotum, which is to be well ſupported, and at one ſide of the ſeptum, and continued upwards till the ſtone is felt, when an inciſion is to be made into the urethra, and the ſtone extracted as before directed.

Chap. XXVIII. *Of Incontinence and Suppreſſion of Urine.*

337 Cauſes of incontinence of urine.

Incontinence of urine may ariſe from various cauſes, as, from a loſs of power in the ſphincter of the bladder, while the natural tone of that organ remains unimpaired; or from irritation about the neck of the bladder, produced by the friction of ſtones contained in it; or from a laceration of parts by the operation of lithotomy; or from the preſſure of the uterus in a ſtate of pregnancy.

338 Treatment.

When the diſeaſe is owing to a want of tone in the ſphincter, the cure is very difficult, becauſe the conſtitution in general is frequently affected. The moſt uſeful remedies are tonics, eſpecially Peruvian bark, chalybeate waters, and the

Inconti-nence and Suppreſſion of Urine.

the cold bath, both generally and locally applied. Cold ſubſtances applied to the perinæum are perhaps of greater ſervice than any thing elſe, as cloths wet with vinegar and cold water, or with a ſtrong ſolution of ſaccharum ſaturni in vinegar; but the beſt method of applying cold is to daſh water immediately from the fountain upon the anus and perinæum. When it ariſes from the irritation of ſtones in the bladder, opiates and mucilaginous liquors plentifully uſed frequently give great relief. When incontinence of urine is owing to a laceration of parts in performing the operation of lithotomy, the diſeaſe is nearly of the ſame nature as that from the cauſe firſt mentioned, and therefore the ſame remedies are of ſervice. When theſe remedies fail in either of the caſes, compreſſion of the urethra prevents any inconvenience ariſing from the conſtant dripping of the urine; and for this purpoſe an inſtrument termed *jugum penis* (fig. 90.) is applied to the penis; or, to preſs againſt the urethra of the female, peſſaries (fig. 91. *a* and *b*) are contrived, which are made in ſuch a way as to be introduced into the vagina, and there to preſs upon the urethra. They are ſometimes made of ſponge, but thoſe of ivory or wood well poliſhed are more generally preferred. A ſmall bottle made of elaſtic gum, and open at both ends for the paſſage of the menſtrual diſcharge, anſwers the purpoſe equally well. Certain caſes however occur where preſſure upon the urethra is improper, eſpecially where there is a conſtant deſire to paſs water; and here much relief is obtained from the uſe of receivers, which are now ſuited to both ſexes. Fig. 92. repreſents one for the male, and fig. 93. one for the female.

Plate ccccxci.

339 Of ſuppreſſion of urine.

We ſhall here treat only of that ſpecies of ſuppreſſion of urine where the urine is collected in the bladder, but from ſome obſtructing cauſe is prevented from being diſcharged. It ariſes from a variety of cauſes.

340 Treatment when it ariſes from want of tone in the body of the bladder.

When it ariſes from a want of tone in the body of the bladder, it is often connected with palſy of the lower extremities; it is frequently owing alſo to retaining urine too long. The catheter, in this caſe, is commonly an effectual remedy, and ought to be employed as ſoon as the ſuppreſſion is evidently formed, and repeated from time to time, till the tone of the ſyſtem is recovered by the uſe of proper remedies. The method of introducing the catheter is the ſame with that already directed for ſounding for the ſtone. Fig. 94. a catheter for the male, fig. 95. one for the female.

When the affection ariſes from ſpaſm about the neck of the bladder, opiates, warm water thrown into the rectum, and afterwards the warm bath, are the beſt means of producing relief. When it proceeds from ſcirrhus of the proſtate gland, or from other tumors, or from obſtructions of the urethra in conſequence of gonorrhœa, the treatment to be afterwards deſcribed will be found beſt ſuited for ſuch complaints. When the ſuppreſſion ariſes from the preſſure of the uterus in the latter months of pregnancy, change of poſture is ſometimes found to have ſome effect; but if this fail, immediate relief can commonly be given by the introduction of the catheter, which in women is for the moſt part readily done.

341 From inflammation of the neck of the bladder.

Suppreſſion of urine from inflammation affecting the neck of the bladder is one of the moſt alarming varieties of the diſeaſe, as it produces pain, and ſuch a degree of ſwelling in the parts as to render the introduction of the catheter inadmiſſible. It may ariſe from the matter in gonorrhœa paſſing backwards along the courſe of the urethra. An improper uſe of injections has likewiſe frequently produced this ſpecies of the diſeaſe. The treatment is nearly the ſame as for inflammatory complaints in other parts of the body. Blood-letting ſhould be employed, and particularly leeches ſhould be applied to the perinæum. Opiates ought to be given in large doſes. Injections of warm water ſhould be frequently thrown up the rectum, and the whole body ſhould be immerſed in the warm bath. If theſe means be properly uſed, they will very ſeldom fail of ſucceſs; but when they do not prove effectual, when the bladder becomes painfully diſtended, and when every attempt to introduce the catheter has failed, nothing is to be depended upon but a puncture made into the body of the bladder, in order to diſcharge the water contained in it.

Inconti-nence and Suppreſſion of Urine.

342 Method of puncturing the bladder above the pubes.

Various methods have been propoſed for effecting this operation. Puncturing the bladder above the pubes has been recommended by many reſpectable authors. The following is the method of doing it: A lancet-pointed trocar, about two inches long, is to be at once introduced through the integuments, about an inch and half above the pubes, into the body of the bladder. The ſtilette is to be removed as ſoon as the water begins to flow through a groove formed in it, and the urine allowed to flow through the canula, which is ſecured to the body by means of a bandage. A cork is to be fitted to the canula, that the urine may paſs off at intervals only. The canula is to be retained till the cauſe which produced the obſtruction is ſo far removed that the patient can diſcharge the urine in the natural way. It ought to be removed every three or four days, and cleared from the ſordes which adheres to it, otherwiſe it ſoon becomes covered with a calculous cruſt, which renders the extraction exceedingly difficult. On theſe occaſions a firm probe, of ſufficient length, ought to be paſſed through it into the bladder, upon which it may again be eaſily returned as ſoon as it is properly cleaned.

This method of puncturing the bladder is not altogether free from objections; the bladder being ſuſpended for a long time on the canula, its tone is ſometimes deſtroyed; and if it happen to ſlip off the canula, the operation muſt be repeated; beſides, the urine may be diffuſed in the ſurrounding cellular ſubſtance.

343 Method of puncturing from the perinæum.

When the bladder is to be punctured from the perinæum, the trocar, which ought to be longer than the one for puncturing above the pubes, is to be introduced at a little diſtance from the rapha perinæi, and then paſſed into the body of the bladder, a little to the upper and outſide of the proſtate gland, carrying the point of the inſtrument a little upwards, to avoid wounding the ends of the ureter or ſeminal veſſels. Puncturing from the anus, or the vagina in females, is attended with ſo many inconveniences that it ought never to be attempted.

Chap. XXIX. *Diſeaſes of the Penis.*

Sect. I. *Of Obſtructions of the Urethra.*

344 Cauſes of obſtructions of the urethra.

Obstructions of the urethra frequently occur after repeated or ſevere attacks of the venereal diſeaſe. They may be owing to caruncles or fleſhy excreſcences in the urethra; to tumors in the lining membrane, or parts contiguous to the urethra, in conſequence of inflammation; to ſpaſmodic affections of the urethra; or to ſtrictures properly ſo called.

Till of late years almoſt every inſtance of obſtruction in the urethra has been attributed to caruncles, but their occurrence is much leſs frequent than was formerly imagined. They are rarely found except near the point of the urethra. They are conſidered to be nearly of the ſame nature with the warts which grow upon the prepuce or root of the glans in venereal caſes. Tumors obſtructing the paſſage in the urine may be occaſioned either immediately by inflammation, or in conſequence of old ſores within the urethra;

Obſtructions of the Urethra.

thra; or tumors, from whatever cauſe, may be ſeated in the corpora cavernoſa contiguous to the urethra, and may preſs upon it in ſuch a manner as to cauſe an adheſion of its ſides, and thereby produce ſtoppage of the urine. Spaſmodic ſtrictures of the urethra ſometimes ariſe from ſtone in the bladder. Sometimes in gonorrhœa there is ſuch a degree of contraction that neither ſtaff nor bougie can enter. This variety of obſtruction is known by its coming on ſuddenly, and going off ſometimes almoſt completely in the ſpace of a few hours. Of the permanent ſtricture, or ſtricture properly ſo called, Mr Hunter obſerves, that in moſt of the caſes of this kind which he has ſeen, the diſeaſe extends no farther in breadth than if the part had been ſurrounded with a piece of packthread. He has however ſeen the urethra irregularly contracted for above an inch in length, owing to its coats or internal membrane being irregularly thickened and forming a winding canal. He farther obſerves, that a ſtricture does not ariſe, in all caſes, from an equal contraction of the urethra all round; but in ſome, from a contraction of one ſide, which throws the paſſage to the oppoſite ſide, and often makes it difficult to paſs the bougie. In ſome few caſes, he ſays, there are more ſtrictures than one; he has ſeen half a dozen in one urethra, and finds that the bulbous part is much more ſubject to ſtrictures than the whole of the urethra beſides; that they are ſometimes on this ſide of the bulb, but very ſeldom beyond it; and that they are often ſlow in forming, it being frequently years from the time they are perceived before they become very troubleſome. Contrary to the opinion of others, Mr Hunter doubts very much if the ſtricture commonly, or even ever, ariſes from the effects of the venereal diſeaſe, or the method of cure; for ſtrictures are common to other paſſages, and ſometimes happen in the urethra where no venereal complaint had ever been.

345 Methods of cure.

When obſtructions are occaſioned by caruncles in the urethra, bougies (fig. 96.) ſhould be introduced rubbed over with bland oil until a reſiſtance is met with. When a bougie cannot be introduced far enough, one with a ſmaller point is to be uſed, but not till the day following, leſt the part be too much irritated. They ought not to be allowed to remain long at firſt, particularly when they occaſion a conſiderable degree of pain.

When ſuppreſſion of urine ariſes from ſwellings in or about the urethra, in conſequence of inflammation, an attempt ſhould be made to diſcuſs theſe immediately, or bring them into a ſtate of ſuppuration, and diſcharge the pus as ſoon as it is formed. But when the nature of the tumor is ſuch as not to terminate in either of theſe ways, extirpation of the diſeaſed parts, when this is found practicable, is the only probable means of relief. Bougies ſhould at the ſame time be uſed to aſſiſt in the cure.

When ſpaſmodic affections are preſent in the urethra, the remedies to be employed are, warm emollients, as rubbing the part with warm oil; anodynes, as opium given by the mouth, but more eſpecially by the anus; blood-letting in plethoric habits and this to be generally and locally applied; bliſters put to the penis or perinæum; electricity, after plethora has been removed. Some caſes may be treated with bougies; but where the diſeaſe is purely ſpaſmodical, they are generally found to be hurtful; though in other caſes, when the violence of the diſeaſe is ſo far removed, if they can be introduced, they are of ſervice, by relieving any obſtructions which may remain after the remedies abovementioned have been exhibited. Coſtiveneſs ought likewiſe to be guarded againſt. The permanent ſtricture is to be cured by bougies.

Bougies act ſolely by preſſure, and by ſupporting the part; hence they ſhould be ſo large as to fill the paſſage, and ſufficiently flexible to be eaſily introduced. They are formed of various materials, as a compoſition of diachylon plaſter, oil, and wax melted and put upon linen, which is afterwards properly rolled up; or they are formed of leather, catgut, &c. properly prepared: but the beſt of any are thoſe which are formed of elaſtic gum. Bougies, when properly made, can ſometimes be kept in for ſix or eight hours together; but the length of time proper for their retention muſt depend much upon the feelings of the patient. At all times when they give much pain they ought to be removed, and not introduced again till the part is in a ſtate fit for receiving them. They ſhould be gradually increaſed in their ſize, till the paſſage returns to its natural dimenſions. They ought to be continued for ſome time after, till it appear that there is no danger of a return of the complaint.

Phymoſis and Paraphymoſis.

Sect. II. *Of Phymoſis and Paraphymoſis.*

346 Cauſes of phymoſis.

In phymoſis the prepuce is thickened, and contracted before the glans, ſo that it cannot be readily drawn behind it. In ſome people there is a conſtitutional phymoſis from the natural ſtraitneſs of the prepuce. Sometimes it ariſes from the matter ſecreted by the odoriferous glands at the root of the glans being confined and becoming acrid; ſometimes from an anaſarcous ſwelling of the ſcrotum and penis; but moſt frequently from venereal virus.

347 Cure.

The cure muſt depend upon the nature of the cauſe producing the diſeaſe. If the ſymptoms be inflammatory and of no long continuance, fomenting the parts frequently with warm emollient decoctions, or bathing them in warm milk, and then applying emollient poultices, or keeping the diſeaſed parts conſtantly moiſt with a cold aſtringent ſolution, and turning the penis upwards and ſupporting it againſt the belly, commonly give relief. If the inflammation has ariſen from a venereal cauſe, part of the fluid ought frequently to be injected, by means of a ſyringe, between the prepuce and glans, ſo as to waſh off any matter which may there be concealed; but if the inflammation ſtill continues to increaſe, blood-letting is neceſſary, both general and local. The veins of the penis are ſometimes adviſed to be opened with a lancet; but this is unſafe on account of the nerves. Leeches may be applied; but care muſt be taken, in venereal caſes, leſt the bites of theſe animals, by abſorbing venereal matter, turn into chancres. Along with the remedies already adviſed, gentle laxatives, low diet, and abſtinence, ought to be preſcribed. But if, after a due perſeverance in theſe means, it is found that they have had little effect in removing the diſorder, or perhaps that the ſymptoms are conſtantly increaſing, and that chancres are confined under the prepuce; in that caſe it is neceſſary to ſlit open the prepuce, which is beſt done by a ſharp-pointed biſtoury, concealed in a grooved director, fig. 98. This is to be introduced between the prepuce and glans, till the director is found by the finger to have reached the upper or back part of the prepuce. The operator is now to keep the director firm with one hand, while with the other he puſhes forward the knife, till its point paſſes through the prepuce; then drawing the inſtrument towards him, he cuts the prepuce through its whole length.

The operation being performed, the parts are to be waſhed and cleaned with warm water, and the ſore dreſſed with a little ſoft lint, and a compreſs of linen laid over it. The whole may be retained by a ſmall bag properly adapted, and ſecured by two ſtraps to a bandage put round the body. This bag may be left open at the under end, to allow the patient to make water, without removing the dreſſings; but if this be found impracticable, the dreſſings may be removed with little inconvenience. If the glans be

Phymoſis and Paraphymoſis. much inflamed and excoriated, care ſhould be taken to inſert lint ſpread with emollient ointment between the glans and prepuce, otherwiſe troubleſome adheſions are apt to enſue. It is evident, that when this diſeaſe is of the venereal kind, the ſore will not readily heal till the poiſon be eradicated from the conſtitution.

In ſome caſes of phymoſis the preputium is ſo remarkably long, and the contraction ſo much confined to the point, that a circular inciſion is preferable to a longitudinal one; and it is eaſily effected, by ſeparating ſuch a portion as may be found neceſſary of the whole circumference of the prepuce. The dreſſings in this caſe are the ſame as when the prepuce is ſlit open.

348 Of paraphymoſis. Paraphymoſis is the reverſe of phymoſis, being formed by a retraction of the prepuce, producing ſtricture behind the glans of the penis. Like the former diſeaſe, it ariſes moſt frequently from a venereal infection, but may be produced from whatever preternaturally enlarges the glans or conſtricts the prepuce.

349 Treatment. In the incipient ſtate, the patient may generally be relieved by the ſurgeon puſhing the glans gently back with his thumbs, while with his fingers he brings the prepuce gradually forward. But a more effectual method than this is to incloſe the glans with one of the hands, and preſs gently on all ſides, by which the fluids forming the enlargement will be puſhed into the body of the penis behind the ſtricture. If this method be perſevered in for a conſiderable time, it will generally be found to anſwer the purpoſe: but ſhould it prove ineffectual, we may try the effects of cold applications; and the beſt ſeem to be thoſe of the ſaturnine kind. When the penis is evidently much ſwelled and inflamed, the patient ſhould be kept cool, gentle laxatives and low diet ſhould be preſcribed, and a number of leeches applied to the penis. Should the diſeaſe ſtill continue to increaſe, and an œdematous ſwelling appear about the under part of the prepuce, an operation is neceſſary to prevent a mortification from taking place in the glans. An inciſion is to be made on each ſide of the penis immediately behind the glans, ſo large as completely to divide the ſtricture. The wound ought to be allowed to blood freely; after which a pledget ſpread with ſimple ointment is to be applied, and an emollient poultice laid over the whole.

Sect. III. *Of an Incomplete Urethra.*

In children, eſpecially males, the urethra is ſometimes incomplete, ending before it reaches the uſual place of termination. Sometimes it does ſo without any external opening, at other times it opens at a diſtance from the common termination. In the firſt caſe, a ſmall trocar is to be introduced in the direction the urethra ought to take, till the urine be diſcharged; after which, the paſſage is to be kept open by the uſe of bougies, till the ſides be rendered callous and an opening preſerved. In the other caſe, as the opening which is already found affords a temporary paſſage for the urine, it will be better to delay doing any operation till the patient be farther advanced in life, when it is to be performed as in the former caſe.

After the operation, a piece of flexible catheter may be introduced, as well for the purpoſe of rendering the paſſage free and callous, as for carrying off the water till a cure is made.

Sect. IV. *Of Amputating the Penis.*

This operation is found neceſſary in certain diſeaſes which will not yield to other remedies; as in caſes of mortification and cancer. The following is the method of performing it:

Amputating the Penis. A circular inciſion is firſt to be made through the ſound ſkin a little beyond the diſeaſed parts; the ſkin is then to be drawn back by an aſſiſtant, and the body of the penis divided by one ſtroke of the knife (fig. 99.) immediately at the edge of the retracted ſkin. The principal arteries, which are two or three on each ſide, are next to be ſecured by ligatures; and if an oozing of blood ſtill continue, the ſurface of the ſore ought to be duſted with ſome ſtyptic powder. To allow the patient to make water, a ſilver canula (fig. 99. *a*) is to be introduced into the urethra, and retained there by two ſmall ligatures fixed to the ſide of the canula, their other extremities being faſtened to a bandage put round the body. The wound is to be dreſſed with ſoft lint, kept in its place by a piece of linen previouſly perforated for the introduction of the canula. The dreſſings are to be kept on by a narrow roller paſſed a few times round the penis, which, by gently compreſſing the penis upon the inſtrument, will effectually prevent any farther diſcharge of blood. The after treatment of the ſore ſhould be ſimilar to wounds in other parts of the body. But it will not be neceſſary to make any farther compreſſion of the penis upon the canula, as the diſcharge of blood will, previous to this time, be entirely ſtopped. The tube is to be allowed to remain in the urethra during the whole time of the cure.

Before any operation of this kind is attempted, the ſurgeon ought to examine attentively, whether the diſeaſe be in the penis itſelf, or only in the ſkin, as the prepuce alone is frequently ſo much enlarged and otherwiſe diſeaſed as to give cauſe for ſuſpicion that the glans and body of the penis are likewiſe affected. This precaution is the more neceſſary, as ſeveral inſtances have occurred where the glans and body of the penis have been removed, and, after the operation, have been found perfectly ſound. Previous to amputation, therefore, where there is any cauſe for ſuſpicion, the prepuce ſhould be ſlit open, and the glans examined, ſo as to avoid amputating more than what is abſolutely diſeaſed.

350 Of ſhortneſs of the frænum. It ſometimes happens that the frænum of the penis is ſo ſhort as to give conſiderable uneaſineſs in time of an erection. When this is the caſe, it may be ſafely divided by a pair of ſciſſars, or by a ſharp-pointed biſtoury, and the wound dreſſed with a little charpie.

Sect. V. *Of Fiſtula in Perinæo.*

The term implies a ſinuous ulcer in the perinæum, commonly communicating with the urethra, but ſometimes opening into the bladder. The ſame term is alſo applied to ſimilar ſores opening into the ſcrotum, or into any part of the penis.

351 Cauſes of fiſtula in perinæo. The diſeaſe may ariſe from wounds in the bladder, and of the urethra, from external violence; from a laceration of parts when performing the operation of lithotomy; from inciſion into the urethra for the extraction of calculi impacted there; from ſinuſes producing matter capable of corroding the membranous part of the urethra; from ſuppuration in the perinæum in conſequence of inflammation; from the urine paſſing through an opening in the urethra into the perinæum or other neighbouring parts, and rendering the edges of the ſore callous; and moſt frequently the diſeaſe is occaſioned by venereal complaints.

352 Treatment. In the treatment of this diſeaſe, when it is the conſequence of a general affection of the ſyſtem, a removal of the primary diſorder is neceſſary before a cure can be attempted. When the complaint is of a local nature, a ſimple inciſion into the ſinus is all that is neceſſary; and for this purpoſe a ſtaff is to introduced into the urethra, ſo as to paſs the opening at which the urine is diſcharged. A probe, or a ſmall director, is now to be paſſed at the external opening of

Hemorrhoids or Piles.

the ſore till it reach the ſtaff; and cutting upon it, the ſinus is to be laid open through its whole length till it terminates either in the urethra, or, if neceſſary, in the bladder itſelf. When more openings than one are preſent, they are to be treated in the ſame manner; and if the ſinuſes are found to be remarkably hard, the removal of a ſmall portion of the diſeaſed part will expedite the cure, though the conſequent inflammation and ſuppuration will render this ſeldom neceſſary. After the operation, the wound is to be dreſſed with pledgets of emollient ointment, ſo as to allow it to fill up completely from its bottom. The whole is to be covered with a pledget of emollient ointment; and proper compreſſes being applied over it, the dreſſings are to be ſupported by a T bandage.

If ſymptoms of inflammation be violent, an emollient poultice is to be applied in the courſe of twenty-four hours after the operation; and as ſoon as free ſuppuration is formed, light eaſy dreſſings are to be uſed till the ſore is completely healed.

CHAP. XXX. *Diſeaſes about the Anus.*

SECT. I. *Of Hemorrhoids or Piles.*

THE treatment of piles has been already conſidered under the article MEDICINE; but it ſometimes happens, that although the means mentioned there have been employed, the diſeaſe becomes ſo violent as to require the aſſiſtance of the ſurgeon. Where the diſcharge of blood is ſo great as to endanger the life of the patient, we ought to attempt to ſtop it either by compreſſion, or by ſecuring the bleeding veſſels by a ligature; and here the tenaculum is preferable to the needle, becauſe, when the latter is uſed, a portion of the rectum is apt to be included in the ligature. When piles arrive at ſuch a ſize as to obſtruct the paſſage of the fæces, or to produce great irritation, the removal of them by the knife or by ligature becomes neceſſary. The firſt of theſe may be uſed when their ſize is of ſuch a nature as not to threaten a dangerous hemorrhagy; but when this is the caſe, they ought to be removed by ligature, the manner of applying which has been conſidered under the treatment of *Polypi*. The dreſſings are to be of a ſimple nature.

SECT. II. *Of Condylomatous Excreſcences, &c. of the Anus.*

EXCRESCENCES are ſometimes produced about the anus, which from their figure get the name of *fici*, *ariſtæ*, &c; but they are all of the ſame nature, and to be cured by the ſame means. They ſometimes grow within the gut itſelf, but more frequently are ſituated at the verge of the anus. They vary conſiderably in their colour, figure, and conſiſtence. Sometimes they are only one or two in number, but commonly all the ſkin about the anus becomes covered with them. They vary in ſize from that of ordinary warts to that of ſplit garden beans. They ſeem originally to be productions of the ſkin, though at laſt they ſometimes proceed as deep as the muſcles. They frequently remain long without producing much uneaſineſs. When this is the caſe, they ought not to be touched; but ſometimes they become ſo troubleſome as to render their removal neceſſary.

The ſofter kinds can frequently be removed by rubbing them often with gentle eſcharotics, as crude ſal ammoniac, or pulvis ſabinæ; but the harder kinds are to be removed chiefly by lunar cauſtic, or by the knife; the latter of which is greatly preferable, and may be done with the utmoſt ſafety.

The ſores are afterwards to be treated like wounds produced by any other cauſe. If cauſtic is to be uſed, care ought to be taken that it do not injure the rectum.

Fiſtula in Ano.

SECT. III. *Of Fiſtula in Ano.*

THE fiſtula in ano is a ſinuous ulcer in the neighbourhood of the rectum. When it opens externally, and has likewiſe a communication with the gut, it is termed a *complete fiſtula*; but if it has no communication with the rectum, it is called *incomplete*. When the ulcer communicates with the gut, but has no external opening, it is named an *internal* or *occult fiſtula*. It is likewiſe diſtinguiſhed into ſimple and compound. The firſt is where one or more ſinuſes communicate with the internal ulcer, but where the parts in the neighbourhood are ſound. The compound fiſtula is where the parts through which the ſinus runs are hard and ſwelled, or where the ulcer communicates with the bladder, vagina, os ſacrum, and other contiguous parts.

353 Cauſes of fiſtula in ano.

The cauſes producing the diſeaſe may be, whatever tends to form matter about the anus, piles, condylomatous tumors, hardened fæces, or any cauſe which produces irritation and inflammation, ſo as to end in ſuppuration. As ſoon as a ſwelling about the anus appears to terminate in ſuppuration, every thing ought to be done which can accelerate the formation of matter.

354 Treatment during the firſt ſtage of the ſimple fiſtula.

A proper degree of heat, warm poultices, fomentations, and the ſteams of warm water, are the means beſt ſuited for this purpoſe; and as ſoon as matter is formed, it ought to be diſcharged by a free inciſion in the loweſt part of the tumor. Much depends upon the proper treatment here; for if the opening be made too ſmall, or if long delayed, the matter gets into the looſe cellular ſubſtance, and inſtead of producing one, produces many ſinuſes, and theſe ſometimes running to a great depth. The parts ought then to be covered with ſoft lint ſpread with mild ointment, and an emollient poultice kept conſtantly over the whole. By this any remaining hardneſs will be removed, the cavity will fill up like impoſthumous tumors in other parts, and a complete cure will in general ſoon be made.

It more frequently happens, however, that the practitioner is not called in till the abſceſs has burſt of itſelf, and till matter has inſinuated into the ſurrounding cellular ſubſtance, and formed one or more real fiſtulæ.

The firſt thing to be done now is to diſcover the real courſe of the different ſinuſes, and the probe is the beſt inſtrument for this purpoſe. If there be openings in the external ſurface, there is commonly little difficulty in this. If they run along the perinæum or the muſcles, the probe will generally detect them. If they follow the direction of the gut, the beſt method is to introduce the fore-finger oiled into the rectum, while the probe is entered at the external orifice. If there be a communication between the gut and the ſinus, the probe may be made to paſs till its point is felt by the finger in the rectum. We diſcover with certainty if a ſinus communicate with the gut, when air or fæces are diſcharged, or when any mild fluid injected returns by the anus.

355 Treatment after ſinuſes are formed.

After the courſe of the ſinus has been diſcovered, the method of cure is next to be conſidered. Aſtringent or eſcharotic injections, preſſure, and ſetons, are inſupportable, on account of the violent pain which they produce. The only method therefore of bringing on a proper degree of inflammation is a free inciſion along the whole courſe of the ſinus. The courſe of the different ſinuſes having been previouſly diſcovered, a laxative ought to be given on the day preceding this operation, and a clyſter an hour or two before performing it. The patient is to be placed with his back towards a window, while his body leans upon a bed, table, or chair. The finger of the ſurgeon is to be rubbed over with oil, and introduced into the rectum. The end of a crooked probe-pointed biſtoury (fig. 100.) is then to be paſſed into the fiſtula, and puſhed againſt the finger in the rectum, if the fiſtula be complete. But in caſes of incomplete fiſtulæ, the point of the inſtrument muſt be made to perforate the gut before it can reach the finger. Some make the perforation with a ſharp-pointed biſtoury, which can be made to ſlip along the ſide of a probe-pointed one, as at fig. 101. After the biſtoury has reached the cavity of the rectum, the point of it is then to be brought out at the anus, and a cut made downwards to lay the ſinus completely open. In this operation the ſphincter ani muſcle is commonly cut, if the ſinus be high; but no inconvenience is found to ariſe from this circumſtance. It ſometimes, though rarely, happens, that the ſinus goes beyond the reach of the finger, and even as high as the upper end of the ſacrum. The only thing which can be done in this caſe is to cut as high as the finger can go, ſo as to give a free and eaſy vent to the matter.

Some practitioners, with a view to prevent troubleſome hemorrhagies, and others to free the patient from the dread of the knife, have propoſed to open the ſinuſes by means of ligature (fig. 102.). By introducing one end of a piece of ſilver or leaden wire into the ſinus, then bringing it out at the anus, and twiſting the ends together, the contained parts may be ſo compreſſed as to produce a complete diviſion of them. But this is both more painful and tedious than the ſcalpel, and appears to be by no means neceſſary.

356 Method of diſcovering the preſence of an occult fiſtula.

When the preſence of an occult fiſtula is ſuſpected, its exiſtence ought firſt to be fully aſcertained, by examining whether the matter which is paſſed by ſtool proceeds from an ulcer in the bowels or from an abſceſs at the ſide of the anus. It is diſcovered by matter from the bowels being mixed with the fæces, and no pain about the anus. In occult fiſtula, a hardneſs, ſwelling, and diſcoloration, are obſerved upon ſome ſpot near the anus, and there is a ſenſation of conſiderable pain upon preſſure being made upon it. The operation in this is the ſame with that in the other two varieties of the diſorder; only that an opening is previouſly to be made, by a lancet or ſcalpel, in that ſpot where the matter appears to be lodged. By this the ſore will be reduced to a complete fiſtula, and the reſt of the operation will be eaſily performed.

357 Treatment in compound fiſtula.

In this manner the different ſinuſes are to be operated upon, when in a ſimple ſtate; but in thoſe of a compound nature, where the parts in the vicinity of the ſores have been ſeparated from each other by an effuſion of matter into the cellular ſubſtance, and where all the under end of the rectum has, in ſome rare caſes, been attached from the ſurrounding parts, two modes of operating have been recommended; either to remove a conſiderable portion of the external integuments, ſo as to give free vent to the matter; or to extirpate all the lower end of the rectum which is found to be detached from the ſurrounding parts. But from the pain and ſubſequent diſtreſs which they occaſion, theſe methods are judiciouſly laid aſide. All that is neceſſary to be done here is to lay the detached portion of gut completely open, as in caſes of ſimple fiſtulæ; but if this be inſufficient for allowing the gut to apply properly to the contiguous parts, another inciſion ſhould be made on the oppoſite ſide. If the neighbouring bones be found ſound, and the conſtitution in other reſpects be unimpaired, a complete cure will probably be obtained.

The matter ſometimes inſinuates itſelf between the ſkin and muſcles of the perinæum, or of the hip. When this is obſerved, the ſac produced by it ſhould be laid open from one end to the other by one or more inciſions as circumſtances may require. Sometimes, from neglect or improper treatment, the matter collected does not find a proper outlet, and then the parts moſt contiguous to it inflame, become painful, and gradually acquire ſuch a morbid calloſity as to put on a ſcirrhous appearance. In ſuch caſes a cure may be effected by giving free vent to the matter, preventing every future collection, and inducing and preſerving a ſuppuration in the ſubſtance of the parts chiefly affected. To accompliſh this laſt circumſtance, however, it may ſometimes be neceſſary not only to lay the ſinuſes freely open, but to cut in upon the obdurated parts.

358 Treatment after laying open the ſinuſes.

The different ſinuſes having been laid open, care muſt be taken to apply the neceſſary dreſſings. Upon this much of the ſucceſs attending the operation depends. Dry lint, till lately, was much uſed by practitioners; but it has been found to produce ſo much irritation, eſpecially when too much crammed in, as to be one of the cauſes of that diarrhœa which is frequently ſo troubleſome after operations of this kind. Inſtead, therefore, of this ſort of dreſſing, pledgets, lint, or ſoft old linen ſpread with any ſimple ointment, are to be preferred. After the ſores have been cleared from clotted blood, the pledgets are to be gently inſinuated between their edges, but not to ſuch a depth, or with ſuch force, as to give any uneaſineſs. This being done, and a compreſs of ſoft linen with a T bandage being applied over the whole, the patient is to be carried to bed; and the dreſſings being renewed, either after every ſtool, or, when theſe are not frequent, once in the twenty four hours, the ſores will generally fill up from the bottom, and will at laſt cicatrize in the ſame manner as wounds in any other part of the body. Sometimes, however, they acquire a ſoft, flabby, unhealthy aſpect, and the matter diſcharged from them is thin, fetid, and occaſionally mixed with blood. Theſe appearances may ſometimes ariſe from ſome part of a ſinus having been overlooked. In this caſe advantage may follow from the part being laid completely open. But it more uſually proceeds from ſome affection of the general ſyſtem; and till this is eradicated the ſores cannot be expected to heal.

In the cure of ſores in other parts of the body, practitioners have ſometimes found great advantage to ariſe from the uſe of iſſues. The ſame thing is now found to be applicable here. Wherever therefore fiſtulæ are of long ſtanding, while any diſorder exiſting in the conſtitution is properly attended to, practitioners recommend, that an iſſue, in proportion to the quantity of the matter diſcharged by the ſores, ſhould be immediately employed. In this way, if the bones in the neighbourhood are not diſeaſed, there will be reaſon to expect that a complete cure will be obtained.

SECT. IV. *Of Prolapſus Ani.*

THIS is a protruſion of part of the rectum beyond the anus. It is often occaſioned by debility of the parts, but is moſt frequently owing to violent exertions made in the rectum in conſequence of irritation. The reduction ſhould be effected as ſoon as poſſible; for although this part of the inteſtine can bear expoſure to air much longer than any of the reſt, yet allowing it to remain a long time out would be attended with great uneaſineſs, and probably with danger. In the reduction, the tumor ought to be ſupported with the palm of one hand, while with the fingers of the other the part of the gut laſt protruded is to be returned. If the gut has been long expoſed previous to the reduction, veneſection may become neceſſary, and gentle aſtringents may be applied to the part. The patient during the reduction is to be kept in a reclined poſture. As ſoon as the bowels

Imperforated Anus.

are returned, a proper bandage (fig. 103.), is to be applied. Such remedies are afterwards to be exhibited as moſt tend to recover the tone of the parts.

Sect. V. *Of Imperforated Anus.*

This diſorder, though not frequent, now and then occurs; and when preſent; unleſs ſpeedy relief be given, muſt prove fatal. In ſome caſes, the end of the rectum protrudes at the uſual ſituation of the anus, and is only covered with the common integuments; but in others, no termination of that gut is diſcoverable. Sometimes the rectum ends within an inch of the uſual ſeat of the anus; at others, it reaches no farther than the top of the ſacrum. In ſome caſes it terminates in the bladder; in others, in the vagina. In the moſt favourable caſes, where the rectum protrudes, an opening may be readily made by a ſcalpel or lancet; but when no direction of this kind is met with, an inciſion is then to be made in the place where the anus is uſually ſituated, and is to be continued in the direction of the os coccygis and ſacrum, which is the courſe the inteſtine commonly takes. The finger is to be uſed as a director along it; the parts are to be cut either till fæces are obſerved, or till the inciſion has been made the length of the finger. If ſtill the fæces do not appear, a lancet-pointed trocar is to be puſhed forward upon the finger in ſuch a direction as the operator thinks will moſt probably reach the gut. An artificial anus is likewiſe to be attempted, where the gut terminates in the bladder or vagina. After the operation, the greateſt attention is neceſſary to preſerve the opening which has been made. Subſtances which irritate leaſt are the moſt uſeful; ſuch as doſſils of lint moiſtened in oil, and rolls of ſoft bougie plaſter.—We ſhall conclude this chapter with two ſhort ſections of imperforated hymen and prolapſus uteri, though they do not properly come under it.

Sect. VI. *Of an Imperforated Hymen.*

When the hymen is imperforated, the moſt troubleſome ſymptoms, at a certain period of life, may be produced by the accumulation of that fluid, which ought to be diſcharged; for then a tumor is formed, by which the moſt violent bearing-down pains are occaſioned. Theſe increaſe in ſeverity to ſuch a degree, as ſometimes to be miſtaken for labour-pains. They diſappear, however, during the intervals of the accuſtomed periods. In the treatment of this diſeaſe, all that is neceſſary is to make either a ſingle or a crucial inciſion into the obſtructing membrane, and then to prevent the accretion of its edges by doſſils of lint ſpread with ſome emollient ointment till the parts are healed.

Sect. VII. *Of Prolapſus Uteri.*

This is a falling down of the uterus, occaſioned by debility or by exceſſive ſtraining in the time of parturition. The diſorder ſeldom occurs before child-bearing, and is commonly met with in thoſe who are ſomewhat advanced in life. The parts protruding are to be reduced by gentle preſſure, while the patient is put in an horizontal poſture. Peſſaries (fig. 91. *a* and *b*) are to be employed, which ought to be made of the lighteſt materials, finely poliſhed, and ſomewhat compreſſible; and none poſſeſs theſe qualities in a more perfect degree than a peſſary made of the elaſtic gum-bottle. This, or whatever elſe may be uſed to anſwer the purpoſe, is to be retained by a proper bandage till by tonic medicines the parts recover ſtrength to retain their natural ſituation.

Chap. XXXI. *Of Luxations.*

Sect. I. *Of Luxations in general.*

A bone is ſaid to be luxated when that part of it forming a joint is moved out of its place. When the bone is forced entirely out of its cavity, the luxation is termed *complete*; when this is not the caſe, it is *partial* or *incomplete*. When there is alſo a wound of the ſoft parts communicating with the joint, it is called a *compound*, and when there is no wound, a *ſimple luxation*.

Luxations in general.

359 Symptoms of luxation.

The common ſymptoms of a diſlocated bone are, inability to move the injured limb; pain, tenſion, deformity in the part affected; and ſometimes inflammation, ſubſultus tendinum, and fever: and theſe three laſt are greateſt in partial diſlocations. The ſwelling which firſt appears is always inflammatory; but afterwards a ſecondary ſwelling comes on, ſeemingly œdematous, and probably owing to the preſſure of the lymphatics by the diſlocated bone.

360 Prognoſis.

In judging of the practicability of reducing a luxation, we ought to attend to its nature and extent, the other circumſtances with which it may be complicated, and the length of time which it has continued. When a bone is only partially diſlocated, it is evident that it may be reduced with much more eaſe and certainty than where it is completely diſplaced. It is evident alſo that fracture attending diſlocation muſt render reduction much more difficult and uncertain. Indeed, when both the bones forming the joint are broken, there is the greateſt hazard of its remaining ſtiff during life, even when the greateſt attention has been paid. Luxated bones are moſt eaſily reduced immediately after they are diſplaced: the difficulty indeed of reducing them is generally proportional to the time that has intervened ſince the accident happened. When a bone has been ſome time lodged among the contiguous muſcles, it forms a ſocket for itſelf, and is firmly graſped by the ſurrounding ſoft parts. The cavity, too, from which it was diſlodged may be partially filled with ſome of the ſurrounding ſoft parts, or at leaſt diminiſhed by the conſtant action of the contiguous muſcles on its cartilaginous brim. Diſſections, however, ſhow, that inſpiſſated ſynovia does not, as was formerly ſuppoſed, fill up this cavity. In delicate conſtitutions and advanced periods of life, when the muſcles give little reſiſtance, diſlocations are more eaſily reduced than in the vigour of youth or in robuſt conſtitutions.

361 Treatment of ſimple luxations.

In the treatment, we ought, 1. To reduce diſlocation with as much eaſe and expedition as poſſible; 2. Retain the bone in its ſituation till the parts have recovered their tone; and, 3. Obviate all uneaſy ſymptoms.

1. When the ſurrounding ſkin and muſcles are much contuſed and inflamed, we ſhould endeavour to remove the inflammation by local blooding, ſaturnine applications, and laying the limb in an eaſy poſture, before we attempt to reduce the bone, as conſiderable injury may be done by ſtretching a limb while the parts ſurrounding the joint are inflamed. The upper part of the limb ſhould be kept ſteady while the ſurgeon endeavours to replace the under bone, which alone is commonly diſplaced. This is not eaſily done; for the contractile power of the muſcles acts ſtrongly againſt every attempt, and not only draws it beyond the contiguous bone againſt which it ſhould be placed, but frequently forces it out of its natural ſituation, and fixes it firmly in ſome neighbouring cavity, from which it is with difficulty removed. To prevent this reſiſtance as much as poſſible, the muſcles ought to be put into a ſtate of relaxation. If this is properly done, the force neceſſary for reducing a luxated bone may generally be obtained from aſſiſtants alone; ſometimes, however, machinery is required, and various inſtruments have been invented for this purpoſe. Freke's machine is the moſt generally uſed. The force ought always to be applied in a gradual manner, and to the diſlocated bone alone, and not to any more diſtant parts of the limb. After the end of the diſlocated bone is brought into a line with that to which it

Luxations of the Bones of the Head and Neck.

is oppoſed, the reduction is eaſily completed either by the action of the muſcles alone, or, if that is not ſufficient, by gentle preſſure.

2. After the reduction there is ſeldom any difficulty in retaining the bone in its place, unleſs it has often been diſlocated before. All that is neceſſary is to place the limb in a relaxed poſture, and to ſupport the bone with a bandage till the parts have recovered their tone.

3. The moſt urgent ſymptoms which accompany diſlocations are, pain, inflammation, and ſwelling. Theſe uſually abate ſoon after the reduction. If any degree of inflammation remain, the uſe of leeches is the beſt remedy.

362 Treatment of compound luxations.

When diſlocated bones are accompanied with fracture near the joint, the fracture muſt be allowed to heal before reduction be attempted. This, however, is not always neceſſary in very ſmall bones, as thoſe of the fingers. When the fracture is at a diſtance from the joint, the diſlocation may generally be reduced immediately. Compound luxations are to be treated nearly as compound fractures. After the bone is replaced, leeches ſhould be applied to abate the inflammation; after which the ſore ſhould be dreſſed with Goulard's cerate, or any other mild ointment, and the pain moderated by opiates and a low regimen: care ought alſo to be taken that no matter lodge about the joint. When luxations are produced by tumors or collections of matter in the neighbourhood of the joints, they may be conſidered as incurable: when they proceed from too great a relaxation of the ligaments and tendons of the joint, the bone can hardly be prevented from being now and then diſplaced; but the inconvenience may be ſomewhat obviated by ſupporting the limb with a proper bandage, by the uſe of the cold bath, and by electricity.

Sect. II. *Luxations of the Bones of the Head and Neck.*

363 Luxations of the bones of the cranium.

364 Of the bones of the noſe.

365 Of the lower jaw.

If the bones of the cranium be ſeparated by external injury, all that can well be done is, to ſupport the parts by a bandage, to prevent inflammation, to keep the patient quiet, and in a proper poſture during the cure. The bones of the noſe are ſeldom luxated without fracture: when they are, the injury is eaſily diſcovered by the touch. When one of the bones is driven inwards, it may be raiſed and reduced by puſhing a tube of a proper ſize, and covered with ſoft lint, into the noſtril; which may be afterwards retained till there is no danger of the bone being again diſplaced. If the bone be luxated outwards, it may be reduced by the fingers, and retained by a double-headed roller. The lower jaw is luxated moſt frequently when the mouth is opened widely; it can only take place forwards and downwards, which are leaſt ſurrounded by the neighbouring parts: both ſides are generally luxated at once; and in that caſe the mouth is opened wide, the chin thrown forwards and towards the breaſt. When only one ſide is diſlocated, the mouth is diſtorted, and wideſt on the ſound ſide of the jaw, which is drawn a little towards the contrary ſide. The patient ſhould be ſeated, and his head ſupported. The ſurgeon ſhould puſh his thumbs, protected by a covering of ſtrong leather, as far as poſſible between the jaws, and then with his fingers, applied on the outſide of the angle of the jaw, endeavour to bring it forward till it move a little from its ſituation. He ſhould then preſs it forcibly down, and the condyles will immediately ſlip into their place. The thumbs ought to be inſtantly withdrawn, as the patient is apt to bite them involuntarily. The patient ſhould for ſome time avoid much ſpeaking or opening his mouth wide.

366 Of the head or neck.

When the head is luxated, it commonly falls forward on the breaſt, the patient is inſtantly deprived of ſenſe and motion, and ſoon dies if the luxation be not quickly reduced. In reducing the luxation, the patient ſhould be placed on the ground, and ſupported by an aſſiſtant: the ſurgeon ſtanding behind ſhould gradually pull up the head, while the ſhoulders are preſſed down by the aſſiſtant till the bones are brought into their place, which is known by a ſudden crack or noiſe: if the patient be not dead, he immediately recovers his faculties, at leaſt in ſome meaſure. He ſhould then be put to bed with his head elevated and retained in one poſture. He ſhould loſe a quantity of blood, and live for ſome time on a low diet.

Luxations of the Spine, Os Coccygis, Clavicle, and Ribs.

Sect. III. *Luxations of the Spine, Os Coccygis, Clavicle, and Ribs.*

367 Luxations of the vertebræ.

368 Of the os coccygis.

The vertebræ are ſometimes partially, but hardly ever completely, diſlocated without fracture. When they occur high up, they are attended with the ſame ſymptoms as diſlocation of the head: when farther down, beſides diſtortion of the ſpine, paralyſis enſues of every part of the body ſituated under the luxated bone; there is commonly alſo either a total ſuppreſſion of urine, or it is diſcharged involuntarily together with the fæces. As luxations of this kind are generally owing to falls or violent blows, the diſplaced vertebra is driven either forwards or to one ſide; it is therefore very difficult to reduce it. The beſt, as well as the ſimpleſt method, is to lay the patient on his face over a cylindrical body, as a large caſk, and at the ſame time to attempt to replace the bone with the fingers. If the bone be very much diſplaced, there is very little reaſon to hope for ſucceſs. The os coccygis is more liable to diſlocation than any other part of the ſpine. It is ſometimes forced outwards in laborious births. This is diſcovered by the great pain which is felt at the connection of the os coccygis with the ſacrum, and by the bone appearing to be diſplaced when examined. It may generally be eaſily reduced by preſſure with the fingers. The beſt ſupport afterwards is a compreſs, with the T bandage. When the coccyx is luxated inwardly, the patient complains of ſevere pain, teneſmus, and a ſenſe of fulneſs in the rectum; the fæces are paſſed with difficulty, and in ſome caſes a ſuppreſſion of urine takes place. The injury is eaſily diſcovered by introducing the finger into the anus. In this caſe the bone ſhould be preſſed outwards, by introducing the fore and middle fingers of one hand dipped in oil into the rectum, and ſupporting the parts which correſpond with it externally till the reduction is accompliſhed. Diſlocations of theſe bones are apt to excite inflammation, which often terminates in dangerous abſceſſes; it ought therefore to be guarded againſt by every means in our power.

369 Of the clavicle.

The clavicle is moſt frequently luxated at its junction with the ſternum; becauſe the violence which produces the injury is generally applied to the ſhoulder. The luxation is diſcovered by pain in the part, by the projection of the bone, and by the immobility of the ſhoulder. It is eaſily reduced by puſhing the bone into its place with the fingers, while an aſſiſtant draws back the arms and ſhoulders. It is not ſo eaſy to retain the bone in its place. When it is the inner extremity of the clavicle which has been diſlocated, the ſhoulder ſhould be kept in its natural ſituation, neither raiſed nor depreſſed: the fore arm ſhould be ſupported, as ſhould alſo the head and ſhoulders, and a moderate preſſure ſhould be made upon the diſplaced end of the bone. For this purpoſe the machine repreſented fig. 104. the invention of Mr Park of Liverpool, anſwers beſt. But when the outer extremity of the clavicle has been diſlocated, the ſhoulder muſt be conſiderably raiſed, the arm ſupported in a ſling, and the bone kept in its proper ſituation by a ſmall compreſs placed over its end, and ſecured by a roller forming the figure 8; or it may be retained by the machine abovementioned. The bandage ought to be retained for a conſiderable time.

370 Of the ribs. Luxations of the ribs are exceedingly rare. The ſymptoms are nearly the ſame with thoſe ariſing from fracture, only that the pain is more ſevere at the articulation, and that no other ſpot but that will yield to preſſure. All that can be done is to bend the body forward over a caſk or ſome ſuch body, in order to aſſiſt the viſcera in preſſing out the rib. Bandages are of little uſe. The patient ſhould be kept quiet, and fed on a low diet: inflammation ſhould be prevented, and opiates given if he has a troubleſome cough.

Sect. IV. *Luxation of the Bones of the Superior Extremities.*

371 Luxation of the head of the os humeri. The head of the os humeri is moſt frequently diſlocated forwards and downwards, ſometimes downwards and backwards, but never upwards without a fracture of that part of the ſcapula which is placed above the joint. The luxation is diſcovered by the patient's inability to raiſe his arm, by violent pain attending the attempt, by the luxated arm being of a different length from the other, by the head of the humerus being felt out of its natural ſituation, while a vacuity is perceived under the acromion, and by the flatneſs of the injured joint, while the ſound one has its natural fulneſs. When the luxation is of long ſtanding, the whole arm is apt to become œdematous.

372 Method of reduction. The patient ſhould be ſeated on a chair, and his body ſecured by a broad belt paſſed round it, and held by aſſiſtants. The elbow ſhould be bent, in order to relax the muſcles on the fore part of the luxated joint. A firm leather belt four or five inches broad, with ſtrong ſtraps, and lined with flannel, is to be tied round the arm immediately above the elbow: aſſiſtants are to extend the arm gradually, by pulling theſe ſtraps, while another aſſiſtant draws back the ſcapula. The ſurgeon ſtands on the outſide of the arm, directs the aſſiſtants, and varies the direction of the extenſion, according to the ſituation of the head of the bone. As ſoon as the head of the bone has cleared the brim of the ſocket, the muſcles draw it into its place, a crack is heard, the patient is relieved, and the anterior part of the ſhoulder acquires its uſual fulneſs.

373 Various methods of extending the arm. Various other methods of extending the arm have been propoſed in difficult caſes; as, ſuſpending the patient by the luxated arm over the ſtep of a ladder or the top of a door, raiſing him up by the arm with ropes running over pulleys fixed in the ceiling of a room, &c. The jerk produced by the body being ſuddenly raiſed and let down again on a feather bed, has ſometimes ſucceeded when other means have failed. A gentler method is to lay the patient on the floor while two or three ſtout men ſtanding on a table lay hold of him by the arm and pull him up. But all theſe methods are in danger of lacerating the ſoft parts by the ſuddenneſs with which the force is applied, and even ſometimes of breaking the end of the humerus if it be preſſed againſt the neck of the ſcapula. Mr Freke's improvement on the ambé of Hippocrates has been conſidered as the beſt machine for extending the arm. But machinery is very ſeldom neceſſary; even caſes of long ſtanding may by proper management be reduced by means of aſſiſtants, provided reduction be at all practicable. Inflammation after the operation ſhould be obviated by the uſual remedies. If the bone be apt to ſtep out again, which ſometimes happens after repeated diſlocations, the arm ſhould be ſupported in a ſling till the parts have recovered their tone. Bliſters, friction, ſtimulating medicines applied to the ſhoulder, and cold water poured on it, have ſometimes been uſeful in reſtoring the ſtrength of the joint.

374 Luxations of the elbow. Luxations at the elbow moſt commonly happen upwards and backwards; and then the fore-arm is ſhortened, the end of the ulna projects behind, and is higher than uſual, while the extremity of the humerus can be felt in the bend of the elbow. The ſurgeon ſhould take hold of the wriſt with one hand, and the upper part of the fore-arm (which is to be moderately bent) with the other, and gradually pull the top of the fore-arm downwards, while at the ſame time he increaſes the curvature of the elbow to diſengage the ends of the bones from each other. He ſhould then pull the bones forward into their ſituation. When the luxation happens upwards and forwards, it ſhould be reduced while the arm is extended. After the reduction, the muſcles of the fore-arm ſhould be kept relaxed by bending the elbow a little till the parts have recovered their tone. When the bones of the fore-arm are diſlocated from each other, which happens moſt frequently at the wriſt, the rotatory motion of the hand is deſtroyed. After the reduction, the bones ſhould be bound together by a tight flannel roller, or a couple of ſplints ſhould be applied along the fore-arm, and the arm ſupported in a ſling.

375 Luxations at the wriſt. The bones of the wriſt are not ſo often luxated as might be expected from the ſmallneſs of their ſize. When they are, great ſwelling and pain enſues, and the motion of the joint is entirely deſtroyed. Great attention is neceſſary, leſt luxation ſhould be miſtaken for a ſprain. The arm and hand ſhould be ſupported by aſſiſtants, but not ſtretched; and then the bones ſhould be puſhed into their place, and afterwards retained by proper bandages and ſplints. The bones of the metacarpus, when they happen to be diſlocated, which is very ſeldom, are to be reduced in the ſame manner. Diſlocations of the thumb or fingers are eaſily diſcovered. To reduce them, an aſſiſtant ſhould hold the phalanx from which the diſlocation happened, while the ſurgeon endeavours to elevate the bone from the one contiguous to it, and to paſs it into its place.

Sect. V. *Luxations of the Bones of the inferior Extremities.*

376 Luxation of the hip joint. From the great ſtrength of the hip joint, it was formerly believed that the head of the thigh-bone was never luxated by external violence; but it is now known that it happens by no means unfrequently. The ball in ſtarting from its ſocket generally paſſes forwards and downwards into the foramen thyroideum.
377 Symptoms. When this happens, the limb is conſiderably lengthened, the head of the bone is lodged near the under and fore part of the pelvis, the large trochanter is obſerved on the fore part of the thigh, a vacancy is perceived where the head of the bone and the trochanter ſhould be, and the toes are turned outwards. When the bone is diſlocated upwards and backwards, the limb is ſhortened, the great trochanter higher than uſual, the knee and foot turned inwards. When it is diſlocated upwards and forwards, the leg is ſhortened, the ball of the bone is felt on the os pubis in the groin, and the great trochanter on the upper and lower part of thigh; a vacancy is diſcovered in the correſponding part of the hip; the knee and toes are turned outwards. When the ball ſlips downwards and backwards, the leg is lengthened, the toes turned inwards, and the great trochanter is lower than that of the other limb. If the ball ſlip directly downwards, the leg is lengthened, but the knee and toes keep nearly their natural ſituation. It is ſometimes difficult to diſtinguiſh between luxation and fracture of the neck of the bone. In fractures the bone is moſt frequently puſhed upwards, and the leg ſhortened, the knee and point of the toes are turned inwards, and may be moved much more readily outwards and inwards than when the bone is diſlocated.

378 Method of reduction. For reduction, the patient ſhould be laid on a mattreſs on the ſound ſide, and a wooden roller covered with ſeveral folds of flannel placed between his thighs, and fixed firmly by ſtraps to the wall. A ſtrong bandage of buff leather, or ſomething ſimilar, ſhould be applied to the under end of the thigh, with ſtraps fixed to it to make the extenſion. The trunk of the body ſhould be properly ſecured, and the joint of the knee bent. The extenſion ſhould be made at firſt gently, and increaſed gradually, while, at the ſame time, the thigh is made to roll in different directions. When the extenſion is ſufficient, two aſſiſtants ſhould lay hold of the roller, and attempt to raiſe the bone; the extending force ſhould then be ſlackened, and the ſurgeon ſhould puſh the head of the bone upwards and outwards, while an aſſiſtant preſſes the knee forcibly inwards. The muſcles themſelves will then commonly bring the bone into its place; and this is done with ſuch a jerk and noiſe, that it is heard by the byſtanders. If the reduction be not obtained, the extenſion muſt be repeated with greater force. Inſtead of the roller a broad ſtrap or table cloth is frequently uſed. The limb ſhould not be uſed for ſome time after reduction, and inflammation ſhould be prevented by the proper remedies.

379 Luxation of the patella. The patella can neither be luxated upwards or downwards, without rupture of the tendons of the extenſors muſcles, or of the ſtrong ligament which fixes it to the tibia; but it may be luxated to either ſide. The luxation produceſs lameneſs, and much pain on attempting to move the joint. In recent caſes the injury is eaſily diſcovered; but when the ſurgeon is not called immediately, the ſwelling may be ſo great as to render it more difficult. For reduction, the limb ſhould be kept extended; the ſurgeon, by depreſſing the edge of the patella moſt diſtant from the joint, is enabled to raiſe the other, and puſh the bone into its place.

It may be neceſſary to remain a day or two in bed till the knee recover its tone. Sometimes after the bone has been diſplaced, returns of the ſame complaint become frequent. In ſuch caſes, proper machinery applied to the ſide of the tumor, where the bone is apt to ſtart out, is uſed with advantage.

380 Luxation of the tibia at the knee. From the ſize of the joint, and the great ſtrength of the ligaments, luxations of the tibia from the os femoris rarely occur. When it does, it is eaſily diſcovered by the pain, lameneſs, and deformity of the limb. The patient ſhould be laid on a table, the muſcles relaxed, and the thigh ſecured by aſſiſtants; the limb ſhould then be extended, and the bones cleared of each other, when they will be eaſily replaced. After the reduction, the limb ſhould remain for ſome time perfectly at reſt; and inflammation, which is very apt to enſue, and is attended with very bad conſequences, ſhould be aſſiduouſly guarded againſt.

381 Luxation of the ankle-joint. If the ankle joint be diſlocated forwards, the fore part of the foot is lengthened; if backwards, the foot is ſhortened and the heel lengthened (this is the moſt common variety); if to either ſide, there is an uncommon vacancy on the one ſide, and a prominency on the other. Diſlocation, however, can hardly take place outwardly without fracture of the end of the fibula.

For reduction, the limb ſhould be firmly held by aſſiſtants, the muſcles relaxed, and extenſion made till the bones are cleared of each other, when the aſtragulus will eaſily ſlip into its place.—The ſame rules ſhould be obſerved in reducing diſlocations of the bones of the foot. Luxations of the metatarſal bones and toes are reduced exactly in the ſame manner as the bones of the metacarpus and fingers.

CHAP. XXXII. *Of Fractures.*

SECT. I. *Of Fractures in general.*

THE term *fracture* is generally confined to ſuch diviſions in bones as are produced by external injury. When the integuments remain ſound, the fracture is called *ſimple;* when it communicates with a wound, it is called *compound*.

382 Symptoms of fracture. The general ſymptoms of fracture are pain, ſwelling, and tenſion in the contiguous parts. A grating noiſe when the part is handled, diſtortion, and a certain degree of loſs of power in the injured part, accompany almoſt every fracture, except when it runs longitudinally, and the divided parts are not completely ſeparated from each other. When there is only a ſingle bone in a limb, a fracture is eaſily detected; but where only one of two bones of a limb has ſuffered, it is often difficult to judge with certainty, eſpecially if the contiguous ſoft parts be tenſe and painful before the practitioner is called. In that caſe, the opinion muſt be regulated, not only by the attendant ſymptoms, but, 1ſt, By the age and habit of the patient; for bones are more eaſily fractured in old than in young perſons. Different diſeaſes, too, induce brittleneſs of the bones, as the lues venerea and ſea-ſcurvy. 2d, By the ſituation of the part; for bones are more apt to be fractured in the ſolid parts of their bodies than towards their extremities, where they are more ſoft and pliant. 3d, By the poſture of the limb; for a weight may fracture a bone lying on an unequal ſurface, which it would have ſuſtained without injury if equally ſupported. Fractures are ſometimes attended with a great degree of echymoſis, occaſioned by the ends of the fractured bones wounding ſome of the contiguous blood-veſſels.

383 Prognoſis. In giving a prognoſis of fracture, various circumſtances are to be attended to. It is evident that ſmall fractured bones are more eaſily healed than large ones, and that the fracture of the middle of a bone is not near ſo dangerous as near the extremity. A cure is effected much more readily in youth than in old age, and in good conſtitutions than in bad. We ought alſo to attend to the concomitant ſymptoms, and the injury which the neighbouring parts may have ſuſtained. The more moderate the ſymptoms, the more favourable our prognoſis may be.

384 Treatment. The treatment of fractures conſiſts of three particulars; replacement, retention, and obviating bad ſymptoms.

1. When bones are fractured directly acroſs the parts, they are often very little moved from their natural ſituation; but when the fracture is oblique, they are apt to paſs over each other, and to produce much uneaſineſs and deformity; the contiguous muſcles are ſeverely injured, and the pain is aggravated by the ſlighteſt motion. The ſurgeon ſhould put the limb into the beſt poſture for relaxing all the muſcles connected with it, according to the practice firſt introduced by Mr Pott. If it be properly attended to, the ends of the bones will in general be eaſily replaced. When any difficulty occurs, a ſmall degree of extenſion may be made, taking care to keep the muſcles as relaxed as poſſible. Much attention ſhould be paid to replacing the bones properly, otherwiſe the limb will remain for ever after diſtorted.

2. After the bones are replaced, the limb ſhould be laid in the eaſieſt poſture, and the bones afterwards retained in their ſituation by proper compreſſes and bandages, not applied too tightly, till the cure be completed. The time neceſſary for this purpoſe depends on the ſize of the bone, the age and habit of the patient, the ſteadineſs with which the limb has been retained in its place, and the violence of the

Fractures in general.

the attending ſymptoms. In middle-aged perſons, and under favourable circumſtances, a fracture of the thigh bone, or of the bones of the leg, may be cured in two months; of the arm bone, or bones of the fore arm, in ſix weeks; of the ribs, clavicles, and bones of the hand, in three weeks. In infancy the cure will take a ſhorter, and in old age a longer, time than this.

3. In ſimple fractures the inflammatory ſymptoms generally ſubſide in a few days. When they become worſe, which is ſometimes the caſe, aſtringent applications ſhould be employed. If theſe fail, blood ought to be drawn from the parts affected. This is of ſo much advantage, that it ought never to be omitted where the ſurrounding ſoſt parts are much injured. Friction with emollient oils, warm bathing, the uſe of Bath and other ſimilar waters, are alſo of much ſervice. The limb ſometimes puts on a clumſy appearance from an overgrowth of callus. When this tendency appears, ardent ſpirits and other aſtringents are conſidered as uſeful; ſometimes preſſure on the part by a thin plate of lead fixed by a bandage may be advantageous. Many inſtances occur, however, where no remedies prove ſucceſsful: The patient ought therefore to be acquainted beforehand with the probable event, to prevent unpleaſant reflections afterwards.

Sometimes the ends of the bone remain looſe long after they might have been reunited. This may be owing to ſome conſtitutional diſeaſe, to the bones not being kept ſteadily in contact, to ſome of the ſoft parts getting in between them, or to the bone being broken in different places, and the intermediate fractures being too ſmall to adhere. Pregnancy has alſo been mentioned as a cauſe. By removing theſe obſtructions, a perfect union may in recent caſes be accompliſhed. But where the caſe is of long ſtanding, callus of the bones become ſo hard and ſmooth as to move with the eaſe of a joint, ſo that no advantage can be derived from laying them together. In that caſe, an inciſion ſhould be made through the ſoft parts, and a ſmall portion of the ends of the bone removed with a ſaw. If this be properly performed, nature will ſupply the deficiency. When ſmall pieces of bone remain long looſe, they ſhould be extracted by making an opening. The intervention of muſcles or other ſoſt parts is known by the very ſevere pain and tenſion, and by particular motions of the limb cauſing great pain and twitching of the muſcles which move it. The limb ſhould be put into all the variety of ſituation; and if this does not ſucceed, an opening muſt be made, and the ſoft parts removed. Sometimes in fractures blood-veſſels are ruptured by the ſharp ſpiculæ of the bone: this happens moſt commonly in compound fractures. When the effuſion of blood is great, the part ſwells ſo much that it is neceſſary to lay it open, and to ſecure the divided veſſels by a ligature. When the ſwelling is not great, the abſorption of the blood is truſted to nature. When the blood remains long in contact with the fractured bone, it ſometimes prevents the formation of callus; the perioſteum ſeparates from a conſiderable portion of the bone, and a thin fetid ſanies is diſcharged at the wound. When this happens, no cure can be expected till the parts of the bone deprived of perioſteum have exfoliated, or have been ſeparated by a ſaw.

SECT. II. *Fractures of the Bones of the Face.*

385 Fracture of the noſe.

FRACTURES of the noſe may impede reſpiration, affect the ſpeech, and ſenſe of ſmelling, give riſe to polypi and tedious ulcers, and may beſides be dangerous from their vicinity to the brain. When any part of the bones of the noſe has been raiſed above the reſt, it is to be preſſed into its place with the fingers; if it has been puſhed into the noſtril, it is to be raiſed with the end of a ſpatula or other ſimilar inſtrument. If any portion be almoſt entirely ſeparated from the reſt, it ſhould be removed; but if it adheres with conſiderable firmneſs, it is to be replaced. If the bones, after being replaced, do not remain in their proper ſituation, they are to be retained either by tubes introduced into the noſtrils, or by a double-headed roller, with proper compreſſes as the caſe may require. Inflammation ſhould be prevented by the proper remedies.

Fractures of the Clavicles, Ribs, Sternum, and Spine.

Much care is neceſſary in replacing the fractured bones of the face, and in dreſſing them, in order to prevent deformity. The dreſſings may be retained by adheſive plaſters. Inflammation, by which the eyes, noſe, or antrum maxillare is apt to be injured, ſhould be prevented. When matter collects in the antrum, it is to be removed by the methods formerly deſcribed.

386 Fractures of the lower jaw.

For replacing fractures of the lower jaw, the patient ſhould be ſeated in a proper light, with his head firmly ſecured. The ſurgeon ſhould preſs with one hand on the inſide of the bone, while with the other he guards againſt inequalities on the outſide. If a tooth come in the way, it ſhould be extracted; when any of the others are forced out of their ſockets, they ſhould be replaced, and tied to the neighbouring teeth till they become firm. The fractured parts being kept firm by an aſſiſtant, a thick compreſs of linen or cotton ſhould be laid over the chin, and made to extend from ear to ear over it; a four-headed roller ſhould be applied firm enough to keep the fractured parts in contact. The patient ſhould be kept quiet during the cure, and fed upon ſpoon-meat. The dreſſings ſhould be removed as ſeldom as poſſible. When the fracture is accompanied with an external wound, the parts ſhould be ſupported by an aſſiſtant during the dreſſing of it.

SECT. III. *Fractures of the Clavicles, Ribs, Sternum, and Spine.*

387 Fracture of the clavicle.

A FRACTURE of the clavicle is eaſily diſcovered by the grating noiſe in the fractured bone upon moving the arm freely, by the ends of the bone yielding to preſſure, and by the motion of the humerus being impeded. All that can be done is to raiſe the arm, and ſupport it at a proper height, either by a ſling, or, which is better, by the leather caſe recommended in caſe of luxation of this bone. By this the fractured parts will be brought together, ſo far at leaſt as to prevent deformity, and render the bone ſufficiently ſtrong.

388 Of the ribs.

Fractures of the ribs are diſcovered by preſſures with the fingers. The ſymptoms are commonly moderate, and the patient ſoon gets well. In ſome caſes, however, the pain is ſevere, the breathing becomes difficult, attended with cough, and perhaps with ſpitting of blood, and the pulſe is quick, full, and ſometimes oppreſſed. Theſe ſymptoms ariſe from the ribs being beat in on the lungs.

In the treatment, it is proper in every caſe to diſcharge ſome blood. If one end of the rib riſe, it ought to be repreſſed by moderate preſſure; and to prevent its riſing again, a broad leather belt ſhould be applied pretty tight, and continued for ſome weeks. When a portion of the rib is forced inwards, an opening ſhould be made over it with a ſcalpel, and then it ſhould be elevated with the fingers or a forceps. When diſtreſſing ſymptoms proceed from air or blood collected in the cavity of the cheſt, theſe fluids ought to be diſcharged by an operation.

389 Of the ſternum.

The ſymptoms of a fractured ſternum are nearly the ſame with thoſe of the ribs. It requires great attention from the vicinity of the heart and large blood-veſſels. The patient ought to loſe a quantity of blood, and be kept on an antiphlogiſtic regimen. If the pain, cough, and oppreſſed breathing, do not yield to theſe remedies, and inciſion ſhould be made on the injured part, and the depreſſed piece raiſed with a levator. Should this be inſufficient, it may be effected by means of the trepan: this indeed requires the greateſt caution, but it may certainly be attended with advantage when the patient's life is in danger.

390 Of the vertebræ. Fractures of the vertebræ generally end fatally. We judge of the exiſtence of fracture there by examining the parts, by the ſeverity of the pain, and by palſy occurring in the parts ſituated below the injured part.

When any parts of the vertebræ near the integuments are looſe, they may be replaced with the fingers, and retained by proper bandages. When this is impoſſible, ſome of the lateſt authors think it adviſable to make an inciſion, and raiſe any portions of the bone which may be depreſſed.

Sect. IV. *Fracture of the Bones of the Superior Extremities.*

391 Fracture of the ſcapula. The ſcapula is ſeldom fractured; when it is, the fracture is eaſily diſcovered by the pain, the immobility of the arm, and by the touch. The parts may be replaced with greater eaſe if the muſcles connected with them be relaxed. They are retained with difficulty. A long roller ſhould be employed for this purpoſe, with which the head and ſhoulders are alſo to be ſupported. The arm ſhould alſo be ſuſpended to relax the muſcles as much as poſſible, and inflammation particularly guarded againſt by local bloodings.

392 Of the os humeri; Fractures of the humerus are eaſily diſcovered by the pain, the immobility of the arm, and a grating noiſe on handling the parts. In reducing the fracture, the muſcles ſhould be completely relaxed by bending the arm and raiſing it to a horizontal poſture. Extenſion, if neceſſary, may be made by one aſſiſtant graſping the arm between the fracture and the ſhoulder, and another between the fracture and the elbow. After the reduction, one ſplint covered with flannel ſhould be laid along the whole outſide, and another along the whole inſide of the arm; and then a flannel roller applied ſufficiently tight to ſupport the parts without interrupting the circulation. The arm may either be ſupported in a ſling or Mr Park's leather caſe, (fig. 104). The bandages ſhould not be removed for ſeveral days, unleſs ſome urgent ſymptoms render it neceſſary. In about a week, however, the arm ſhould be examined to ſee whether the bones have been properly ſet.

393 Of the bones of the fore-arm; When both of the bones of the fore-arm are broken, the fracture is eaſily diſcovered; but when only one bone is fractured, eſpecially if it be the radius, the firmneſs of the other renders the diſcovery more difficult; the grating noiſe, however, on moving the bone in different directions, will generally be a ſufficient ſymptom that a fracture has taken place. When the fracture happens near the wriſt, particular attention is neceſſary in order to prevent a ſtiff joint. In order to replace the parts, the muſcles are to be relaxed by bending the joints of the elbow and wriſt, and the limb extended a little above and below the fracture. After reduction, a ſplint reaching from the elbow to the ends of the fingers is to be applied along the radius, and another along the ulna; and both are to be ſecured with a roller or twelve tailed bandage. When the ſplints are applied, the palms ſhould be turned towards the breaſt as the moſt convenient poſture. The arm ſhould be hung in a ſling. A partial diſlocation of the bones of the wriſt ſometimes attends a fracture of the radius, by which a ſtiff joint, under the beſt practice, is apt to enſue, or permanent painful ſwellings of the fore-arm. In ſuch caſes, the patient ought to be warned of the danger, that no blame may be afterwards incurred.

394 Of the olecranum; When the olecranum is fractured, the arm muſt be kept in an extended ſtate during the cure, by applying a ſplint oppoſite to the joint of the elbow, reaching from the middle of the humerus to the points of the fingers. The arm ſhould be hung by the patient's ſide, to which it ſhould be fixed by means of ſtraps. To prevent the conſequences of a ſtiff joint, the dreſſings ſhould be removed about the eighth or tenth day, the fore-arm for ſome time ſlowly moved backwards and forwards, and the joint rubbed with an emollient oil. By a repetition of this at proper intervals, a ſtiff joint may be prevented.

395 Of the bones of the wriſt; Anchyloſis, or ſtiffneſs of the joint commonly ſucceeds fractures of the bones of the wriſt, owing to the great inflammation which enſues, and to their not readily reuniting from their ſmallneſs. To prevent this as much as poſſible, after replacing the bones, the injured parts ſhould be leeched freely, and in proportion to the violence of the ſymptoms. Splints ſhould be applied exactly as in fractures of the fore-arm, and the arm ſupported by a ſling.

396 Of the bones of the fingers. In fractures of the metacarpal bones, a firm ſplint ſhould be applied over the whole palm and inſide of the arm, from the points of the fingers to the elbow, in order to prevent the action of the flexors of the fingers. The beſt ſplint for a fractured finger is a piece of firm paſteboard properly fitted and ſoftened in water till it can be readily moulded into the form of the part. This ſhould be applied along the whole length of the finger, and ſecured with a narrow roller. At the ſame time, a large roller ſhould be applied over the inſide of the hand to prevent the parts from being moved. To prevent ſtiffneſs, the dreſſings ſhould be removed about the end of the ſecond week, and the joint cautiouſly bent; and this ſhould be repeated daily till the cure be completed.

Sect. V. *Fractures of the Bones of the inferior Extremities.*

397 Fracture of the thigh-bone. Fractures of the body of the thigh bone are readily diſcovered by the grating noiſe when the ends of the bones are forcibly rubbed together, by the ſhortneſs of the limb if the fracture be oblique, and by the limb being unable to ſuſtain the body. But fractures of the neck of the bone are often not eaſily diſtinguiſhed from diſlocation of the joint In general they may be diſtinguiſhed by the circumſtances mentioned in treating of luxations of this bone. In forming a prognoſis, we ought to conſider that no fractures are more apt to diſappoint our expectations than thoſe of the thigh, eſpecially when the neck of the bone is broken, owing to the difficulty of diſcovering the place of the fracture, and of retaining the bones even after they have been replaced. In order to reduce fractures of the thigh, the muſcles are to be relaxed by moderately bending the joints of the thigh and knee: when this is done, unleſs there be much pain and tenſion, the bones are eaſily replaced by one aſſiſtant holding the upper part of the thigh, while another ſupports and gently pulls down its lower extremity, while the ſurgeon is employed in adjuſting the fractured pieces. It is more difficult to reduce fractures of the neck of the bone, on account of the great ſtrength and various directions of the ſurrounding muſcles. In general, however, we ſhall ſucceed by moderate extenſion, if we take care previouſly to relax all the muſcles as much as poſſible: if we do not ſucceed, we muſt have recourſe to machinery.

The greateſt difficulty is to retain the bones in their ſituation after they are replaced. The limb muſt be firmly ſecured by ſplints made of thin ſlips of wood glued to leather (fig. 105. *a* and *b*), or of thick paſteboard. One ſplint, broad enough to cover half of the thigh, ſhould reach from the top of the hip joint to a little below the knee, and another, covering about a third part of the thigh, from the groin to a little below the knee. The ſplints ſhould be lined with flannel. They are to be ſecured by a twelve-tailed bandage, and over all a thin pillow ſhould be put nearly as long as the thigh. The ſplints and bandages may be put on in the following manner: The patient being placed on a firm hair mattreſs, with his knee moderately bent, the long ſplint bandage and pillow are to be applied to the outſide of the thigh, and the patient ſhould be turned ſomewhat towards the affected ſide, with the knee and leg raiſed a little higher than the body: the ſhort ſplint ſhould then be applied along the inſide of the thigh, and the bandage already placed without the other ſplint, applied ſo tight as to make an equal moderate preſſure over the whole: (See fig. 106.) To make the part ſtill more ſecure, it is proper to inſert a long firm ſplint of timber under the middle of the pillow, and to fix it by two broad ſtraps to the upper part of the limb. To prevent the limb from being affected by involuntary ſtartings, the pillow ſhould be fixed to the bed by ſtraps: to keep off the weight of the bed-clothes, a frame with hoops ſhould be placed over the thigh. The parts ſhould be examined after ſome time to ſee that the bones be not diſplaced. When there is pain, ſwelling, and inflammation, leeches and other remedies ſhould be applied. To render the ſituation of the patient as eaſy as poſſible during the cure, he may be allowed after the ſecond week to turn a little more towards his back, and at the ſame time to extend the joint of the knee in a ſmall degree: after this time a little flexion and extenſion of the limb may be daily repeated to preſerve the uſe of the joint.

The method here deſcribed generally ſucceeds. Sometimes, however, notwithſtanding all our care, the ends of the bone ſlip over each other. To prevent the deformity which this occaſions, it has been attempted to make extenſion and counter-extenſion by machines: but the pain and irritation have always been ſo great that little advantage has yet been derived from ſuch means. The invention (fig. 107.) of the late Mr Gooch of Norwich, improved by the late Dr Aitken of Edinburgh, has been recommended as one of the beſt machines for oblique fractures of the thigh. After endeavouring to remove the pain, ſwelling, and inflammation, which are ſometimes ſo great as to preclude the application of the ſimpleſt bandage, this machine may be tried. But if it be found impracticable to uſe it, the cure muſt be conducted in the uſual way with the chance of the fractured pieces overlopping one another, and of courſe the limb being ſomewhat ſhortened.

398 Fracture of the patella.

The *patella* is moſt frequently fractured tranſverſely, ſometimes lengthwiſe, and ſometimes into ſeveral pieces. Fractures of this bone have been ſaid commonly to end in a ſtiff joint; but this is perhaps moſt frequently owing to the limb being kept too long in an extended poſture. In the treatment of fractures of this bone, the leg ſhould be extended to relax as much as poſſible the ſoft parts connected with the bone. The patient ſhould be placed on a firm mattreſs, and a ſplint be placed under the limb long enough to reach from the top of the thigh to the under end of the leg, to which the limb ſhould be fixed by a number of ſtraps to keep it in a ſtate of extenſion. The fractured bones are then to be brought together, and ſuch a number of leeches applied to the joint as will remove as much blood as the patient can bear; and as long as much pain and tenſion continue, ſaturnine and other aſtringents are to be uſed for removing them. When this is accompliſhed, and the parts properly adjuſted, a large pledget of Goulard's cerate ſhould be laid over the joint, and a hooped frame employed to keep off the bed-clothes. In a longitudinal fracture the parts are eaſily kept together by a common uniting bandage or adheſive plaſter; but in tranſverſe fractures more force is neceſſary. Various bandages have been employed for drawing the pieces together in ſuch fractures: one of the beſt of theſe is that repreſented fig. 108. We need not be anxious, however, about bringing the pieces very cloſe together, as a cure may be made though they remain at a conſiderable diſtance. The bandages, unleſs particular ſymptoms occur, ſhould not be removed till the end of the ſecond week; after which the joint ſhould be cautiouſly bent every ſecond day to prevent ſtiffneſs.

399 Of the leg;

The leg is commonly fractured near the lower end, this being the weakeſt part of the bones. In the treatment of a fractured leg the ſame rules apply which were given for a fractured thigh-bone. The muſcles ſhould be relaxed by bending the knee; but little advantage can be derived from bending the foot, for in proportion as the muſcles behind are relaxed thoſe before are put on the ſtretch: the patient may be therefore allowed to keep the foot in the eaſieſt poſture. The bones are commonly replaced by the gentle extenſion of the upper part of the limb by an aſſiſtant, while another ſupports it at the ankle. The bones being replaced, and the limb laid on its outſide with the knee bent, two ſplints (fig. 109.) are to be applied, long enough to reach from the upper part of the knee to the edge of the ſole, ſo as to prevent the motion both of the knee and ankle. The ſplints are to be retained by a twelve-tailed bandage, as in the caſe of fractured thigh-bone. See fig. 106.

If the patient be either very reſtleſs or troubled with ſpaſmodic affections of the muſcles of the leg, an additional ſplint, ſhaped to the form of the leg, ſhould be applied along the outſide of it, and fixed by a ſtrap at the upper, and another at the under part of the leg. When the patient cannot reſt when lying on either ſide, he may be placed on his back, and the curved ſtate of the knee ſtill preſerved by raiſing the leg a little above the level of the body on a frame made for the purpoſe. This variety of poſture may likewiſe be uſed in fractures of the thigh. The patient may from the firſt be laid in this poſture, or he may alternately change from the one to the other. No change of poſture, however, ſhould be allowed for the firſt ten or twelve days. When the fibula only is fractured, it is apt to be conſidered as a ſprain of ſome of the muſcles; but this ought to be particularly attended to, as the miſtake may be followed by bad conſequences. When both the bones of the leg are broken, the portion next the foot is commonly drawn towards the back part of the leg, ſo that a prominency is produced by the fractured part of the upper portion of the bone; and this is improperly termed the riſing end of the fractured bone. The appearance is entirely produced by the inferior portion falling back. Hence no advantage is derived from preſſure being made on the upper end of the bone: the inferior portion ſhould be raiſed ſo as to bring the parts into contact, and then by proper bandages they ought to be ſupported till they are perfectly united.

400 Of the bones of the foot and toes.

Fractures of the bones of the foot and toes are treated nearly in the ſame manner as fractures of the hand and fingers. Beſides the ſplint which may be neceſſary for the particular part, a large one ſhould be applied over the ſole; nor ſhould any motion be allowed for a conſiderable time either in the foot or ankle, otherwiſe the bones may be diſplaced, and a proper cure prevented.

Sect. VI. *Of Compound Fractures.*

401 Whether amputation ſhould be performed in caſes of compound fractures.

By compound fracture is now generally meant a fracture of a bone communicating with an external wound in the integuments. They are much more dangerous than ſimple fractures. The generality of authors have conſidered amputation as indiſpenſable in caſes of compound fractures; while a few, particularly Mr Bilgue, ſurgeon-general to the armies of the late king of Pruſſia, affirm that it is ſcarcely ever neceſſary. Both ſeem to have carried matters too far. Some of the lateſt and beſt ſurgeons have recommended

mended never to amputate immediality in private practice, unleſs when the bones are ſo much ſhattered that they cannot reunite, or the texture of the ſoft parts completely deſtroyed; becauſe, even if amputation be at laſt neceſſary, the patient will have a greater chance of recovering than if it had been performed immediately after the accident: for the ſtate of weakneſs to which he is generally reduced render the attendant ſymptoms leſs violent. On the other hand, it has been conſidered as no bad rule in the army or navy, where patients cannot be kept in a proper ſituation, and where ſufficient attention cannot be given, to amputate immediately in caſes of compound fractures of the large bones of the extremities. When amputation is not performed immediately, it is not, for ſeveral days at leaſt, admiſſible. It may afterwards be rendered neceſſary by hemorrhagies, which cannot be ſtopped but by means more dangerous than amputation itſelf; by extenſive mortification; or by the ends of the fractured bones remaining long diſunited, while a great diſcharge of matter endangers the patient's life.

402 Treatment of compound fractures. In treating compound fractures, all extraneous bodies ſhould be removed, as alſo all thoſe ſmall pieces of bone which will probably not unite with the reſt. For this purpoſe the opening, if neceſſary, ſhould be enlarged with a ſcalpel. The next ſtep is to replace the bones by relaxing the muſcles as in ſimple fractures. Sometimes part of a bone projects ſo far through the integuments that it cannot be replaced without either ſawing off the end of it, or enlarging the wound. If the fractured bone be long, ſharp, and projecting much, it is beſt to ſaw it off; for though it were reduced, it would not readily reunite, and it would be apt to excite much pain and inflammation: But if it be broad at the baſe, and of no great length, it ought certainly to be ſaved, even though it cannot be reduced without enlarging the wound. For the moſt part, it is only the ſkin which it is neceſſary to cut; but even the muſcles ought to be divided, though as much as poſſible in the direction of their fibres, when the bone cannot otherwiſe be replaced. After the reduction, a pledget of ſome emollient ointment is to be laid over the wound, and the limb placed on a firm ſplint, and ſtill kept in a relaxed poſture. In dreſſing the wound, the limb ought not to be moved: the many-tailed bandage, therefore, ſhould be uſed rather than a roller. Various contrivances have been fallen upon to allow the limb to be at reſt while the ſurgeon is dreſſing it. The fracture box, invented by the late Mr Rae ſurgeon in Edinburgh, is one of the beſt. When the leg is laid on this, it may be dreſſed with tolerable facility without moving it. We are happy to have it in our power to announce to the gentlemen of the medical faculty, that another machine has lately been invented by Mr Samuel James ſurgeon in Hoddeſden, Herts, which, we are told, will effectually relax the muſcles, and retain the bones in their natural ſituation, without pain to the patient or the leaſt inconvenience to the operator. See fig. 110.

Plate ccccxcii.

It is of the greateſt importance to prevent inflammation, which is apt either to produce mortification, or to give riſe to extenſive abſceſſes. The dreſſings ſhould be removed once or twice daily according to the quantity of matter. The common application of warm poultices, on account of their inconvenience, may be deferred till they become neceſſary by the approach of inflammation, which they are to be conſidered as the ſureſt means of preventing by exciting a diſcharge of matter. Whenever the inflammation ſubſides, and a free diſcharge of pus is produced, the poultices ought to be laid aſide, leſt they do harm by relaxing the parts too much, and exciting too copious a diſcharge. The ſore ought then to be dreſſed with mild aſtringents, and the patient kept on a nouriſhing diet with tonic medicines. A free paſſage ſhould be given to the matter by putting the limb in a favourable poſture, and by making a counter opening, if neceſſary, to the moſt depending part. But this may be frequently avoided, by covering the ſore with ſoft lint or ſponge to abſorb the matter. If the diſcharge become exceſſive, and cannot be leſſened by the means abovementioned, it will be found to proceed from a portion of looſe bone which has not been earlier noticed, by the removal of which it may be ſtopt. If, inſtead of producing matter, the inflammation terminate in gangrene, the danger is ſtill greater than under the moſt extenſive abſceſſes. For the treatment of this, the reader is referred to Chap. III. Sect. 2d.

CHAP. XXXIII. *Of Diſtortions.*

403 Cauſes of diſtortions. DISTORTIONS of the bones may ariſe from external injuries, from diſeaſed conſtitutions, from a morbid ſtate of the bones, or a contracted ſtate of the muſcles, or both; but the affection is moſt frequently owing to a weakly, delicate conſtitution, as in rickety or ſcrophulous caſes.

404 Treatment of diſtortion of the ſpine. In the treatment of diſtortions of the ſpine, particular attention ought to be paid to the cauſe of the diſorder. If it appear to ariſe from the patient continuing too long in any particular poſture, every habit of this kind ſhould be guarded againſt on the firſt appearance of the diſeaſe. If the patient has turned too much to one ſide, the reverſe of this ſhould be adviſed. He ought to ſleep upon a firm hair mattreſs that his body may lie upon an equal ſurface. He ſhould uſe an invigorating diet, the cold bath, bark, and other tonics. By a ſtrict attention to the uſe of theſe remedies the diſeaſe has ſometimes been retarded in its progreſs. Various machines have been invented for removing diſtortions of the ſpine by preſſure; but conſiderable caution is here required, otherwiſe much injury may ariſe from it. Some advantage, however, in certain caſes, has been derived from the uſe of the common collar (fig. 111.); or the ſtays and machinery adapted to them (fig. 112.), for which a patent was granted to Mr M'Kechnie of Philadelphia, are found to be ſtill better ſuited to this purpoſe.

405 Of the limbs. The ſame cauſes which produce diſtortions of the ſpine may likewiſe produce diſtortions of the limbs. Sometimes the diſtortion takes place with the original formation of the bones, at other times it occurs in infancy, and now and then at a more advanced period of life. In early infancy the bones are ſo pliable as to be readily affected by the poſtures of the body. When a child is too ſoon allowed to attempt to walk, its legs are apt to become crooked from their inability to ſupport the weight of the body. Certain diſeaſes likewiſe, eſpecially rickets ſoften the bones ſo much, that they yield to the poſture of the body, and to the common action of their muſcles.

When the diſtortion of a limb, is owing to a curvature in a bone, if the caſe be recent, and eſpecially if it occur in childhood, it may frequently be removed, without much difficulty, by making a gradual but conſtant preſſure, by the uſe of machinery, on the convex ſide of the limb, till it recover its natural appearance. When the deformity occurs in the leg, a method has been uſed, in ſeveral inſtances, which is to fix a firm ſplint of iron, lined with leather, in the ſhoe, on the concave ſide of the leg, the other end of the ſplint to reſt againſt the under end of the thigh; when, if a broad ſtrap or two be applied round the leg and ſplint, an eaſy gradual preſſure may be made, and conſiderable advantage derived from it. See fig. 113.

Along with the curvature abovementioned, it commonly happens that the feet and ankles are affected. When the bones of the leg are bent outward, the fore part of the foot is turned inward, and the inner edge upwards; and the reverſe, if the leg be bent inward. In theſe caſes the affections of the feet are generally owing to the curvature of the bones of the leg. By removing the curvature of theſe, the foot will commonly regain its natural ſituation, and the ſplint abovementioned will for the moſt part be ſufficient for the purpoſe. But in caſes where the ſole of the foot is turned much out of its natural direction, it may be neceſſary to fix the ſplint and ſhoe to a frame (fig. 114.), which will render the cure ſtill more effectual.

Beſides the inſtrument already mentioned, ſome have uſed a kind of boot, cut lengthwiſe, made of hardened leather or of metal, &c. which may in ſome caſes ſufficiently anſwer the purpoſe.

In caſes of club-foot, where the diſtortion is in the middle of the foot, a pair of ſhoes, ſuch as are repreſented in fig. 115. have been found uſeful. After the feet are fixed in the ſhoes, the fore part of the feet may be ſeparated by means of a ſcrew in two plates, which are fixed to the ſole.

CHAP. XXXIV. *Of Amputation.*

SECT. I. *Of Amputation in general.*

IN amputation, which in ſurgery ſignifies cutting off a limb, the great end to the aimed at is, the procuring of a handſome ſtump, in which the bone may not protrude, but be well covered with fleſh; ſo that no excoriation or rawneſs may be apt to take place. As long ago as the year 1679, it was propoſed by Jacob Young, an Engliſh ſurgeon, in a treatiſe intitled *Currus Triumphalis ex Terebinthino,* to preſerve a flap of fleſh and ſkin, which was to be folded over the bone, and which, uniting to the parts of the wound after amputation, would effectually cover the bone, and prevent the inconveniences abovementioned. No traces of the ſucceſs of this method, however, can be found till the year 1696; when a Latin diſſertation was publiſhed upon it by P. Adriens Verduin, an eminent ſurgeon in Amſterdam. The moſt ſanguine expectations were formed of its ſucceſs; and it was even thought that the flap would prevent the neceſſity of tying up the blood-veſſels. However, it does not appear that the method as at that time practiſed either did or could ſucceed; and accordingly it was entirely laid aſide; but it has been lately revived with conſiderable improvements.

406
Cauſes rendering amputation neceſſary.

Amputation may be rendered neceſſary when a member is ſo much diſeaſed as to be uſeleſs, or when it puts life in danger.

The cauſes in general rendering this operation neceſſary are, bad compound fractures; extenſive lacerated and contuſed wounds; part of the limb being carried off by a cannon ball or otherwiſe, the bones being unequally broken and not properly covered; extenſive mortification; white ſwellings of the joints; large exoſtoſes; ulcers attended with extenſive caries; cancer or other incurable ulcers; varicoſe kinds of tumors; particular diſtortions of the bones.

Amputation may alſo be ſometimes neceſſary from violent hemorrhagies of ſome principal artery during the cure of a fractured limb, or from ſuch a purſuſe diſcharge of matter taking place that the ſtrength of the patient is exhauſted. Lacerated and contuſed wounds may require amputation, on account of hemorrhagy enſuing which cannot be ſtopped. Extenſive mortification may take place, and ſuch large quantities of matter be formed, that the patient will be unable to bear up under the diſcharge.

Where part of the limb is carried off, it is neceſſary to amputate higher up, ſo as to cut the bone, as well as the ſoft parts, in ſuch a manner as may admit of a much ſpeedier and ſafer cure. When mortification occurs, every thing ought to be done for the ſupport of the patient till the diſeaſe be ſtopped; the firſt ſign of which is, the appearance of an inflamed circle between the diſeaſed and ſound parts. As ſoon as the diſeaſed begin to ſeparate from the ſound parts, amputation of the limb ought to be performed, and no time ought now to the loſt, leſt the patient ſuffer from the abſorption of putreſcent matter.

No part of ſurgery is brought to greater perfection than the manner of performing amputation. Before the invention of the tourniquet, and the method of ſecuring the veſſels by ligature, the operation was ſeldom undertaken; and a great proportion of thoſe upon whom it was performed died ſoon after. In the preſent improved method, one death does not happen in twenty, or even thirty caſes. In performing the operation, particular attention is to be paid to the ſpot where the inciſion is to be made; the quantity of ſkin and cellular ſubſtance neceſſary to be ſaved, ſo as to cover the muſcles and bone completely, without being ſtretched; cutting the muſcles in ſuch a manner that they may unite with each other and entirely cover the end of the bone; the prevention of hemorrhages during the operation; the tying of the arteries alone, without including the nerves or any of the contiguous parts; ſecuring the integuments ſo as to prevent them from retracting after the operation; and a proper ſubſequent treatment of the caſe.

407
Method of performing amputation.

The following are the general ſteps of the operation: The patient being properly placed, with aſſiſtants to attend, and the apparatus in proper order, the flow of the blood to the limb is to be ſtopped by the tourniquet (fig. 16.). The firſt inciſion is to be made through the ſkin and cellular ſubſtance by one, or rather by two, ſtrokes of the amputating knife repreſented in fig. 116. Theſe are next to be ſeparated from the muſcles, as far as may appear ſufficient for covering the ſtump. The ſeparated ſkin or flap ſhould be ſtrongly drawn up, or what perhaps anſwers better, turned up all round the limb, leaving this part of the muſcles quite bare. The flap is to be kept in this ſituation by an aſſiſtant, while the operator makes the next inciſion at the edge of the reflected ſkin, and cuts till he comes to the bone. This inciſion ſhould be begun on the lower ſide of the limb, that the blood may not prevent the eye from readily following the edge of the knife during the whole cut. The muſcles are now to be ſeparated from the bone as high as may enable them afterwards completely to cover it. The ſoft parts in general are then to be drawn up by retractors, which may be either of leather, as in fig. 117. or metal, as in fig. 118. *a* and *b*. The perioſteum is to be divided at the place where the ſaw is to be applied; but no part of the bone is to be denuded of this membrane, which is afterwards to cover the ſtump, otherwiſe troubleſome exfoliations may enſue. At this place the ſaw (fig. 119.) is to be applied and the bone divided with long ſteady ſtrokes. In this part of the operation a good deal depends upon the ſteadineſs of the aſſiſtant who holds the limb; for if it be held too high, the motion of the ſaw will be impeded; while the bone may be ſplintered if it be not ſufficiently raiſed. Any points or ſplinters which may be left ſhould be immediately removed with the pincers (fig. 120.). The retractors are now to be laid aſide, and the principal arteries ſeparated from the nerves, and ſecured by the tenaculum (fig. 17.), or forceps (fig. 120. *a*), and ligatures.

The tourniquet ſhould next be a little ſlackened, to allow the different branches to be diſcovered: The clotted blood is to be cleared away with a warm ſponge. The patient ſhould get ſome warm cordial drink, and all the arterial branches which can be diſcovered ought to be taken up. The ends of the ligatures are then to be cut of ſuch a length as to allow them to hang without the lips of the wound. The muſcles and ſkin are now to be drawn down and brought

into

Amputating the Arm and Fore-arm.

into cloſe contact, that the ſtump may by completely covered. The parts are next to be ſecured by proper bandaging; and if the operation has been properly performed, the cure will commonly be made by the firſt intention, and may be completed in the courſe of three or four weeks, and ſometimes in a ſhorter period. This however muſt depend much upon the conſtitution of the patient, as well as the manner of performing the operation.

Sect. II. *Of Amputating the Arm and Fore-arm.*

Amputation of the arm is performed according to the rules already laid down. No more of it ſhould be removed than is diſeaſed; for the longer the ſtump is, the more uſeful it proves. The tourniquet is to be applied a little above the part where the operation is to be performed: As much of the integuments ſhould be ſaved as may be perfectly ſufficient for covering the ſore. In taking up the artery after the bone has been divided, the operator ought to be attentive not to include the radial nerve, which may be readily diſcovered and ſeparated, as it lies cloſe upon the fore part of the artery. The fore-arm is to be amputated nearly in the ſame manner as the leg; only that the ſtump may be covered by amputating with the double inciſion, without the aſſiſtance of a flap, which it is neceſſary to form in the leg.

Sect. III. *Of Amputating the Thigh.*

408 Method of performing the amputation.

In performing this operation, the patient ought to be placed upon a table of ordinary height, with the diſeaſed limb ſupported and ſecured by an aſſiſtant ſeated before him, while other aſſiſtants take care of the other leg and the arms. The courſe of the blood is to be ſtopped by applying the tourniquet over the trunk of the femoral artery, near the upper part of the thigh. No more of the thigh ought to removed than is rendered neceſſary by the diſeaſe, as the more of it is left, the more uſeful it will be to the patient. An aſſiſtant ſhould graſp the limb with both hands a little above the place where the ſkin is to be divided, and draw it up as far as poſſible; while the operator; ſtanding on the outſide of the limb, makes a circular inciſion down to the muſcles by one or two ſtrokes of the knife. As much of the integuments is then to be diſſected with a ſcalpel from the muſcles as may cover the ſtump completely; and this part of the ſkin may either be turned back, or drawn tightly up by an aſſiſtant. The muſcles may then be divided quite acroſs to the bone by the edge of the ſkin, in the common way, or cut obliquely upwards, according to the method of Allanſon, ſo as to lay the bone bare two or three fingers-breadth higher than is done in the common way. The muſcles are next to be ſeparated from the bone with a ſcalpel a little way, that a ſufficient quantity may be left for covering the end of it. The reſt of the operation is to be performed exactly according to the general rules laid down in the firſt ſection of this chapter. The muſcles and integuments are to be drawn over the end of the bone, and applied cloſely together, that the ſkin may completely cover the ſtump, and retained in this ſituation by an aſſiſtant till a flannel or cotton roller, according to the ſeaſon of the year, which has been previouſly fixed round the body, be applied in ſuch a manner as to ſupport and fix them. For which purpoſe it ſhould be paſſed two or three times, in a circular direction, round the top of the thigh, and ſhould afterwards, with ſpiral turns, be brought down near to the end of the ſtump and faſtened with pins; and it ſhould not be tighter than may be ſufficient to aſſiſt the plaſters in preventing retraction.

409 Of dreſſing the ſtump.

The ends of the divided muſcles are now to be laid exactly over the bone; and the edges of the ſkin are to be brought into contact, either ſo as to form a ſtraight longitudinal line, according to the method of Mr B. Bell, &c.; or they are to be placed horizontally, "that the wound may appear only in a line with the angles at each ſide," as adviſed by Allanſon. The ligatures may either hang over the edges of the wound, or be brought to the angles. After the edges of the ſkin are in this manner exactly applied to each other, either a few ſlips of adheſive plaſter are to be laid acroſs the face of the ſtump, or two large pieces of adheſive plaſter, with ſeveral pieces of tape fixed to them, are to be applied to the ſurface of the ſkin. The tapes are then to be tied with a running knot immediately over the wound; by which the parts will be kept ſo cloſely together as to prevent any collection of matter from being formed. The whole ſurface of the ſtump ſhould next be covered with a large pledget ſpread with an emollient ointment, over which a compreſs of fine tow is to be put, and retained in its place by a broad croſs ſtrap of old linen paſſing ſome way up the thigh, ſo as to be ſecured by the roller, which is now to be paſſed two or three times round the ſtump; and the preſſure formed by the croſs ſtrap may afterwards be increaſed or diminiſhed at pleaſure, by drawing it with more or leſs tightneſs, and fixing it with pins to the roller. While the ſtump is dreſſing, the tourniquet is removed, but replaced again looſely to enable the attendants to check any hemorrhagy which may afterwards enſue.

410 Treatment of the patient after the operation.

The patient is now to be laid to reſt, and the limb is to be placed upon a little tow covered with linen, or upon a thin ſoft pillow; and to prevent the patient from involuntarily moving the limb, and to guard againſt ſpaſmodic ſtartings, which frequently happen after this operation, it may be fixed to the bed by two ſtraps. A baſket or hooped frame ought to be placed over the ſtump to protect it from the bed-clothes. The patient ſhould immediately get an anodyne draught, which will generally procure eaſe through the reſt of the day. For this purpoſe, no more light ſhould be let into the room than is merely neceſſary for allowing the attendants to pay attention to the ſtump. As hemorrhagies ſometimes appear ſeveral hours after the operation, the perſon who takes the charge of the patient ſhould watch this circumſtance with the greateſt attention. If there be only a ſlight oozing of blood, there is no occaſion for being alarmed; but whenever it appears to proceed from a large artery, it muſt be ſecured. The ſpaſmodic affections which frequently occur after amputation are ſeldom troubleſome, unleſs ſome nerve has been included in ſecuring the arteries; but when they do appear, laying the limb in the eaſieſt poſture, and giving opiates, are the principal means of procuring relief.

To prevent inflammation as much as poſſible, the patient is to be kept upon a ſtrict antiphlogiſtic regimen, and his bowels kept open by laxative clyſters, till the inflammatory ſtage is over, which will generally be in a few days. If, notwithſtanding this treatment, the ſtump ſwells, and the patient complains of pain and thickneſs, we ought to endeavour to diſcover from what cauſe the uneaſineſs originates. If it be owing to the ſtraps being too tightly fixed, they muſt be ſlackened. If the ſtump be found much ſwelled, a ſaturnine ſolution ſhould be applied by means of ſeveral folds of linen; and if the patient be young and plethoric, he ought to loſe a few ounces of blood from the arm; but if he is weak and emaciated, a different mode of treatment muſt be followed.

At the end of the third, or fourth day at fartheſt, the ſtump ſhould be examined; and if it appear ſomewhat open and flaccid, the parts muſt be brought cloſer together and ſecured more firmly. After this time the dreſſings ſhould be renewed every day, or every ſecond day. In about a week after the operation the ligatures may generally be removed with eaſe; but if they do not ſeparate readily, they may be gently pulled at every dreſſing, when they will, in a ſhort time, be brought away, and the wound will be ſoon healed by the firſt intention. The roller ſhould be cleaned and renewed as often as it is found ſullied; nor ſhould it be laid entirely aſide till the end of the third or fourth week after the operation. When the roller is removed, we may depend upon the ſtraps or tapes for keeping the parts together till the cure be quite accompliſhed. When the inflammatory ſymptoms are entirely gone, no medicines ought to be given which would debilitate the patient, nor is any thing more neceſſary than to keep the bowels gently open till a complete cure be made.

Sect. IV. *Of Amputating the Leg.*

The leg may be amputated for a diſeaſe in the foot at two different parts; the one a hand-breadth under the knee, the other a little above the ankle. The former makes a ſufficient ſupport for the body to reſt upon an artificial leg; but the latter does that equally well, and likewiſe preſerves the motions of the knee.

411 Amputation of the leg near the knee.

In performing the operation a little way under the knee, the patient is to be placed and ſecured in the ſame manner as in operating upon the thigh. The tourniquet is to be placed a little above the knee, with the cuſhion upon the artery in the ham. The ſurgeon places himſelf upon the inſide of the leg, and makes a circular inciſion through the integuments down to the muſcles. The place where the inciſion ſhould be made muſt depend upon the length of the limb; but in general it may be between ſix and ſeven inches under the top of the tibia in an adult, or far enough down upon the limb to ſave as much integuments as will cover the ſtump. After the integuments are cut through in the manner already directed, as much of the muſcles are to be divided by the knife as can be done by a circular inciſion; and the interoſſeous parts are to be divided by a ſcalpel or catline, (fig. 121.). The retractors are then to be applied, and the bone ſawed off immediately below the inſertion of the tendons of the flexor muſcles. In ſawing, the operator ought to begin upon both bones at the ſame time, that he may finiſh upon the tibia, leſt ſplinters ſhould be formed. The veſſels are next to be ſecured; the ſoft parts drawn over the bones; the adheſive plaſters and other bandages applied in the ſame manner as directed for amputating the thigh, only that here the roller need not be applied ſo high as in the former operation. Two or three turns above the knee, however, are neceſſary to prevent the dreſſings from ſlipping down.

412 At the ankle.

In amputating upon the ankle, the operator ſhould fix upon that ſpot which will leave the ſtump of ſuch a length as may be moſt convenient for being fitted with an artificial machine reſembling the other leg. Nine inches from the joint of the knee, in a leg of ordinary length, was found by Mr Wilſon, a late ingenious artificial limb-maker in Edinburgh, to be the beſt part ſuited to this purpoſe, on account of the equal preſſure it makes upon the ſurface of the leg, without making any upon the end of the tender ſtump. The operation is performed in the ſame manner as that a little below the knee.

Sect. V. *Of Amputating at the Joints of the Extremities.*

The circumſtances moſt to be attended to in performing amputation at the joints are, firſt to ſtop the circulation by the tourniquet; or, where that is impracticable, to take up the trunk of the artery by a ligature; to make a circular inciſion in ſuch a place as may, after the operation is over, be ſufficient to cover the wound: Then a longitudinal inciſion is to be made upon the oppoſite ſides of the limb, extending from the joint to the circular cut, and as deep as the bone, by which two flaps will be formed to cover that part of the joint which remains after the operation is finiſhed. The ligaments of the joint are next to be divided, and the affected limb or part of the limb removed.

After this part of the operation, it was formerly a frequent practice to ſcrape off the remaining cartilage, to unite the parts more firmly together. But this is now found to be unneceſſary; for when the fleſh is applied properly to the bone, if it do not grow to it, the union at leaſt is ſo cloſe that it afterwards gives no inconvenience to the patient.

Any branches of arteries which may have been cut during the operation are now be ſecured; clotted blood is to be removed; and the muſcles and ſkin are to be brought into cloſe contact with the ends of the ligatures hanging out of the wound. The parts are to be retained by adheſive plaſters, or twiſted ſuture, or both; and proper bandages applied in ſuch a way that a cure may be made by the firſt intention.

413 Amputation at the ſhoulder joint.

Amputating the arm at the ſhoulder-joint has always been conſidered as a dangerous as well as a difficult operation. It ſhould never be attempted, when the ſame purpoſe can be accompliſhed by operating lower down. But caſes occaſionally occur, where the life of the patient cannot, in any other manner, be ſaved.

Amputation may become neceſſary here in conſequence of abſceſſes of the joint; caries of the humerus reaching to the joint; compound fractures, eſpecially thoſe from gunſhot wounds, extending to the head of the bone; and of mortification.

In performing the operation, the patient ſhould be laid upon a table of convenient height, covered with a mattreſs. He is then to be brought as near to the edge of it as poſſible, and ſecured by aſſiſtants. The circulation of the blood in the arm is next to be ſtopped, by an aſſiſtant preſſing ſtrongly with a firm compreſs over the ſubclavian artery where it paſſes over the firſt rib; or an inciſion may be made along the courſe of the artery, which may be ſecured after ſeparating from it the contiguous nerves. When the artery is compreſſed, it will readily be known whether the compreſſion proves effectual, by obſerving when the pulſe at the wriſt is entirely ſtopped. As ſoon as this is the caſe, a circular inciſion is to be made through the integuments at the inſertion of the deltoid muſcle into the humerus. An aſſiſtant then draws the ſkin a little back, and at the edge of the retracted ſkin the muſcles are to be cut in a circular direction to the bone.

If the artery has not been taken up at the beginning of the operation, it is now to be ſecured, as well as any branches which come in the way.

The amputation knife is now to be laid aſide, and the reſt of the operation finiſhed with a ſtrong ſcalpel. A perpendicular inciſion is next to be made at a little diſtance from the outſide of the artery, beginning at the acromion, and terminating in the circular inciſion, cutting as deep as the ſurface of the bone. A ſimilar inciſion is to be made upon the back part of the arm, ſo that the flaps may be nearly of an equal breadth. The arterial branches are here to be ſecured; the flaps are to be ſeparated from the bone, guarding againſt wounding the trunk of the artery; the flaps are to be ſupported by an aſſiſtant; and the capſular ligament of the joint is to be cut from the ſcapula: and thus the arm will be entirely ſeparated.

After the arm has been ſeparated, any arteries which appear about the joint are to be tied, and all the ligatures brought over the edges of the wound. The parts are to be cleared of clotted blood, and the two flaps drawn over the wound, and ſecured by the twiſted ſuture. A pledget of any emollient ſhould then be applied, and a ſufficient cuſhion of lint, with a compreſs of old linen, put over the whole. A moderate preſſure is next to be applied by a flannel roller; by which the parts will be ſupported, their union facilitated, and matter moſt likely prevented from being lodged. The treatment is then the ſame with that after amputation in other parts of the extremities. For two or three days after the operation, it is neceſſary that an aſſiſtant ſit with the patient to compreſs the artery in caſe a bleeding ſhould enſue.

414 At the wriſt.

When it is neceſſary to amputate the whole hand, the operation may be performed at the wriſt, ſo as to leave as much of the member as poſſible; and the ſame rules hold here as in amputating at any of the reſt of the joints. The tourniquet is to be applied to the artery in the arm, and the cure is to be completed by the firſt intention. When any of the carpal bones are affected, the ſore will not heal till they either work out by ſuppuration, or are cut out by the knife. When the middle of any of the metacarpal bones is diſeaſed, while their extremities are ſound, the trepan may be applied, and the diſeaſed parts removed, while the remaining ſound parts are perſerved. But if the whole bodies of one or two of theſe bones be affected, while the reſt remain ſound, all the affected bones ought to be removed. In performing the operation, an inciſion, is to be made along the courſe of the part affected; and if the operator have it in his choice, the inciſion ſhould be made upon the back part, ſo as to ſave the great veſſels and nerves ſituated in the palm. The integuments are then to be diſſected, and turned to each ſide; after which the diſeaſed bones or parts of bones are to be removed, guarding as much as poſſible againſt wounding the principal arteries or nerves which lie near them.

The diſeaſed parts are next to be ſeparated; any arteries which happen to be cut are to be ſecured; and, on account of the free communication which they have with neighbouring branches, they ought to be tied at both cut ends. If after this a bleeding ſtill continue, compreſs, ſtyptics, and other remedies proper for ſtopping blood, are immediately to be uſed. The ſides of the wound are to be brought together, and an attempt made to cure them by the firſt intention.

415 At the joints of the fingers.

In amputating the fingers, it was formerly the practice to operate opon the bodies of the bones in the ſame manner as in the larger extremities; but at preſent the removal at the joints is more frequently practiſed.

In performing the operation, it is neceſſary to ſave as much ſkin as may cover the ſtump, and this ought to be done upon the ſide next the palm, ſo as to guard againſt the effects of friction. The general ſteps of the operation are the ſame with thoſe for amputation of the larger joints.

A circular inciſion is to be made on the finger by a crooked biſtoury, about the middle of the phalanx, and it may be carried at once to the bone. Another inciſion is to be made with a common ſcalpel at each ſide of the finger, beginning at the circular one and continuing it to the joint, by which two flaps will be left to cover the ſtump. The ligaments of the joint are now to be divided, and the bone removed. The blood-veſſels are to be ſecured by ligature, and the flaps exactly applied to each other; but in order to protect the end of the bone completely, a ſmall portion may be cut from the uppermoſt flap. The flaps are to be retained by adheſive plaſter, or by the twiſted ſuture; but if the latter be uſed, the tendons ought to be avoided. Over the ſore an emollient pledget is to be applied, and then a compreſs and roller. If the diſeaſe be ſo ſituated, that inſtead of amputating at the cavity of the joint, the ſurgeon ſhall think proper to operate upon the body of the bone, flaps are to be formed as above, and the bone is to be divided by means of the ſmall ſpring ſaw, fig. 122.

416 At the hip joint.

The amputation of the thigh, at the hip joint, has always been conſidered as one of the moſt formidable operations in ſurgery; ſo much ſo, that very few caſes appear on record of its having ever been put in practice. In the Medical Commentaries of Edinburgh, an inſtance is recorded where the thigh was amputated at this joint, and where the patient ſurvived the operation 18 days, and then died from a different cauſe, when all riſk of hemorrhagy was over, and when the ſore had even a favourable appearance, which ſhows at leaſt that the operation has been done with ſafety. It certainly ought never to be done, however, unleſs as the laſt reſource, and when the life of the patient is in abſolute danger; and then only when as much ſkin and muſcles can be ſaved, as will cover the ſore, and when there is alſo a probability of being able to ſtop the hemorrhagy, and prevent it from returning.

When the operation is to be performed, the patient is to be laid upon his back on a table, and properly ſecured by aſſiſtants; one of whom ſhould be ready with a firm cuſhion to preſs, if neceſſary, upon the top of the femoral artery, juſt after it paſſes from behind Poupart's ligament to the thigh. A longitudinal inciſion is now to be made through the ſkin, beginning immediately under the ligament, and continuing it downwards along the courſe of the artery for about ſix or ſeven inches. The aponeuroſis of the thigh is then to be divided by gentle ſcratches till a furrowed probe can be introduced, when the opening is to be dilated by means of a ſcalpel, till two or three inches of the artery be laid bare. A ſtrong ligature is now to be put under the artery by the aſſiſtance of a curved blunt-pointed needle.

The part where the ligature ſhould be paſſed is immediately above the origin of the arteria profunda; for if that artery be not affected by the ligature, the patient might ſuffer by the loſs of blood during the reſt of the operation. The ligature is now to be ſecured by a running-knot: Another ligature is to be introduced a little below the former, and likewiſe ſecured; the artery is then to be divided between the ligatures. A circular inciſion is now to be made through the integuments of the thigh, about ſix inches from its upper end. The retracted ſkin is then to be pulled at leaſt an inch upwards; and at the edges of it the amputating knife is to be applied, ſo as to cut the muſcles down to the bone. This being done, a cut is to be made upon the poſterior part of the thigh, beginning a little higher than the great trochanter, and continuing it down to the circular inciſion, and as deep as the joint. A ſimilar cut is to be made on the anterior part of the thigh, at a ſmall diſtance from the artery, and this reaching likewiſe down to the bone. The two muſcular flaps are to be ſeparated from the bone and joint, and held back by an aſſiſtant. Every artery which appears is now to be ſecured. Then the capſular ligament, and next the round one, are to be ſeparated from the acetabulum; by which means the limb will be removed from the body. The acetabulum and neighbouring bone are next to be examined; and if they appear ſound, the caſe will be more favourable; but at any rate, a cure is to be attempted by the firſt intention. For which purpoſe, after removing all the clotted blood from the ſurface of the wound, and bringing the ligatures over the edges of the ſkin, the muſcles are to be placed as nearly as poſſible in their natural ſituation; and drawing the flaps together, ſo as to cover the wound in the moſt accurate manner, they are to be kept in this ſituation by adheſive plaſter, and

Removing the Ends of Carious Bones in the Joints.

by the twiſted ſuture and other dreſſings, as in amputating at the under part of the thigh. The dreſſings are to be retained by a broad flannel roller paſſed three or four times round the body, and ſpirally over the ſtump, and ſecured. The patient is then to be laid in bed on the ſound ſide, and treated as for amputation in other parts of the body; only that greater attention is neceſſary, as there is no aſſiſtance from a tourniquet. Uncommon attention will alſo be neceſſary to prevent inflammation, and every ſymptom of fever which may ſucceed to the operation.

417 At the joints of the foot.

When the foot is ſo much diſeaſed as to require amputation, the operation might be performed at the point of the ankle; but for the reaſons given, when treating of amputation of the leg, it is found better to do it above the ankle. When a conſiderable part remains ſound, it ought to be ſaved. If any of the tarſal bones are affected, theſe are to be removed. When the middle or whole body of any of the metatarſal bones are diſeaſed, they are to be removed in the ſame manner as directed for ſimilar operations in bones of the hand; and if even two of them remain ſound, provided they be ſo placed as to ſupport the toes, they ought to be preſerved, as it is known that, by proper treatment, an oſſeous matter may afterwards fill a conſiderable part, if not the whole, of the void; or if any cavity remain, it may be ſo ſtuffed that the uſe of the foot may ſtill be enjoyed.

In performing an operation of this kind, the patient ſhould be laid upon a table, and the tourniquet applied in the ham to prevent hemorrhagy. An inciſion is then to be made along the affected part; and if the ſeat of the diſeaſe admit it, the inciſion ſhould be made upon the upper ſide of the foot ſo as to ſave the ſole. The integuments are to be ſeparated and turned to each ſide, to allow the affected parts to be completely removed.

The principal veſſels and nerves are to be ſaved as much as poſſible; but if any particular artery be cut, it is to be ſecured, and the part treated as after the removal of ſimilar parts of the hand.

418 Of the toes.

The amputation of the toes is exactly ſimilar to that of the fingers.

Sect. V. *Of removing the Ends of Carious Bones in the Joints.*

In compound fractures, the ends of bones, when they protruded in ſuch a manner, that they could not otherwiſe be returned, have frequently been ſawed through; and their place has frequently been ſupplied by a renewal of bone, ſo as to preſerve the ordinary uſe of the limb. Many caſes have likewiſe happened, where a large part of the body of the bone has been thrown out by ſuppuration, and its place ſupplied; and a few are upon record, where either the whole of a bone, or that end next the joint, has been thrown out, and its place filled up with callus, ſo that no inconvenience has been felt. From theſe circumſtances, Mr White of Mancheſter was led to preſerve an arm by ſawing off the head of a diſeaſed humerus; and Mr Park of Liverpool, to ſave a limb, by ſawing off the ends of the bones, in a caſe of white ſwelling of the knee. When therefore it happens that the end of a bone is diſeaſed, while the other parts are ſound, the diſeaſed part may be removed, and the ſound one ſaved, ſo as in a great meaſure to preſerve the free uſe of the limb.

In performing the operation, the firſt ſtep ſhould be, to uſe ſuch means as may enable the operator to have a full management of the circulation of the part affected. Then a longitudinal inciſion of ſufficient length, and perhaps another acroſs it, may be neceſſary to be made through the ſoft parts of the joint; and this opening ought to be at a diſtance from the large blood-veſſels, that they may be in no danger of being injured. After the end of the diſeaſed bone is ſufficiently laid bare, it is either to be brought out of the joint, or a ſpatula or ſome other proper ſubſtance is to be introduced between the bone and ſoft parts, ſo as to defend the latter in time of ſawing the bone. After the diſeaſed part of the bone is removed, the arterial branches are to be ſecured, and the wound treated like any other wound of equal ſize.

During the cure the limb ought to be kept in the poſture moſt favourable for the removal of the bone, and afterwards for the preſervation of the natural motion of the joint.

In this way a limb may ſometimes be ſaved which would otherwiſe have been removed. But though the removal of the diſeaſed end of one bone may be readily effected, the removal of all that part of the bones which enters into the compoſition of a joint muſt be attended with ſo much inconvenience, that it can ſeldom be uſeful, unleſs it be where the ends of bones are deſtroyed by external violence; for then it appears that this operation may be performed with conſiderable ſucceſs.

Chap. XXXV. *Of Diminiſhing Pain in Surgical Operations.*

Diminiſhing Pain in Surgical Operations.

The pain induced by ſurgical operations may be leſſened in two different ways. The firſt is, by diminiſhing the natural ſenſibility of the ſyſtem; and for this purpoſe narcotics of different kinds, and particularly opium, have been uſed; but theſe are apt to induce diſagreeable ſymptoms, eſpecially ſickneſs and vomiting, which might be attended with bad conſequences after ſome operations. They are therefore ſeldom employed before an operation. When, however, they are given immediately after it, and repeated as circumſtances may require, they often give great relief.

The other method of diminiſhing pain is, by leſſening the ſenſibility of a particular part of the body. It has long been known, that the ſenſibility of any part may not only be leſſened, but entirely ſuſpended, by compreſſing the nerves which ſupply it. From a knowledge of this circumſtance, an inſtrument (fig. 123.) was invented ſome years ago by Mr James Moore of London, by which the principal nerves of a member might be ſo compreſſed as to render the parts below perfectly inſenſible. A difficulty, however, ariſes here; for as the nerves muſt be compreſſed at leaſt an hour previous to the operation, in order to render the parts quite inſenſible, and as it is extremely difficult to compreſs the nerves without at the ſame time affecting the veins, the latter are therefore in danger of being burſt. To prevent this inconvenience, Mr Moore propoſes to open a vein; but this might be attended with bad conſequences in weakly conſtitutions. Beſides, it is ſaid, that by compreſſing the nerves in this manner, although leſs pain may be felt in the time of the operation, it is proportionally greater after the compreſſion is removed. In certain parts of the body, however, where ſufficient compreſſion can be made upon the nerves without acting much upon the veins, it would appear that the method may be practiſed with advantage; though it has not yet been done, excepting in a few inſtances.

Chap. XXXVI. *Of Bandages.*

The proper application of bandages is an object of great importance in ſurgery: and though dexterity is only to be acquired in this branch by practice, yet a few general rules may be found uſeful. Bandages are employed for the retention of dreſſings, for ſtopping hemorrhagies, for removing deformities, and for effecting the union of divided parts. They ought to be formed of ſuch materials as are ſufficiently firm, while, at the ſame time, they give no uneaſineſs to the parts to which they are applied. They may be compoſed either of linen, cotton or flannel. Of late years the two laſt have been preferred by many for their warmth and elaſticity, on which account they are certainly moſt proper, eſpecially in winter; and likewiſe in caſes where the parts are liable to ſwelling and inflammation, as in wounds, luxations, and fractures. Beſides, they more readily abſorb any moiſture which may be diſcharged from the ſores.

When firſt applied, they ſhould be clean, ſufficiently ſtrong, and as free of ſeams as poſſible. They ſhould be ſo tightly applied as to anſwer the purpoſe for which they are intended, without being in danger of impeding the circulation. They ſhould be applied in ſuch a manner that they may be eaſily looſened, and the parts examined with as much accuracy as poſſible; and they ſhould be laid aſide as ſoon as the purpoſe for which they are intended is accompliſhed; for when longer continued, they frequently impede the growth of the parts upon which they are applied.

419 Bandages for the head.

With reſpect to bandages for particular parts, we ſhall begin with the head, and then proceed to the trunk and extremities. The *couvre chef* of the French, which is a ſquare napkin folded cornerwiſe, is moſt frequently uſed where a bandage is wanted for the head; but a nightcap, having a band to go round the head, and another to tie under the chin, appears to be more ſuitable for this purpoſe. For making compreſſion on any particular part of the head, as for ſtopping of bleeding veſſels, the radiated bandage may be employed.

For keeping the edges of wounds together, as in caſes of longitudinal cuts of the head, or of any other parts, the uniting bandage is uſually employed, and is always to be preferred to ſutures, where it retains the edges of the wound with ſufficient exactneſs. For retaining dreſſings upon the eyes, ſeveral turns of a roller have been uſed, and it is termed *monoculus* or *binoculus* according to its being applied to one or both eyes; but the *couvre chef*, and the nightcap already mentioned, are leſs apt to ſlip, and therefore found more convenient for this purpoſe.

420 For the face.

For fractures of the noſe, or wounds there, or on any other part of the face, the uniting bandage anſwers beſt. And in caſes of fracture of the lower jaw, a four-headed roller is moſt convenient: the hole in the centre of the roller receives the chin, and aſſiſts in preventing the bangage from ſhifting. The two upper heads are to be carried backwards; and being made to paſs each other at the occiput, they are afterwards brought once or twice round the head. The two under heads of the roller being reflected over the chin, are then to be turned upwards and fixed on the upper part of the head.

421 For the neck.

The bandages neceſſary for the neck, are, the machine already mentioned after the operation of bronchotomy, and one uſed in caſes of wry neck. For every other purpoſe of bandaging a common roller may anſwer perfectly well.

For fractures of the ſcapula the application of a long roller may be of ſervice.

422 For the breaſt.

For retaining dreſſings upon the thorax the napkin and ſcapulary are commonly, and very properly uſed; and when the napkin is employed merely for retaining dreſſings, it need not be longer than to paſs once round the body; but if it be uſed for making preſſure over a fractured rib, it ought to paſs two or three times round. For both purpoſes its breadth ought to be ſix or ſeven inches for an adult.

The ſame kind of bandages is alſo uſed for making preſſure on the abdomen, as in caſes of umbilical or ventral hernia; and to keep the bandage properly placed, a ſcapulary is uſed for preventing it from ſlipping down, and one or two ſtraps connected with it behind, are brought between the thighs, and fixed to it before to prevent it from moving up.
423 For the belly. A bandage of flannel, and different kinds of belts, are contrived for compreſſing the abdomen in the operation of tapping; and truſſes of various conſtructions are uſed for the retention of the protruded bowels in caſes of hernia.

424 For the ſcrotum and penis.

Bandages of cotton or flannel are uſed for ſupporting the ſcrotum in the various diſeaſes which may occur there, as well as after the operations performed upon it.

One of the beſt bandages for the penis is a linen or cotton bag, fixed by a roller round the body.

425 For the anus.

For retaining dreſſings about the anus, or between that part and the ſcrotum, the T bandage is commonly uſed; and it is made either with one or two tails, according to the ſituation of the part to which it is to be applied.

426 For fractures.

In ſimple fractures, and moſt of the other diſeaſes of the arm, fore-arm, and hand, the roller is the bandage commonly uſed; but in compound fractures of theſe parts, as well as in the different kinds of fractures of the lower extremities, the 12 or 18 tailed bandage is neceſſary.

427 For wounds of the extremities.

For longitudinal wounds of the extremities, the uniting bandage is uſed with the ſame advantage as has been already mentioned for wounds of a ſimilar nature upon the head.

Chap. XXXVII. *The Method of opening a dead Body.*

Surgeons are often called, in order to inveſtigate the cauſe and ſeat of diſeaſes and death, either by the relations of the deceaſed, or the magiſtrates to whom a report is to be made; therefore, at the time of performing this operation, minutes ſhould be taken of what is obſerved. The inſtruments, and all things neceſſary, ſhould be diſpoſed in order, as for any other operation: as knives, a razor, a great and ſmall ſaw, ſciſſars ſtraight and curved, elevators, needles threaded, ſponges, tow, ſaw-duſt or bran, baſons with water, towels, and receivers for the viſcera when they are to be taken out of their cavities. The body is to be laid upon a ſuitable table, advantageouſly placed for the light, having a cloth thrown over the parts which decency demand ſhould be concealed, eſpecially in females.

When it is intended only to inſpect the abdomen and its contents, a longitudinal inciſion from the xiphoid cartilage to the os pubis, interſected by a tranſverſe one at the navel, will give a fair opportunity of anſwering theſe purpoſes, when the angles are reverſed. Should it be required to examine all the three cavities, and the parts contained in them,
428 Method of opening the cranium. we are to begin by opening the head, making an inciſion quite croſs to the bone, from ear to ear; which ſection is preferable to the crucial, commonly made on this occaſion; then the ſcalp may be eaſily diſſected from the ſkull, and turned down over the face, and towards the neck, giving room for the ſaw. The head muſt be held very ſteadily by an aſſiſtant during the ſawing, which ſhould be begun on the middle of the frontal, proceeding to each temporal bone, and ſo to finiſh the circle upon the middle of the occipital bone; which may generally be done conveniently enough, by raiſing the head and inclining it forward after having proceeded as far as this bone; or the body may then be turned prone, ſhould that poſture be found more convenient to complete the circle. The cap of the ſkull is then to be raiſed with the elevator, occaſionally cutting the adheſions of the dura mater; after this the encephalon is to be removed, carefully ſeparating the other attachments of the membrane.

In order to bring the thorax and abdomen, with the parts contained

Method of opening a dead Body.

429 Of opening the thorax and abdomen.

contained in theſe cavities, under one view, an inciſion is to be made on each ſide of the ſternum, in the courſe of the cartilages of the ribs which are annexed to it; diſſecting from thence the muſcles with the teguments, the ſpace of two or three inches towards the ſpine; then cutting through the cartilages, which will be ſeen, and eaſily divided with a knife a little curved near the point; then the inciſions are to be continued from the ſternum through the abdominal cavity, in an oblique direction, to each ilium or inguen; after which the clavicles are to be ſeparated from the ſternum, or this bone divided at its ſuperior cartilaginous junction, with a ſtrong knife, diſſecting it from the mediaſtinum, and turning it downwards with the muſcles, &c. of the abdomen. This is the moſt eligible manner of opening theſe cavities, and gives an opportunity of ſewing them up with a better appearance for any perſon's view afterwards. That kind of ſtitch called by ſempſtreſſes the *herring bone* or *flat ſeam* has a very pretty and neat effect upon theſe occaſions.

If it is propoſed to take out the thoracic and abdominal viſcera together, for further examination, the diaphragm is firſt to be cut down to the ſpine on both ſides; then, to avoid being incommoded with blood, &c. two very ſtrong ligatures are to be paſſed round the œſophagus and large blood veſſels, in which the trachea may be included; tying them ſtrait, and then dividing theſe parts between the ligatures: the ſame meaſures are to be taken in reſpect to the inferior veſſels upon the lumbar region, a little above the bifurcation of the aorta, including the vena cava; and alſo upon the rectum. After having obſerved theſe precautions, the viſcera, with the diaphragm, are to be removed by a wary diſſection, all the way cloſe to the ſpine; and by gently drawing them at the ſame time, the ſeparation will be greatly facilitated.

When the thoracic and abdominal viſcera are to be taken out ſeparately, in the firſt caſe ligatures muſt be made, as have been deſcribed upon the veſſels, &c. juſt above the diaphragm, and in the other juſt below it, and upon the rectum.

430 When the body is become putrid, how it is to be managed.

Should we be called upon to perform this office when the body is become very putrid, it will be abſolutely neceſſary to have ſuch parts of it well waſhed with warm vinegar and brandy, and then ſprinkled with lavender-water or ſome ſuch odoriferous antiputreſcent liquor, before the examination, in order to correct the ſtench, and defend us againſt the noxious quality of the effluvia; a precaution, the neglect of which may be attended with very direful effects.

CHAP. XXXVIII. *Of Embalming dead Bodies.*

IN the early ages of the world, the practice of embalming dead bodies was very common, particularly among the Egyptians; but it has long been diſuſed in almoſt all countries, except for great perſonages. See EMBALMING. The following directions are taken from Mr Gooch, to whom they were communicated by a perſon of great character, and well acquainted with the modern practice of embalming in Britain.

After eviſceration, as has been directed in opening a dead body, and continuing the inciſion farther upwards, even into the mouth, and, if practicable, without cutting the ſkin of the neck, all the cavities are to be well cleanſed, and the humidity ſucked up with ſponges, then waſhed with *tinct. myrrhæ*, and filled with ſpices compounded of fragrant herbs, aromatic drugs, and gums reduced to powder not very fine, firſt reſtoring the heart to its former reſidence, after having opened its ventricles, cleanſed and waſhed them with the tincture, ſtuffed them with the ſpices, and ſewed them up; and then the cavities are to be ſtitched very cloſe with the glover's or ſpiral ſuture. Large and deep inciſions are alſo to be made in all the moſt fleſhy parts, cleaning and waſhing them with the tincture in the ſame manner, filling them with the antiſeptic ſpices, and ſtitching them up. Then the head, trunk, and limbs, are to be perfectly well covered with cerecloth; putting a piece under the chin, to be ſecured by ſewing on the top of the head, after having well adjuſted the cap of the ſkull, ſewed the ſcalp together, and cleaned the mouth, as has been directed for the other parts, and putting in ſome of the ſpices. The cerecloth is to be prepared, according to art, with a conpoſition made of wax, roſin, ſtorax, and painter's drying oil. After the application of the cerecloth, with great care and exactneſs, cut into ſuitable pieces according to the reſpective parts, and cloſing them well everywhere, the face being cloſe ſhaved, is to be covered with ſome of the above compoſition melted, and laid on with a bruſh of a proper degree of heat, and of a moderate thickneſs; which may have a faint fleſh-colour given it with vermilion; and when it is grown cold and ſtiff upon this part, it may be lightly covered with hard varniſh; or this varniſh, applied thick, may here ſerve the purpoſe alone. A cap is to be well adapted to the head, falling down upon the neck, and to be ſewed under the chin, making a few circular turns about the neck with a roller of a proper breadth. All the reſt of the corps is to be incloſed in a ſheet, to be artfully cut, and ſewed on very cloſe and ſmooth, with the fineſt tape, and the *flat ſeam* mentioned in the preceding chapter; over which an appropriate dreſs is to be put, as the relations or friends think fit to direct and appoint, and then laid into the coffin, which ſhould be in readineſs: but when it is ſome great perſonage, who is to lie in ſtate for public view before the funeral rites are ſolemnized, the dreſs muſt be appropriated to his dignity and character. The brain and other viſcera are to be put with ſome of the ſpices into a leaden box. Sometimes the heart, prepared as has been directed, to preſerve it from putrefaction, is depoſited in an urn by itſelf.

Embalming dead Bodies.

EXPLANATION of PLATES.

PLATE CCCCLXXXVII. Fig. 1. A lancet and canula for diſcharging the contents of an abſceſs by means of a ſeton. See nº 50.

Fig. 2. A director for diſcharging the contents of an abſceſs. See nº 50.

Fig. 3. An abſceſs lancet.

Fig. 4. A forceps for extracting polypi. See nº 113.

Fig. 5. A ſlit probe for conducting a ligature to the root of a polypus. See nº 114.

Fig. 6. A ring for aſſiſting in ſecuring a ligature upon the root of a polypus. See nº 114.

Fig. 7. A double canula for fixing a ligature upon the root of a polypus. See nº 114.

Fig. 8. The moſt approved form of a lancet for the operation of blooding-letting. See nº 131.

Fig. 9. A jugum cervicis recommended by ſome practitioners in veneſection in the neck. See nº 137.

Fig. 10. A bandage for making compreſſion after performing the operation of arteriotomy at the temples. See nº 145.

Fig. 11. A ſcarificator with 16 lancets, uſed in the operation of cupping. See nº 146.

Fig. 12. A cupping-glaſs. See nº 147.

Fig. 13. A ſeton needle. See nº 153.

Fig. 14. The common crooked needle uſed in making ſutures. See nº 154.

Fig. 15. *a*, *b*, Two pins of different forms uſed in the twiſted

Explanation of the Plates.

twiſted or hare-lip ſuture. The firſt commonly made of ſilver, with a moveable ſteel point; the other of gold. See n° 157.

Fig. 16. The tourniquet now moſt generally uſed. See n° 160.

Fig. 17. The tenaculum uſed in ſecuring the mouths of bleeding veſſels. See n° 162.

Fig. 18. A common ſcalpel. See n° 174.

Fig. 19. A large lancet uſed for opening cavities of different kinds. See n° 174.

Fig. 20. A blunt-pointed biſtoury. See n° 174.

Plate CCCCLXXXVIII. fig. 21. A raſpatory for removing the pericranium in the operation of the trepan. See n° 186.

Fig. 22. The trephine with all its parts connected and ready for uſe. *a*, The centre-pin, which can be raiſed or depreſſed by the ſlider *b*. *c*, The part where the ſaw is united to the handle by means of the ſpring *d*. See n° 186.

Fig. 23. Handle of the trepan into which the head of the trephine is to be inſerted at *a*. See n° 186.

Fig. 24. A perforator, which can be joined to the handle either of the trephine or trepan. See n° 186.

Fig. 25. A bruſh for cleaning the teeth of the ſaw. See n° 186.

Fig. 26. Forceps for removing the piece of bone when nearly cut through by the trephine or the trepan. See n° 186.

Fig. 26. *a*, A levator alſo employed in removing the piece of bone. See n° 186.

Fig. 26. *b*, Lenticular for ſmoothing the ragged edge of the perforated bone. See n° 186.

Fig. 27. A common probe. See n° 187.

Fig. 28. A directory. See n° 187.

Fig. 29. A ſpeculum uſed for keeping the eyelids ſeparated, and the eye fixed, in performing various operations upon that organ. See n° 205.

Fig. 30. A flat curved hook for elevating the upper eyelid, and fixing the eye, in performing various minute operations upon its ſurface. See n° 205.

Fig. 31. A couching needle. See n° 216.

Fig. 32. A couching needle for the right eye, fitted for the operator's right hand. See n° 217.

Fig. 33. A knife for extracting the cataract. See n° 218.

Fig. 34. A flat probe for ſcratching the capſule in extracting the cryſtalline lens. See n° 218.

Fig. 35. A flat probe or ſcoop for aſſiſting in removing the cataract. See n° 218.

Fig. 36. A knife for extracting the cataract from the right eye. See n° 218.

Fig. 37. One of Anel's probes for removing obſtructions of the lachrymal ducts. See n° 224.

Fig. 38. A ſyringe and pipe (by the ſame) for injecting a liquid into the lachrymal ducts. See n° 224.

Fig. 38. *a*, A crooked pipe which fits the ſyringe. See n° 224.

Fig. 39. An inſtrument for compreſſing the lachrymal ſac. See n° 226.

Fig. 40. A trochar and canula for perforating the os unguis in the operation for fiſtula lachrymalis. See n° 229.

Fig. 41, 42, 43. Inſtruments employed by Mr Pellier in the operation for fiſtula lachrymalis. Fig. 41. A conductor for clearing the naſal duct. Fig. 42. A conical tube to be left in the duct. Fig. 43. A compreſſor for fixing the tube in its place. See n° 230.

Fig. 44. A trocar for making an artificial parotid duct. See Chap. XVI. Sect. i.

Fig. 45. Forceps ſometimes uſed for laying hold of the lip in the operation for hare-lip. See n° 231.

Fig. 46. A pair of ſtrong ſciſſars uſed in the operation for hare-lip. See n° 231.

Fig. 47. Pins uſed in the operation for hare-lip. See n° 231.

Fig. 48. Gum-phleme. See n° 232.

Fig. 49. A trocar for perforating the antrum maxillare. See Chap. XVI. Sect. vi.

Fig. 50. An inſtrument of a tubular form for perforating the antrum maxillare. See as directed in Fig. 49.

Plate CCCCLXXXIX. Fig. 51. n° 1, 2, 3, 4, 5. 1, A file for removing inequalities upon the teeth. 2, 3, 4, 5, Different forms of inſtruments for removing tartar, &c. from the teeth. See n° 235.

Fig. 52, n° 1, 2, 3. 1, 2, Inſtruments for ſtuffing a hollow tooth. 3, The handle which fits the different inſtruments repreſented by fig. 51, 52. See n° 337.

Fig. 53. Inſtrument termed a key for extracting teeth. See n° 338.

Fig. 54. Forceps for extracting teeth. See n° 338.

Fig. 55. A punch or lever for extracting ſtumps of teeth. See n° 338.

Fig. 56. Mr Cheſelden's needle, with an eye near the point, for tying a knot on ſcirrhous tonſils. See n° 242.

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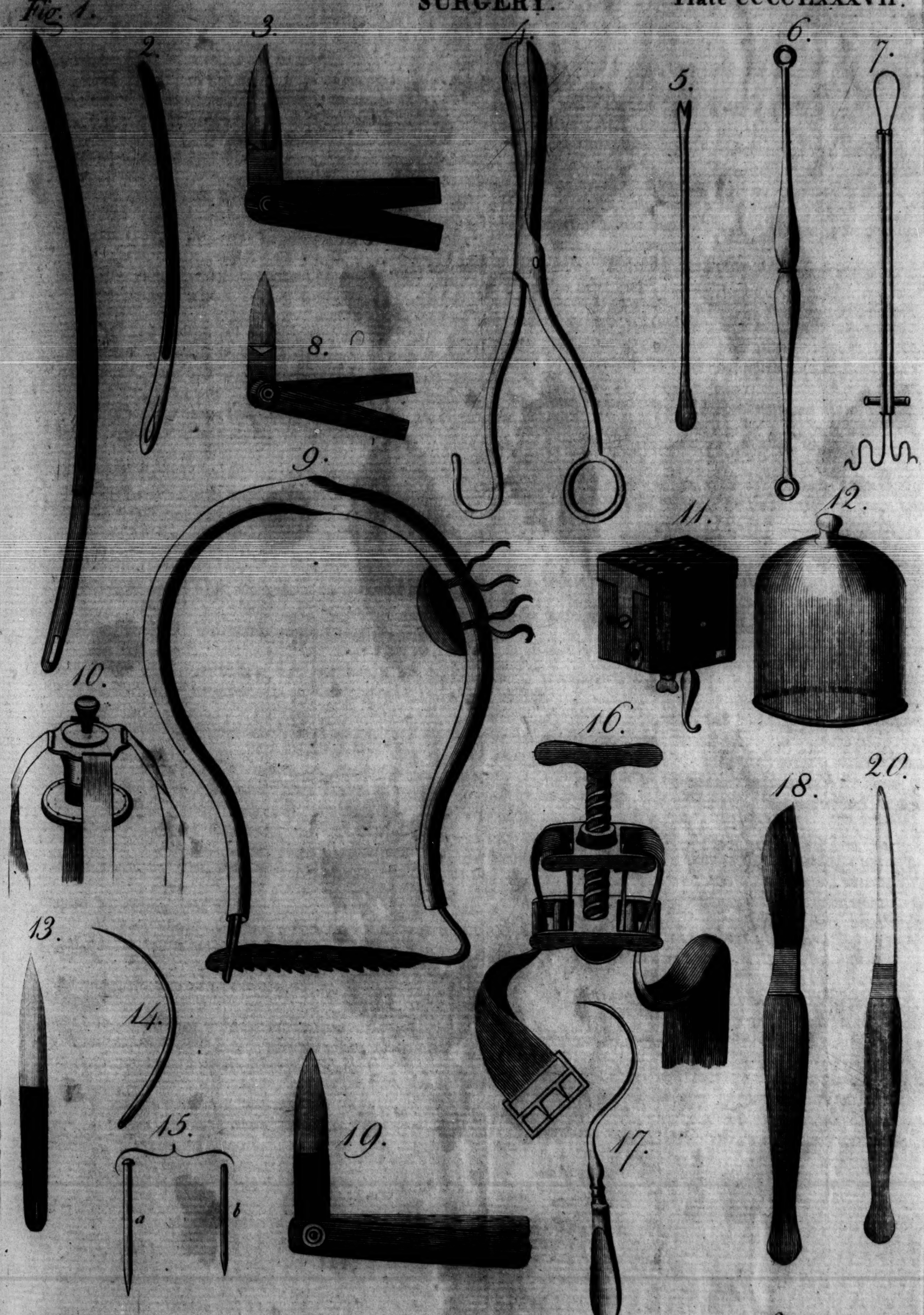
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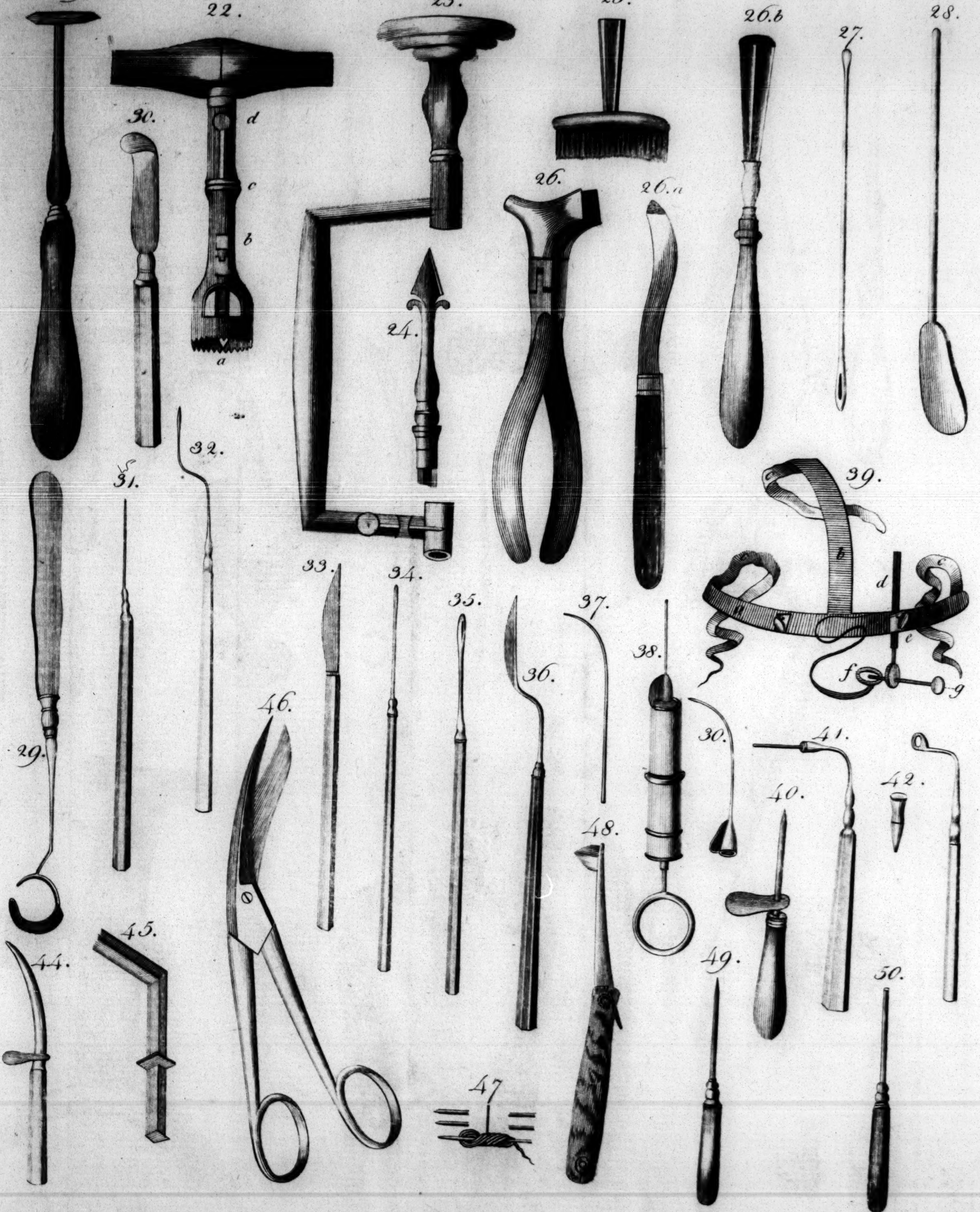
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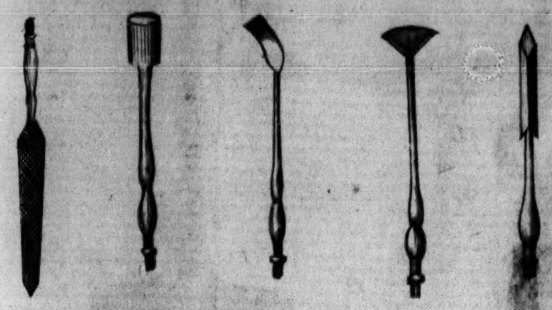

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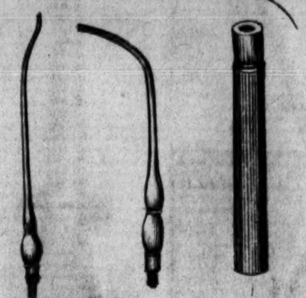

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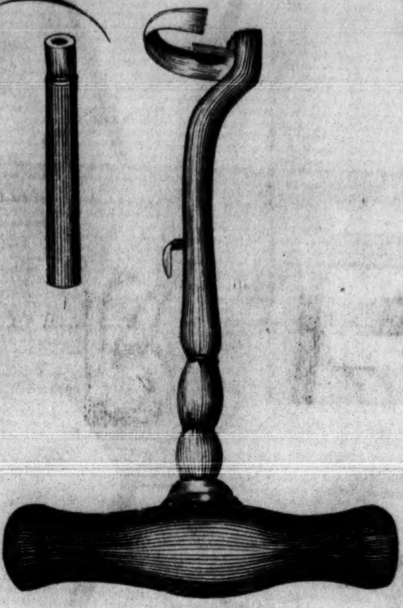

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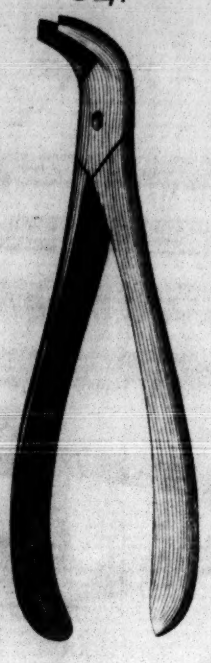

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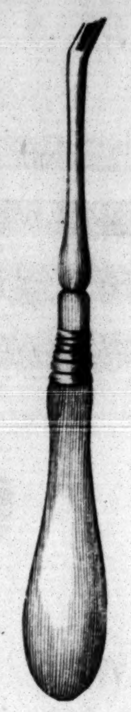

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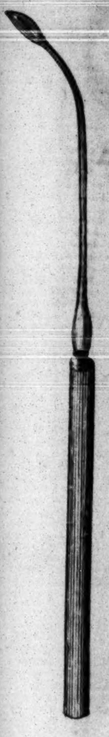

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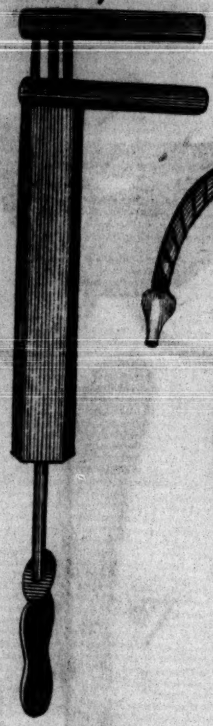

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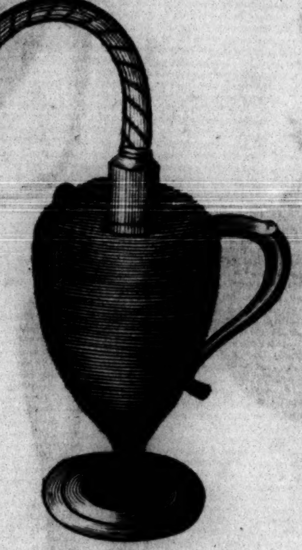

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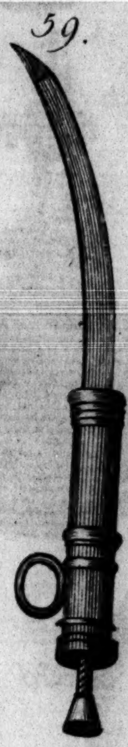

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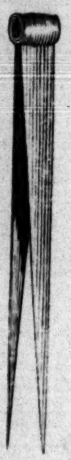

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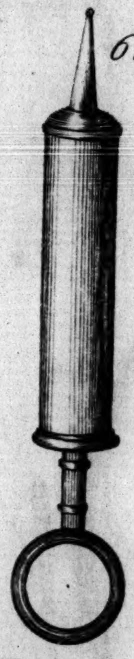

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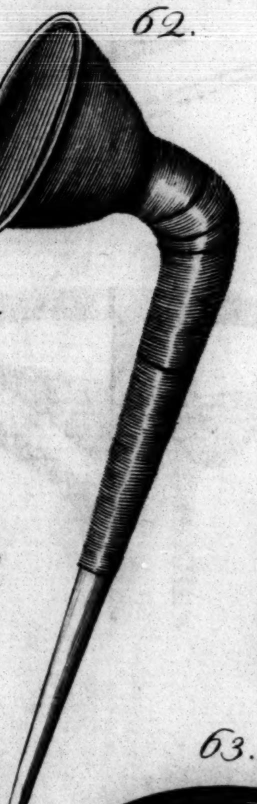

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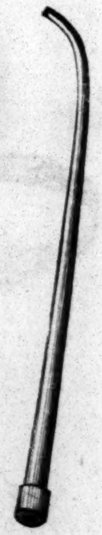

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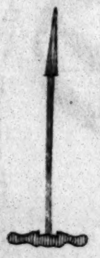

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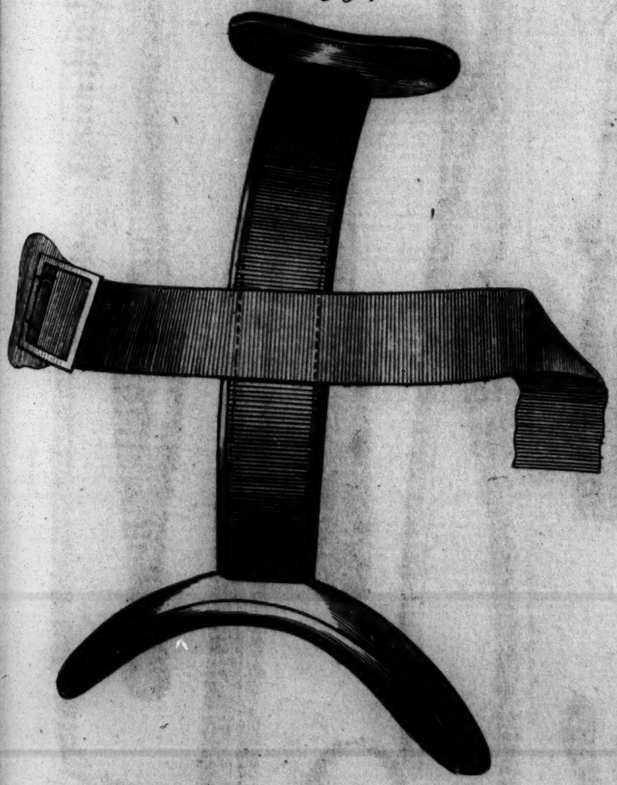

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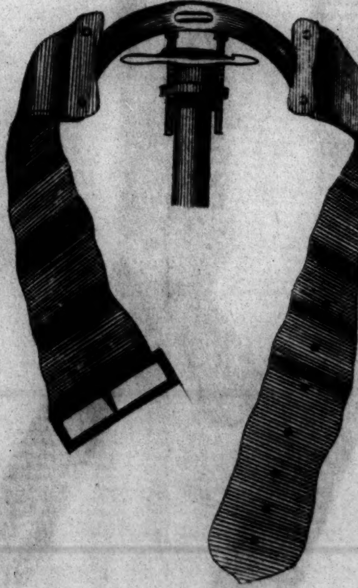

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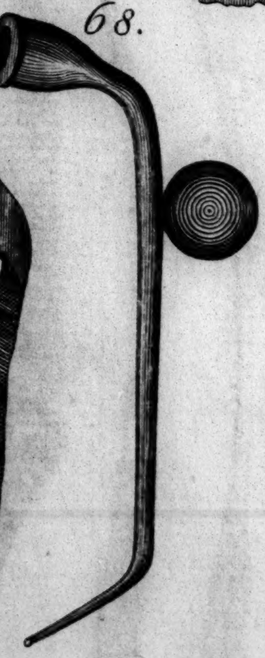

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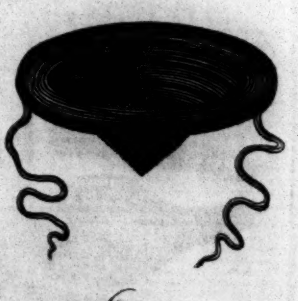

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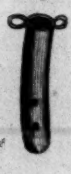

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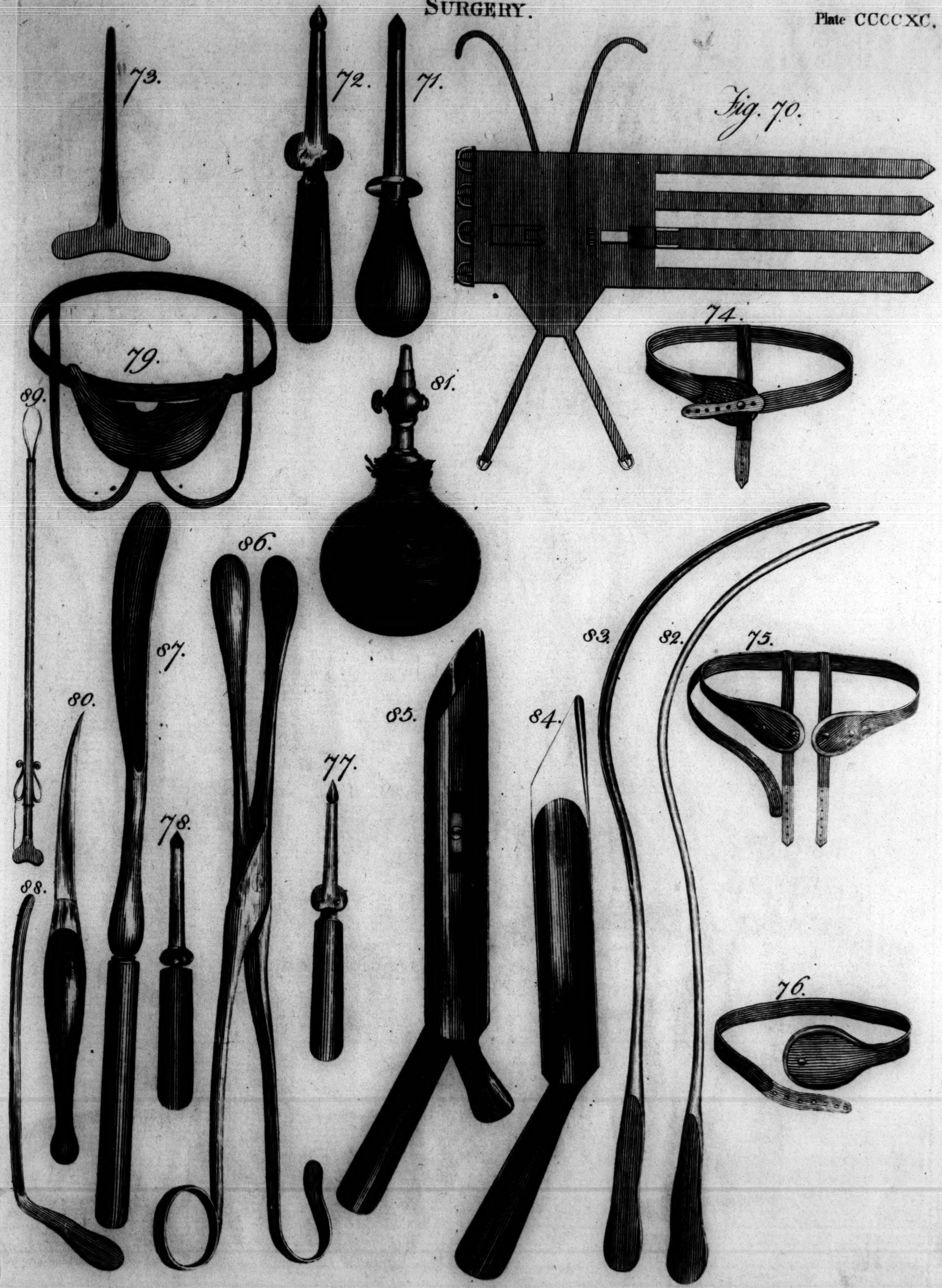
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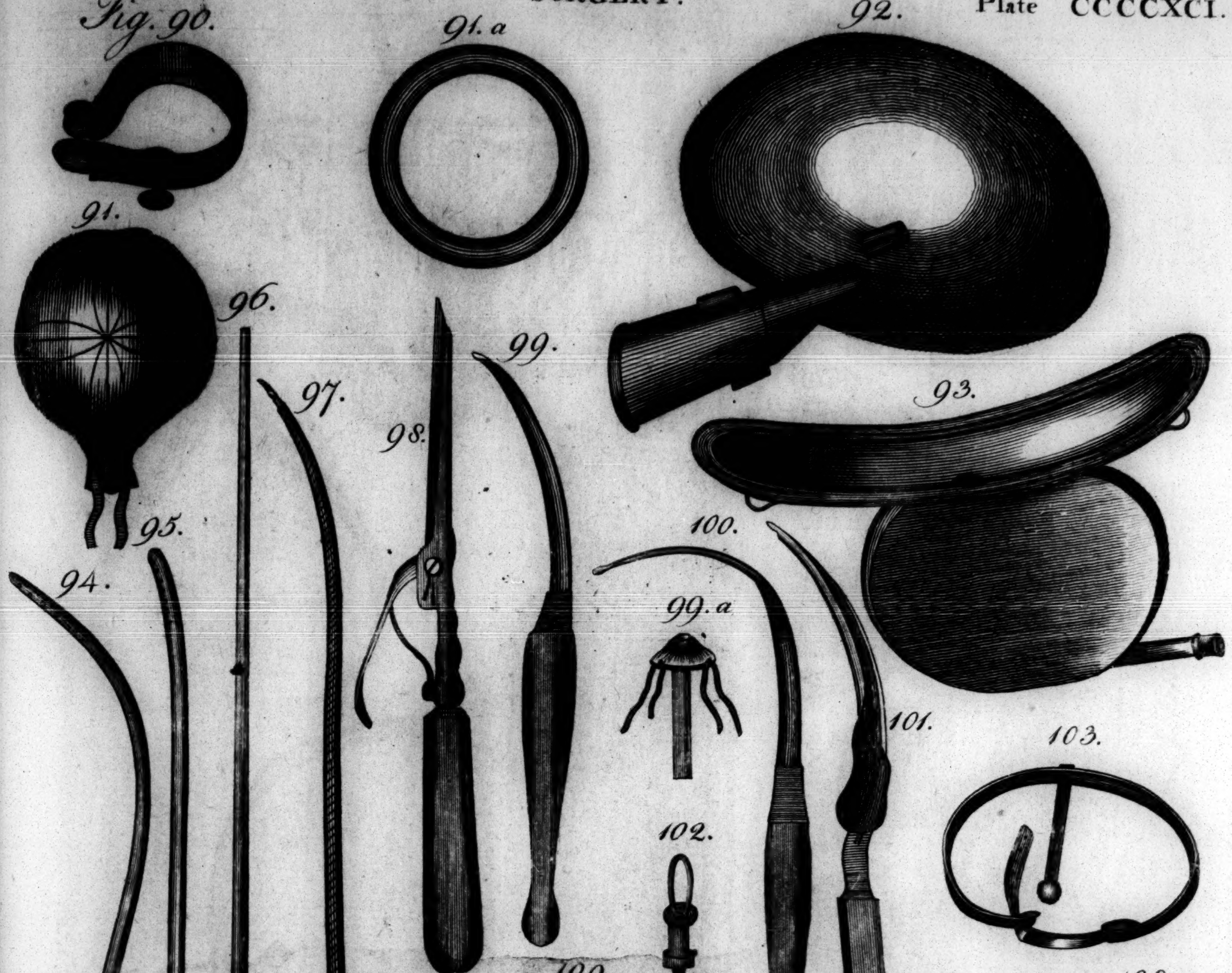
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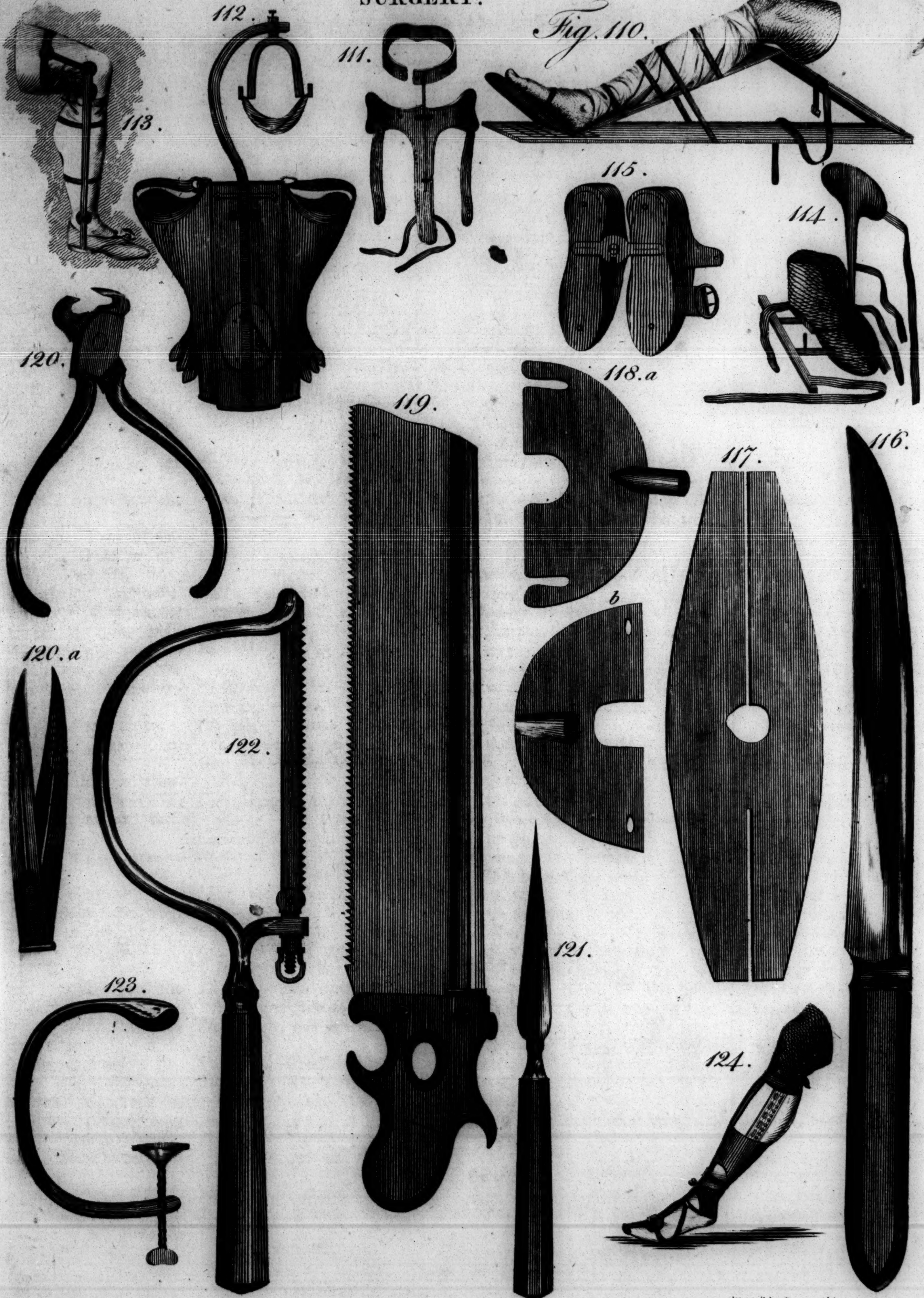
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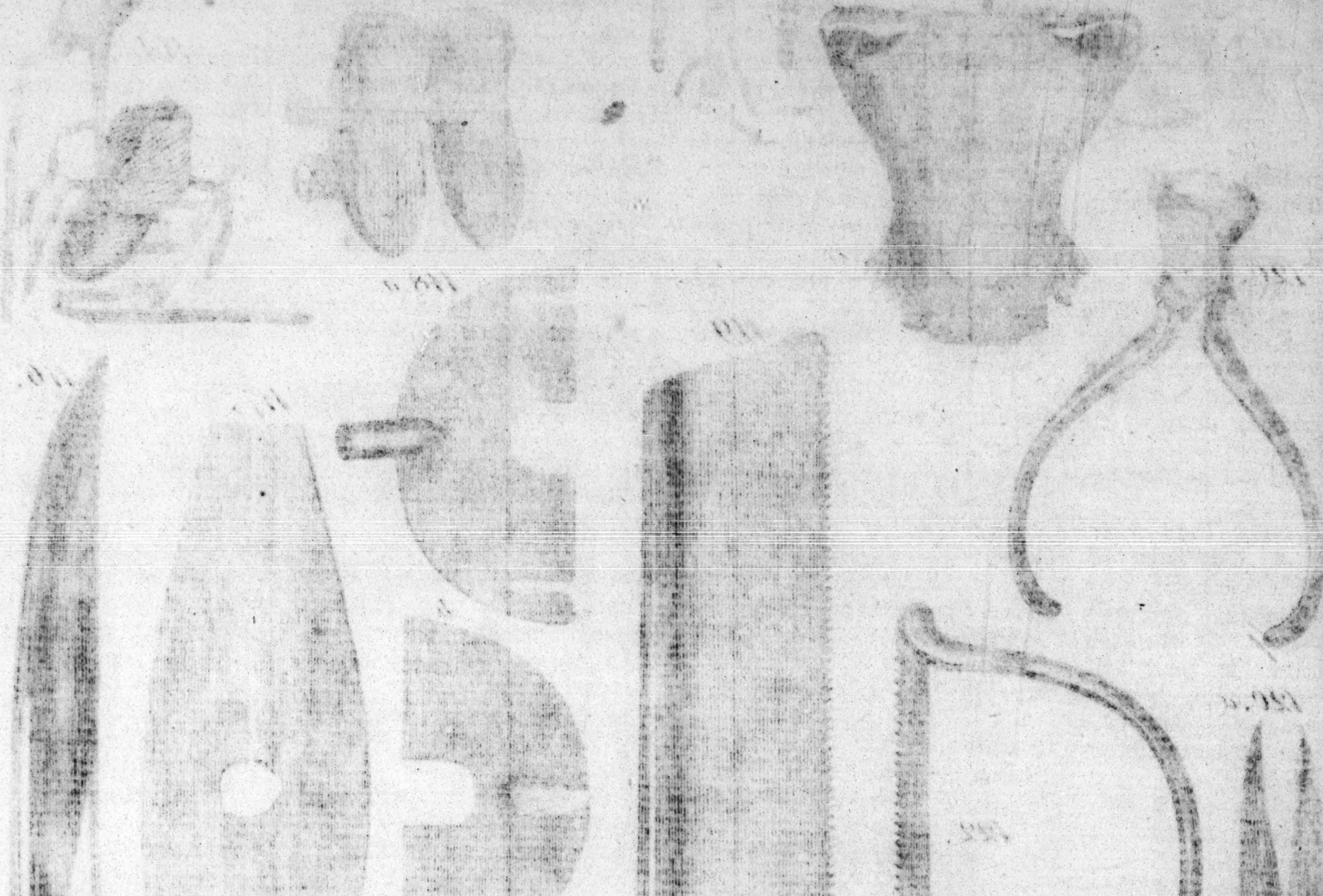

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Surinam
‖
Surname.

SURINAM, the capital of the Dutch ſettlements in Guiana, ſituated on a river of the ſame name, in N. Lat. 6. 16. W. Long. 56. 0. It gives name to the country for 100 miles round; and ſtands on a river of the ſame name, which is navigable for 30 leagues up the country. A ſettlement was formed at Surinam in 1650 by the Dutch, who preſerved poſſeſſion of it ever ſince. The chief trade conſiſts in ſugar, cotton, coffee of an excellent kind, tobacco, flax, ſkins, and ſome valuable drugs for dyeing. Four hundred and thirty plantations have been already formed on the banks of the Surinam and the adjacent country, which in 1775 yielded 24,120,000 weight of rough ſugar, which were ſold in Holland for 347,225 l. Sterling; 15,000,387 lb. weight of coffee, which ſold for 357,538 l.; 970,000 lb. weight of cotton; 790,854 lb. weight of cocao; 152,844 lb. weight of wood for dyeing. The ſum total of theſe productions amounted to 822,905 Sterling, and was brought into the harbours of the republic in 70 veſſels. The number of ſlaves employed in the ſame year was 60,000, who belonged to 2824 maſters, excluſive of the women and children. The white people were of different countries and different religions.

Raynal's History of the Settlements and Trade of the East and West Indies.

Connected with Surinam, we may mention the colonies of Demerary, Iſſequibo, and Berbice, which lie a little to the weſt. The two firſt ſurrendered to the Britiſh troops in 1781; but being left defenceleſs, were retaken by a French frigate. Demerary has lately been taken a ſecond time by the army of Great Britain. It is conſidered as a valuable acquiſition, being a flouriſhing colony. In 1769 there were eſtabliſhed on the banks of the Demerary 130 habitations, in which ſugar, coffee, and cotton were ſucceſsfully cultivated, and ſince that period the number of plantations hath increaſed much.

Iſſequibo is a very inconſiderable ſettlement. Berbice, which lies between Demerary and Surinam, contains about 104 plantations, moſt of them ſmall, and ſcattered at great diſtances from one another upon the banks of the Berbice or of Conje. When Raynal publiſhed the laſt edition of his Hiſtory of Settlements and Trade in the Eaſt and Weſt Indies, the population conſiſted of 7000 ſlaves of every age and ſex, 250 white men, excluſive of the ſoldiers. The coffee, ſugar, and cotton produced was conveyed to Holland in four or five ſhips, and ſold for about 40 or 50,000 l.

SURMOUNTED, in heraldry, is when one figure is laid over another.

SURMULLET. See Mullus.

SURNAME, that which is added to the proper name for diſtinguiſhing perſons and families. It was originally diſtinguiſhed from *ſirname*, which denotes the name of the *ſire* or progenitor: thus Macdonald, Robertſon are ſirnames expreſſing the ſon of Donald, the ſon of Robert. The word *ſurname*, again, ſignified ſome name ſuperadded to the proper name to diſtinguiſh the individual, as Artaxerxes *Longimanus*, Harold *Hareſoot*, Malcolm *Canmore*. From this it is evident that every ſirname was a ſurname, though the reverſe was not ſo. In modern times they are confounded; and as there is now no occaſion to preſerve the diſtinction, Dr Johnſon has rejected the word *ſirname* altogether. See Name.

Surname.

Surnames were introduced among all nations at an early period, and ſeem to have been formed at firſt by adding the name of the father to that of the ſon. This was the practice among the Hebrews, as appears from the Scriptures. Caleb is denominated the ſon of Jephunneh, and Joſhua the ſon of Nun. That the ſame thing was cuſtomary among the Greeks, every one who has read the poems of Homer muſt remember. We have an inſtance of it in the very firſt line of the Iliad: Αχιλληος Πηληιαδεω, "Achilles the ſon of Peleus." This is perhaps the general origin of ſurnames, for it has been common among moſt nations (A).

The Romans generally had three names. The firſt called *prænomen* anſwered to our Chriſtian name, and was intended to diſtinguiſh the individuals of the ſame family; the ſecond called *nomen* correſponded to the word *clan* in Scotland, and was given to all thoſe who were ſprung from the ſame ſtock; the third called *cognomen* expreſſed the particular branch of the tribe or clan from which an individual was ſprung. Thus Publius Cornelius Scipio, *Publius* correſponded to our names John, Robert, William; *Cornelius* was the name of the clan or tribe, as Campbell was formerly the name of all the Duke of Argyle's clients, and Douglas the name of the retainers of the Duke of Hamilton's progenitors. *Scipio* being added, conveyed this information, that Publius, who was of the tribe of the Cornelii, was of the family of the Scipios, one of the branches or families into which that tribe was divided. Reſpecting the three names which were common among the Romans, we may ſay that the firſt was a name and the other two ſurnames.

Du Cheſne obſerves, that ſurnames were unknown in France before the year 987, when the lords began to aſſume the names of their demeſnes. Camden relates, that they were firſt taken up in England, a little before the conqueſt, under King Edward the Confeſſor: but he adds, they were never fully eſtabliſhed among the common people till the time of Edward II.; till then they varied with the father's name; if the father, *e. gr.* was called *Richard*, or *Roger*, the ſon was called *Richardſon*, or *Hodgſon*; but from that time they were ſettled, ſome ſay, by act of parliament. The oldeſt ſurnames are thoſe we find in Domeſday-Book, moſt of them taken from places, with the addition of *de*; as Godefridus *de* Mannevilla, Walterus *de* Vernon, Robert *de* Oyly, &c. Others from their fathers, with *filius*, as Gulielmus *filius* Oſberni; others from their offices, as Eudo *Dapiſer*, Gulielmus *Camerarius*, Giſlebertus *Cocus*, &c. But the inferior people are noted ſimply by their Chriſtian names, without any ſurnames at all.

They ſeem to have been introduced into Scotland in the time of William the Conqueror by the Engliſh who accompanied Edgar Atheling when he fled into that kingdom. Theſe had their proper ſurnames, as Moubray, Lovell, Liſle, uſing the particle *de* before them; which makes it probable that theſe ſurnames had been derived from the lands which their anceſtors or they themſelves had poſſeſſed. In Kenneth II's. time in 800 the great men had indeed begun to call their lands by their own names; but the ordinary diſtinctions then uſed were only perſonal, and did not deſcend to ſucceeding generations, ſuch as thoſe employed by the Hebrews and Greeks: For example, *John the ſon of William*; or the names of office, as Stewart; or accidental diſtinctions from complexion or ſtation, as Black, White,

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(A) This might be ſupported by examples borrowed from many nations. The old Normans uſed *Fitz*, which ſignifies ſon; as Fitzherbert, Fitzſimmons, the ſon of Herbert, the ſon of Simmons. The Iriſh uſed *O*; as O'Neal, the ſon of Neal. The Scotch Highlanders employed *Mac*; as Macdonald, the ſon of Donald. The Saxons added the word *ſon* to the end of the father's name, as Williamſon.

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SURINAM, the capital of the Dutch ſettlements in Guiana, ſituated on a river of the ſame name, in N. Lat. 6. 16. W. Long. 56. 0. It gives name to the country for 100 miles round; and ſtands on a river of the ſame name, which is navigable for 30 leagues up the country. A ſettlement was formed at Surinam in 1650 by the Dutch, who preſerved poſſeſſion of it ever ſince. The chief trade conſiſts in ſugar, cotton, coffee of an excellent kind, tobacco, flax, ſkins, and ſome valuable drugs for dyeing. Four hundred and thirty plantations have been already formed on the banks of the Surinam and the adjacent country, which in 1775 yielded 24,120,000 weight of rough ſugar, which were ſold in Holland for 347,225 l. Sterling; 15,000,387 lb. weight of coffee, which ſold for 357,538 l; 970,000 lb. weight of cotton; 790,854 lb. weight of cocao; 152,844 lb. weight of wood for dyeing. The ſum total of theſe productions amounted to 822,905 Sterling, and was brought into the harbours of the republic in 70 veſſels. The number of ſlaves employed in the ſame year was 69,000, who belonged to 2824 maſters, excluſive of the women and children. The white people were of different countries and different religions.

Connected with Surinam, we may mention the colonies of Demerary, Iſſequibo, and Berbice, which lie a little to the weſt. The two firſt ſurrendered to the Britiſh troops in 1781; but being left defenceleſs, were retaken by a French frigate. Demerary has lately been taken a ſecond time by the army of Great Britain. It is conſidered as a valuable acquiſition, being a flouriſhing colony. In 1769 there were eſtabliſhed on the banks of the Demerary 130 habitations, in which ſugar, coffee, and cotton were ſucceſsfully cultivated, and ſince that period the number of plantations hath increaſed much.

Iſſequibo is a very inconſiderable ſettlement. Berbice, which lies between Demerary and Surinam, contains about 104 plantations, moſt of them ſmall, and ſcattered at great diſtances from one another upon the banks of the Berbice or of Corje. When Raynal publiſhed the laſt edition of his Hiſtory of Settlements and Trade in the Eaſt and Weſt Indies, the population conſiſted of 7000 ſlaves of every age and ſex, 250 white men, excluſive of the ſoldiers. The coffee, ſugar, and cotton produced was conveyed to Holland in four or five ſhips, and ſold for about 40 or 50,000 l.

SURMOUNTED, in heraldry, is when one figure is laid over another.

SURMULLET. See MULLUS.

Surname.

SURNAME, that which is added to the proper name for diſtinguiſhing perſons and families. It was originally diſtinguiſhed from *ſirname*, which denotes the name of the *ſire* or progenitor: thus Macdonald, Robertſon are ſirnames expreſſing the ſon of Donald, the ſon of Robert. The word *ſurname*, again, ſignified ſome name ſuperadded to the proper name to diſtinguiſh the individual, as Artaxerxes *Longimanus*, Harold *Hareſoot*, Malcolm *Canmore*. From this it is evident that every ſirname was a ſurname, though the reverſe was not ſo. In modern times they are confounded; and as there is now no occaſion to preſerve the diſtinction, Dr Johnſon has rejected the word *ſirname* altogether. See NAME.

Surnames were introduced among all nations at an early period, and ſeem to have been formed at firſt by adding the name of the father to that of the ſon. This was the practice among the Hebrews, as appears from the Scriptures. Caleb is denominated the ſon of Jephunneh, and Joſhua the ſon of Nun. That the ſame thing was cuſtomary among the Greeks, every one who has read the poems of Homer muſt remember. We have an inſtance of it in the very firſt line of the Iliad: Αχιλληος Πηληιαδεω, "Achilles the ſon of Peleus." This is perhaps the general origin of ſurnames, for it has been common among moſt nations (A).

The Romans generally had three names. The firſt called *prænomen* anſwered to our Chriſtian name, and was intended to diſtinguiſh the individuals of the ſame family; the ſecond called *nomen* correſponded to the word *clan* in Scotland, and was given to all thoſe who were ſprung from the ſame ſtock; the third called *cognomen* expreſſed the particular branch of the tribe or clan from which an individual was ſprung. Thus Publius Cornelius Scipio, *Publius* correſponded to our names John, Robert, William; *Cornelius* was the name of the clan or tribe, as Campbell was formerly the name of all the Duke of Argyle's clients, and Douglas the name of the retainers of the Duke of Hamilton's progenitors. *Scipio* being added, conveyed this information, that Publius, who was of the tribe of the Cornelii, was of the family of the Scipios, one of the branches or families into which that tribe was divided. Reſpecting the three names which were common among the Romans, we may ſay that the firſt was a name and the other two ſurnames.

Du Cheſne obſerves, that ſurnames were unknown in France before the year 987, when the lords began to aſſume the names of their demeſnes. Camden relates, that they were firſt taken up in England, a little before the conqueſt, under King Edward the Confeſſor: but he adds, they were never fully eſtabliſhed among the common people till the time of Edward II.; till then they varied with the father's name; if the father, *e. gr.* was called *Richard*, or *Roger*, the ſon was called *Richardſon*, or *Hodgſon*; but from that time they were ſettled, ſome ſay, by act of parliament. The oldeſt ſurnames are thoſe we find in Domeſday-Book, moſt of them taken from places, with the addition of *de*; as Godefridus *de* Mannevilla, Walterus *de* Vernon, Robert *de* Oyly, &c. Others from their fathers, with *filius*, as Gulielmus *filius* Oſberni; others from their offices, as Eudo *Dapifer*, Gulielmus *Camerarius*, Giſlebertus *Cocus*, &c. But the inferior people are noted ſimply by their Chriſtian names, without any ſurnames at all.

They ſeem to have been introduced into Scotland in the time of William the Conqueror by the Engliſh who accompanied Edgar Atheling when he fled into that kingdom. Theſe had their proper ſurnames, as Moubray, Lovell, Liſle, uſing the particle *de* before them; which makes it probable that theſe ſurnames had been derived from the lands which their anceſtors or they themſelves had poſſeſſed. In Kenneth II's. time in 800 the great men had indeed begun to call their lands by their own names; but the ordinary diſtinctions then uſed were only perſonal, and did not deſcend to ſucceeding generations, ſuch as thoſe employed by the Hebrews and Greeks: For example, *John the ſon of William*; or the names of office, as Stewart; or accidental diſtinctions from complexion or ſtation, as Black, White,

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(A) This might be ſupported by examples borrowed from many nations. The old Normans uſed *Fitz*, which ſignifies ſon; as Fitzherbert, Fitzſimmons, the ſon of Herbert, the ſon of Simmons. The Iriſh uſed *O*; as O'Neal, the ſon of Neal. The Scotch Highlanders employed *Mac*; as Macdonald, the ſon of Donald. The Saxons added the word *ſon* to the end of the father's name, as Williamſon.

White, Long, Short; or the name of their trade, as Taylor, Weaver.

It was long before any ſurnames were uſed in Wales, except that of ſon, as Evan ap Rice, Evan the ſon of Rice; Evan ap Howel, Evan the ſon of Howel: but many of them have at length formed ſeparate ſurnames, as the Engliſh and Scots, by leaving out the *a* in *ap*, and joining the *p* to the father's name: thus Evan ap Rice becomes Evan Price; Evan ap Howel, Evan Powel.—We are told, ſurnames were unknown in Sweden till the year 1514, and that the common people of that country uſe none to this day; and that the ſame is the caſe with the vulgar Iriſh, Poles, and Bohemians.

When we come to inquire into the etymology of ſurnames, we muſt allow that many of them were originally ſignificant of the qualities of mind, as Bold, Hardy, Meek; ſome of the qualities of body, as Strong, Low, Short; others expreſſive of the trade or profeſſion followed by the perſons to whom they were applied, as Baker, Smith, Wright; Butler, Page, Marſhal. But the greateſt number, at leaſt of the ancient ſurnames, were borrowed from the names of places. Camden ſays, that there is not a village in Normandy but has given its name to ſome family in England. He mentions as examples, Percy, Devereux, Tankervil, Mortimer, Warren, &c. They were introduced with William the Conqueror. Several have been derived from places in the Netherlands, as Gaunt, Tournay, Grandiſon; and many from the names of towns and villages in England and Scotland, as Wentworth, Markham, Murray, Aberdeen. Many have been formed from the names of animals, as quadrupeds, birds, fiſhes; from vegetables, and parts of vegetables, as trees, ſhrubs, flowers, and fruits; from minerals of different kinds. Others are formed from ſuch a variety of accidents that it is impoſſible to particularize them.

SURPLICE, the habit of the officiating clergy in the church of England. By Can. 58. every miniſter ſaying the public prayers, or miniſtering the ſacrament or other rites of the church, ſhall wear a decent and comely ſurplice with ſleeves, to be provided at the charge of the pariſh. But by 1 Eliz. c. 2. and 13 and 14 Car. II. the garb preſcribed by act of parliament, in the ſecond year of king Edward the Sixth, is enjoined; and this requires that in the ſaying or ſinging of matins and even ſongs, baptizing and burying, the miniſter in pariſh churches and chapels ſhall uſe a ſurplice. And in all cathedral churches and colleges, the archdeacon, dean, provoſts, maſters, prebendaries, and fellows, being graduates, may uſe in the choir, beſides their ſurplices, ſuch hoods as pertain to their ſeveral degrees. But in all other places every miniſter ſhall be at liberty to uſe a ſurplice or not. And hence in marrying, churching of women, and other offices not ſpecified in this rubric, and even in the adminiſtration of the holy communion, it ſeems that a ſurplice is not neceſſary. Indeed for the holy communion the rubric appoints a white ALB plain, which differs from the ſurplice in being cloſe ſleeved, with a veſtment or cope.

SURREBUTTER, in law, is ſecond rebutter; or the replication of the plaintiff to the defendant's rebutter.

SURREJOINDER, is a ſecond defence of the plaintiff's declaration, by way of anſwer to the defendant's rejoinder.

SURRENDER, in common law, a deed or inſtrument, teſtifying that the particular tenant of lands and tenements, for life or years, doth ſufficiently conſent and agree, that he who has the next or immediate remainder or reverſion thereof, ſhall have the preſent eſtate of the ſame in poſſeſſion; and that he hereby yields and gives up the ſame to him, ſo that the eſtate for life or years may merge or drown by mutual agreement of the parties. Of ſurrenders there are three kinds; a ſurrender properly taken at common law; a ſurrender of copyhold or cuſtomary eſtates; and a ſurrender improperly taken, as of a deed, a patent, &c. The firſt is the uſual ſurrender, and it is uſually divided into th in deed, and that in law.

SURRENDER, in deed, in that which is really made by expreſs words in writing, where the words of the leſſee to the leſſor prove a ſufficient aſſent to ſurrender his eſtate back again.

SURRENDER, in law, is that wrought by operation of the law, and which is not actual.—As if a man have a leaſe of a farm for life or years, and during the term he accepts a new leaſe; this act is, in law, a ſurrender of the former.

SURRENDER of a bankrupt. See *COMMISSION of Bankruptcy*.

SURRENDER of Copyholds is the yielding up of the eſtate by the tenant into the hands of the lord, for ſuch purpoſes as are expreſſed in the ſurrender; as to the uſe and behoof of A and his heirs, to the uſe of his own will, and the like. This method of conveyance is ſo eſſential to the nature of a copyhold eſtate, that it cannot poſſibly be transferred by any other aſſurance. No feoffment, fine, or recovery (in the king's courts) hath any operation upon it. If I would exchange a copyhold with another, I cannot do it by an ordinary deed of exchange at the common law, but we muſt ſurrender to each other's uſe, and the lord will admit us accordingly. If I would deviſe a copyhold, I muſt ſurrender it to the uſe of my laſt will and teſtament; and in my will I muſt declare my intentions, and name a deviſee, who will then be entitled to admiſſion.

Blackſt. Comment vol. ii.

SURRENDER of Letters Patent and Offices. A ſurrender may be made of letters patent to the king, ſo that he may grant the eſtate to whom he pleaſes, &c. and a ſecond patent for years to the ſame perſon for the ſame thing is a ſurrender in law of the firſt patent. 10 Rep. 66. If an officer for life accepts of another grant of the ſame office, it is in law a ſurrender of the firſt grant; but if ſuch an officer takes another grant of the ſame office to himſelf and another, it may be otherwiſe.

SURREPTITIOUS. See SUBREPTITIOUS.

SURROGATE, in law, denotes a perſon that is ſubſtituted or appointed in the room of another.

SURRY, a county of England, bounded on the weſt by Berkſhire and Hampſhire, on the ſouth by Suſſex, on the eaſt by Kent, on the north by Middleſex, from which it is parted by the Thames, whence it had the name of *Suth-rey* from the Saxons, *i. e.* the country on the ſouth ſide of the river. It is 38 miles in length from eaſt to weſt, 23 in breadth from north to ſouth, and 112 in circumference. It contains 13 hundreds, 140 pariſhes, of which 35 are vicarages, 13 market-towns, 450 villages, 592,000 acres, and about 170,000 inhabitants. The members ſent from it to parliament are 14, of which two are ſent by each of the following boroughs, viz. Southwark, Bleechingley, Ryegate, Guildford, Gatton, Haſlemere, and two for the county.

Camden' Britanni by Goug

The air of this county, towards the middle, which conſiſts moſtly of hills and heath, is ſharp, but pure and wholeſome. About the ſkirts, where it is more level, and the ſoil richer, the air is milder, but alſo ſalubrious. In the middle parts the ſoil is barren enough in general; but towards the extremities, and where the country is open and champaign, it is fruitful in graſs and corn, particularly on the ſouth ſide in Holmſdale, in which meadows, woods, and corn-fields, are agreeably intermixed. The ſoil is alſo very fertile along the Thames, eſpecially towards London, where it greatly contributes to maintain plenty in the London markets. It has ſeveral rivers, abounding with fiſh, the chief of which are the Wye, the Mole, and the Wandle.

SURSOLID, or Surdesolid, in arithmetic, the fifth power of a number, or the fourth multiplication of any number, conſidered as a root.

SURVEYING, the art of meaſuring land; that is, of taking the dimenſions of any tract of ground, laying down the ſame in a map or draught, and finding the content or area thereof. See Geometry.

SURVEYOR, a perſon who has the overſight and care of conſiderable works, lands, or the like.

Surveyor, likewiſe denotes a gauger; as alſo a perſon who ſurveys lands, and makes maps of them.

SURVIVOR, in law, ſignifies the longeſt liver of joint tenants, or of any two perſons jointly intereſted in a thing.

SURVIVORSHIP, is that branch of mathematics which treats of reverſions payable provided one or more particular perſons ſurvive certain others. By reverſions are meant payments not to take place till ſome future period. Survivorſhip forms one of the moſt difficult and complicated parts of the doctrine of reverſions and life-annuities. It has been very fully treated of by Mr Thomas Simpſon in his Select Exerciſes; and brought to a ſtate of very great perfection by Dr Price and Mr Morgan, who have beſtowed a great deal of attention on this ſubject.

The calculations are founded on the expectation of lives at different ages, deduced from tables formed from bills of mortality, of which ſee ſeveral examples under the article *Bills of Mortality*. By the expectation of life is meant the mean time that any ſingle or joint lives at a given age is found to continue; that is, the number of years which, taking one with another, they actually enjoy, and may be conſidered as ſure of enjoying; thoſe who ſurvive that period enjoying as much more time in proportion to their number as thoſe who fall ſhort of it enjoy leſs. Thus, ſuppoſing 46 perſons alive all 40 years of age, and that one will die every year till they are all dead in 46 years, half 46 or 23 will be the *expectation* of each of them. If M. de Moivre's hypotheſis were true, that men always decreaſe in an arithmetical progreſſion, the expectation of a ſingle life is always half its complement (a), and the expectation of two joint lives one-third of their common complement. Thus, ſuppoſing a man 40, his expectation would be 23, the half of 46, his complement; the expectation of two joint lives, each 40, would be 15 years 4 months, or the third part of 46.

The number expreſſing the expectation, multiplied by the number of ſingle or joint lives (of which it is the expectation), added annually to a ſociety, gives the whole number living together, to which ſuch an annual addition would in time grow. Thus, ſince 19, or the third of 57, is the expectation of two joint lives, whoſe common age is 29, twenty marriages every year between perſons of this age would in 57 years grow to 20 times 19, or 380 marriages, always exiſting together. And ſince the expectation of a ſingle life is always half its complement, in 57 years 20 ſingle perſons added annually to a town will increaſe to 20 times 28.5, or 570; and when arrived at this number, the deaths every year will juſt equal the acceſſions, and no farther increaſe be poſſible. It appears from hence, that the particular proportion that becomes extinct every year, out of the whole number conſtantly exiſting together of ſingle or joint lives, muſt, wherever this number undergoes no variation, be exactly the ſame with the expectation of thoſe lives, at the time when their exiſtence commenced. Thus, was it found that a 19th part of all the marriages among any bodies of men, whoſe numbers do not vary, are diſſolved every year by the deaths of either the huſband or wife, it would appear that 19 was, at the time they were contracted, the expectation of theſe marriages. In like manner, was it found in a ſociety, limited to a fixed number of members, that a 28th part dies annually out of the whole number of members, it would appear that 28 was their common expectation of life at the time they entered. So likewiſe, were it found in any town or diſtrict, where the number of births and burials are equal, that a 20th or 30th part of the inhabitants die annually, it would appear that 20 or 30 was the expectation of a child juſt born in that town or diſtrict. Theſe expectations, therefore, for all ſingle lives, are eaſily found by a table of obſervations, ſhowing the number that die annually at all ages out of a given number alive at thoſe ages; and the general rule for this purpoſe is, to divide the ſum of all the living in the table, at the age whoſe expectation is required, and at all greater ages, by the ſum of all that die annually at that age and above it; or, which is the ſame, by the number (in the Table) of the living at that age; and half unity ſubtracted from the quotient will be the required expectation. Thus, in Dr Halley's table, given in the article Annuity, the ſum of all the living at 20 and upwards is 20,724, which, divided by 598, the number living at the age of 20, and half unity ſubtracted from the quotient, gives 34.15 for the expectation of 20.

In calculating the value or expectation of joint lives, Mr de Moivre had recourſe to the hypotheſis, that the probabilities of life decreaſe in a geometrical progreſſion; believing that the values of joint lives, obtained by rules derived from it, would not deviate much from the truth. But in this he was greatly miſtaken; they generally give reſults which are near a quarter of the true value too great in finding the preſent value of one life after it has ſurvived another in a ſingle payment, and about $\frac{2}{7}$ths too great when the value is ſought in annual payments during the joint lives. They ought therefore to be calculated upon the hypotheſis (if they are calculated upon hypotheſis at all), that the probabilities of life decreaſe in arithmetical progreſſion, which is not very far from the truth. Even this hypotheſis never correſponds with the fact in the firſt and laſt periods of life, and in ſome ſituations not in any period of life. Dr Price and Mr Morgan therefore have given tables of the value of lives, not founded on any hypotheſis, but deduced from bills of mortality themſelves. Some of theſe we ſhall give at the end of this article. Mr Morgan has likewiſe given rules for calculating values of lives in this manner.

M. de Moivre has alſo fallen into miſtakes in his rules for calculating the value of reverſions depending on ſurvivorſhip: theſe have been pointed out by Dr Price in the third eſſay in the firſt volume of his Treatiſe on Reverſionary Payments; who has alſo given proper rules for calculating theſe values, the moſt important of which are comprehended in the following paragraphs.

1 Method of finding the number of annuitants that will come on a ſociety.

Suppoſe a ſet of married men to enter into a ſociety in order to provide annuities for their widows, and that it is limited to a certain number of members, and conſtantly kept up to that number by the admiſſion of new members as the old ones are loſt; it is of importance, in the firſt place, to know the number of annuitants that after ſome time will come upon the eſtabliſhment. Now ſince every marriage produces either a widow or widower; and ſince all marriages taken together would produce as many widows as widowers, were every man and his wife of the ſame age, and the chance equal which ſhall die firſt; it is evident, that the

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(a) By the complement of a life is meant what it wants of 86, which M. de Moivre makes the boundary of human life. Thus if a man be 30, the complement of his life is 56.

number of widows that have ever exiſted in the world, would in this caſe be equal to half the number of marriages. And what would take place in the world muſt alſo, on the ſame ſuppoſitions, take place in this ſociety. In other words, every other perſon in ſuch a ſociety leaving a widow, there muſt ariſe from it a number of widows equal to half its own number. But this does not determine what number, all living at one and the ſame time, the ſociety may expect will come to be conſtantly upon it. It is, therefore, neceſſary to determine how long the duration of ſurvivorſhip between perſons of equal ages will be compared with the duration of marriage. And the truth is, that, ſuppoſing the probabilities of life to decreaſe uniformly, the former is equal to the latter; and conſequently that the number of ſurvivors, or (which is the ſame, ſuppoſing no ſecond marriages) of widows and widowers alive together, which will ariſe from any given ſet of ſuch marriages conſtantly kept up, will be equal to the whole number of marriages; or half of them (the number of widows in particular) equal to half the number of marriages. Now it appears that in moſt towns the decreaſe in the probabilities of life is in fact nearly uniform. According to the Breſlaw Table of Obſervation (ſee Annuity), almoſt the ſame numbers die every year from 20 years of age to 77. After this, indeed, fewer die, and the rate of decreaſe in the probabilities of life is retarded. But this deviation from the hypotheſis is inconſiderable; and its effect, in the preſent caſe, is to render the duration of ſurvivorſhip longer than it would otherwiſe be. According to the London Table of Obſervations, the numbers dying every year begin to grow leſs at 50 years of age; and from hence to extreme old age there is a conſtant retardation in the decreaſe of the probabilities of life. Upon the whole, therefore, it appears that, according to the Breſlaw Table, and ſuppoſing no widows to marry, the number inquired after is ſomewhat greater than half the number of the ſociety; but, according to the London Table, a good deal greater. This, however, has been determined on the ſuppoſition that the huſbands and wives are of equal ages, and that then there is an equal chance who ſhall die firſt. But in reality huſbands are generally older than wives, and males have been found to die ſooner than females, as appears inconteſtibly from ſeveral of the tables in Dr Price's Treatiſe on Reverſions. It is therefore more than an equal chance that the huſband will die before his wife. This will increaſe conſiderably the duration of ſurvivorſhip on the part of the woman, and conſequently the number which we have been inquiring after. The marriage of widows will diminiſh this number, but not ſo much as the other cauſes will increaſe it.

2
When the number of annuitants arrives at its maximum.

If the ſociety comprehends in it from the firſt all the married people of all ages in any town, or among any claſs of people where the numbers always continue the ſame, the whole collective body of members will be at their greateſt age at the time of the eſtabliſhment of the ſociety; and the number of widows left every year will at a medium be always the ſame. The number of widows will increaſe continually on the ſociety, till as many die off every year as are added. This will not be till the whole collective body of widows are at their greateſt age, or till there are among them the greateſt poſſible number of the oldeſt widows; and therefore not till there has been time for an acceſſion to the oldeſt widows from the youngeſt part.

Let us, for the ſake of greater preciſion, divide the whole medium of widows that come on every year into different claſſes according to their different ages, and ſuppoſe ſome to be left at 56 years of age, ſome at 46, ſome at 36, and ſome at 26. The widows, conſtantly in life together, derived from the firſt claſs, will come to their greateſt age, and to a *maximum*, in 30 years, ſuppoſing, with M. de Moivre, 86 to be the utmoſt extent of life. The ſame will happen to the ſecond claſs in 40 years, and to the third in 50 years. But the whole body compoſed of theſe claſſes will not come to a *maximum* till the ſame happens to the fourth or youngeſt claſs; that is, not till the end of 60 years. After this the affairs of the ſociety will become ſtationary, and the number of annuitants upon it of all ages will keep always nearly the ſame.

If a ſociety begins with its complete number of members, but at the ſame time admits none above a particular age: If, for inſtance, it begins with 200 members all under 50, and afterwards limits itſelf to this number, and keeps it up by admitting every year, at all ages between 26 and 50, new members as old ones drop off; in this caſe, the period neceſſary to bring on the *maximum* of annuitants will be juſt doubled.

3
What a man ought to pay in a ſingle payment to entitle his widow to a certain annuity.

To determine the ſum that every individual ought to pay in a ſingle preſent payment, in order to intitle his widow to a certain annuity for her life, let us ſuppoſe the annuity 30 l. *per annum*, and the rate of intereſt four *per cent.* It is evident, that the value of ſuch an expectation is different, according to the different ages of the purchaſers, and the proportion of the age of the wife to that of the huſband. Let us then ſuppoſe that every perſon in ſuch a ſociety is of the ſame age with his wife, and that one with another all the members when they enter may be reckoned 40 years of age, as many entering above this age as below it. It has been demonſtrated by M. de Moivre and Mr Simpſon, that the value of an annuity on the joint continuance of any two lives, ſubtracted from the value of an annuity on the life in expectation, gives the true preſent value of annuity on what may happen to remain of the latter of the two lives after the other.

In the preſent caſe, the value of an annuity to be enjoyed during the joint continuance of two lives, each 40, is, by Table II. 9.826, according to the probabilities of life in the Table of Obſervations formed by Dr Halley from the bills of mortality of Breſlaw in Sileſia. The value of a ſingle life 40 years of age, as given by M. de Moivre, agreeably to the ſame table, is 13.20; and the former ſubtracted from the latter, leaves 3.37, or the true number of years purchaſe, which ought to be paid for any given annuity, to be enjoyed by a perſon 40 years of age, provided he ſurvives another perſon of the ſame age, intereſt being reckoned at four *per cent. per annum*. The annuity, therefore, being 30 l. the preſent value of it is 30 multiplied by 3.37, or 101 l. 2 s.

4
What he ought to pay in annual payments.

If, inſtead of a ſingle preſent payment, it is thought preferable to make annual payments during the marriage; what theſe annual payments ought to be is eaſily determined by finding what annual payments during two joint lives of given ages are equivalent to the value of the reverſionary annuity in preſent money. Suppoſe, as before, that the joint lives are each 40, and the reverſionary annuity 30 l. *per annum*. An annual payment during the continuance of two ſuch lives is worth, (according to Table II.) 9.82 years purchaſe. The annual payment ought to be ſuch as, being multiplied by 9.82, will produce 101.1 l. the preſent value of the annuity in one payment. Divide then 101.1 by 9.82, and 10.3 the quotient will be the annual payment. This method of calculation ſuppoſes that the firſt annual payment is not to be made till the end of a year. If it is to be made immediately, the value of the joint lives will be increaſed one year's purchaſe; and therefore, in order to find the annual payments required, the value of a preſent ſingle payment muſt be divided by the value of the joint lives increaſed by unity. If the ſociety prefer paying part of the value in a preſent ſingle payment on admiſſion, and the reſt in annual payments; and if they fix theſe annual payments at a particular ſum, the preſent ſingle payment paid on admiſſion is found by ſubtracting the value of the annual payment during the joint lives from the whole preſent value of the annuity in one payment. Suppoſe, for inſtance, the annual payments to be fixed at five guineas, the annuity to be 30 l. the rate of intereſt four *per cent.* and the joint lives each 40; the value of the annuity in one preſent ſingle payment is 101.1 l. The value of five guineas or 5.25 *per annum*, is (5.25 multiplied by 9.82 the value of the joint lives) 51.55; which, ſubtracted from 101.1 l. gives l. 49.5, the anſwer.

If a ſociety takes in all the marriages among perſons of a particular profeſſion within a given diſtrict, and ſubjects them for perpetuity to a certain equal and common tax or annual payments, in order to provide life annuities for all the widows that ſhall reſult from theſe marriages; ſince, at the commencement of ſuch an eſtabliſhment, all the oldeſt, as well as the youngeſt, marriages are to be intitled equally to the propoſed benefit, a much greater number of annuitants will come immediately upon it than would come upon any ſimilar eſtabliſhment which limited itſelf in the admiſſion of members to perſons not exceeding a given age. This will check that accumulation of money which ſhould take place at firſt, in order to produce an income equal to the diſburſements at the time when the number of annuitants comes to a *maximum*; and therefore will be a particular burden upon the eſtabliſhment in its infancy. For this ſome compenſation muſt be provided; and the equitable method of providing it is, by levying fines at the beginning of the eſtabliſhment on every member exceeding a given age, proportioned to the number of years which he has lived beyond that age. But if ſuch fines cannot be levied, and if every payment muſt be equal and common, whatever diſparity there may be in the value of the expectations of different members, the fines muſt be reduced to one common one, anſwering as nearly as poſſible to the diſadvantage, and payable by every member at the time when the eſtabliſhment begins. After this, the eſtabliſhment will be the ſame with one that takes upon it all at the time they marry; and the tax or annual payment of every member adequate to its ſupport will be the annual payment during marriage due from perſons who marry at the mean age at which, upon an average, all marriages may be conſidered as commencing. The fines to be paid at firſt are, for every particular member, the ſame with the difference between the value of the expectation to him at his preſent age, and what would have been its value to him had the ſcheme begun at the time he married. Or, they are, for the whole body of members, the difference between the value of the common expectation, to perſons at the mean age of all married perſons taken together as they exiſt in the world, and to perſons at that age which is to be deemed their mean age when they marry.

5
Method of finding the preſent value of an annuity to be enjoyed by one life after the expiration of another.

Suppoſe we wiſh to know the preſent value of an annuity to be enjoyed by one life, for what may happen to remain of it beyond another life, after a given term; that is, provided both lives continue from the preſent time to the end of a given term of years; the method of calculating is this: Find the value of the annuity for two lives, greater by the given term of years than the given lives; diſcount this value for the given term; and then multiply by the probability, that the two given lives ſhall both continue the given term; and the product will be the anſwer. Thus, let the two lives be each 30, the term ſeven years, the annuity l. 10, intereſt four *per cent.* The given lives, increaſed by ſeven years, become each 37. The value of two joint lives, each 37, is (by Table II.) 10.25. The value of a ſingle life at 37 is (by the table under the article Annuity) 13.67. The former ſubtracted from the latter is 3.42, or the value of an annuity for the life of a perſon 37 years of age, after another of the ſame age, as has been ſhown above. 3.42 diſcounted for ſeven years (that is, multiplied by 0.76 the value of 1 l. due at the end of ſeven years) is 2.6. The probability that a ſingle life at 30 ſhall continue ſeven years is $\frac{49}{56}$ (B). The probability, therefore, that two ſuch lives ſhall continue ſeven years, is $\frac{2401}{3136}$, or in decimals 0.765; and 2.6 multiplied by 0.765, is 1.989, the number of years purchaſe which ought to be given for an annuity to be enjoyed by a life now 30 years of age, after a life of the ſame age, provided both continue ſeven years. The annuity then being 10 l. its preſent value is l. 19.89.

6
Method of finding the value of an annuity for what may happen to remain of one life after another, provided the life in expectation continues a given term.

Suppoſe the value is required of an annuity to be enjoyed for what may happen to remain of one life after another, provided the life in expectation continues a given time. 1. Find the preſent value of the annuity for the remainder of the life in expectation after the given time, which is done in this manner: Multiply the preſent value of the life at the given time by the preſent value of 1 l. to be received at that time, and multiply the product again by the probability that the life in expectation will continue ſo long. Let the given time which the life in expectation is to continue be 15 years, and let the perſon then be arrived at 50 years of age. A life at fifty, according to M. de Moivre's valuation of lives, and reckoning intereſt at four *per cent.* is worth 11.34 years purchaſe. The preſent value of 1 l. to be received at the end of 15 years, is 0.5553, and the probability that a life at 35 will continue 15 years is $\frac{146}{490}$. Theſe three values multiplied into one another give L. 4.44 for the preſent value of the life in expectation. 2. Find the value of the reverſion, provided both lives continue the given time, by the rule given in parag. 5th. 3. Add theſe values together, and the ſum will be the anſwer in a ſingle preſent payment. We ſhall now illuſtrate this rule by an example.

An annuity of 10 l. for the life of a perſon now 30, is to commence at the end of 11 years, if another perſon now 40 ſhould be then dead; or, if this ſhould not happen at the end of any year beyond 11 years in which the former ſhall happen to ſurvive the latter: What is the preſent value of ſuch an annuity, reckoning intereſt at four *per cent.* and taking the probabilities of life as they are in Dr Halley's table, given in the article Mortality?

The value of 10 l. *per annum*, for the remainder of the life of a perſon now 30, after 11 years is L. 69.43. The probability that a perſon 40 years of age ſhall live 11 years, is, by Dr Halley's table, $\frac{335}{445}$. The probability, therefore, that he will die in 11 years, is $\frac{335}{445}$ ſubtracted from unity (C), or $\frac{110}{445}$; which multiplied by l. 69.43, gives l. 17.16.—The value of the reverſion, provided both live 11 years, is 17 l. and this value added to the former, makes l. 34.16 the value required in a ſingle preſent payment; which payment divided by l. 11.43, the value of two joint lives aged 30 and 40, with unity added, gives 3 l.; or the value required in annual payments during the joint lives, the firſt payment to be made immediately.

(B) The probability that a given life ſhall continue any number of years, or reach a given age, is (as is well known) the fraction, whoſe numerator is the number of the living in any table of obſervations oppoſite to the given age, and denominator, the number oppoſite to the preſent age of the given life.

(C) For the difference between unity and the fraction expreſſing the probability that an event will happen, gives the probability that it will not happen.

Table I. *Showing the Preſent Values of an Annuity of* L. 1 *on a Single Life, according to M. de Moivre's Hypotheſis.*

Age.	3 per Ct.	3½ per Ct	4 per Ct.	4½ per Ct	5 per Ct.	6 per Ct.
8	19,736	18,160	16,791	15,595	14,544	12,790
9	19,868	18,269	16,882	15,672	14,607	12,839
10	19,868	18,269	16,882	15,672	14,607	12,839
11	19,736	18,160	16,791	15,595	14,544	12,790
12	19,604	18,049	16,698	15,517	14,480	12,741
13	19,469	17,937	16,604	15,437	14,412	12,691
14	19,331	17,823	16,508	15,356	14,342	12,639
15	19,192	17,707	16,410	15,273	14,271	12,586
16	19,050	17,588	16,311	15,189	14,197	12,532
17	18,905	17,467	16,209	15,102	14,123	12,476
18	18,759	17,344	16,105	15,015	14,047	12,419
19	18,610	17,220	15,999	14,923	13,970	12,361
20	18,458	17,093	15,891	14,831	13,891	12,301
21	18,305	16,963	15,781	14,737	13,810	12,239
22	18,148	16,830	15,669	14,641	13,727	12,177
23	17,990	16,696	15,554	14,543	13,642	12,112
24	17,827	16,559	15,437	14,442	13,555	12,045
25	17,664	16,419	15,318	14,340	13,466	11,978
26	17,497	16,277	15,197	14,235	13,375	11,908
27	17,327	16,133	15,073	14,128	13,282	11,837
28	17,154	15,985	14,946	14,018	13,186	11,763
29	16,979	15,835	14,816	13,905	13,088	11,688
30	16,800	15,682	14,684	13,791	12,988	11,610
31	16,620	15,526	14,549	13,673	12,855	11,530
32	16,436	15,367	14,411	13,553	12,780	11,449
33	16,248	15,204	14,270	13,430	12,673	11,365
34	16,057	15,039	14,126	13,304	12,562	11,278
35	15,864	14,871	13,979	13,175	12,449	11,189
36	15,666	14,699	13,829	13,044	12,333	11,098
37	15,465	14,524	13,676	12,909	12,214	11,003
38	15,260	14,345	13,519	12,771	12,091	10,907
39	15,053	14,163	13,359	12,630	11,966	10,807
40	14,842	13,978	13,196	12,485	11,837	10,704
41	14,626	13,789	13,028	12,337	11,705	10,599
42	14,407	13,596	12,858	12,185	11,570	10,490
43	14,185	13,399	12,683	12,029	11,431	10,378
44	13,958	13,199	12,504	11,870	11,288	10,263
45	13,728	12,993	12,322	11,707	11,142	10,144
46	13,493	12,784	12,135	11,540	10,992	10,021
47	13,254	12,571	11,944	11,368	10,837	9,895
48	13,012	12,354	11,748	11,192	10,679	9,765
49	12,764	12,131	11,548	11,012	10,515	9,630
50	12,511	11,904	11,344	10,827	10,348	9,492
51	12,255	11,673	11,135	10,638	10,176	9,349
52	11,994	11,437	10,921	10,443	9,999	9,201
53	11,729	11,195	10,702	10,243	9,817	9,049
54	11,457	10,950	10,478	10,039	9,630	8,891
55	11,183	10,698	10,248	9,829	9,437	8,729
56	10,902	10,443	10,014	9,614	9,239	8,561
57	10,616	10,181	9,773	9,393	9,036	8,387
58	10,325	9,913	9,527	9,166	8,826	8,208
59	10,029	9,640	9,275	8,933	8,611	8,023
60	9,727	9,361	9,017	8,694	8,389	7,831
61	9,419	9,076	8,753	8,449	8,161	7,633
62	9,107	8,786	8,482	8,197	7,926	7,428
63	8,787	8,488	8,205	7,938	7,684	7,216
64	8,462	8,185	7,921	7,672	7,435	6,997
65	8,132	7,875	7,631	7,399	7,179	6,770
66	7,794	7,558	7,333	7,119	6,915	6,535
67	7,450	7,234	7,027	6,831	6,643	6,292
68	7,099	6,902	6,714	6,534	6,362	6,040
69	6,743	6,565	6,394	6,230	6,073	5,779
70	6,378	6,219	6,065	5,918	5,775	5,508
71	6,008	5,865	5,728	5,596	5,468	5,228
72	5,631	5,505	5,383	5,265	5,152	4,937
73	5,246	5,136	5,029	4,926	4,826	4,636
74	4,854	4,759	4,666	4,576	4,489	4,324
75	4,453	4,373	4,293	4,217	4,143	4,000
76	4,046	3,978	3,912	3,847	3,784	3,664
77	3,632	3,575	3,520	3,467	3,415	3,315
78	3,207	3,163	3,111	3,076	3,034	2,953
79	2,776	2,741	2,707	2,673	2,641	2,578
80	2,334	2,309	2,284	2,259	2,235	2,188
81	1,886	1,867	1,850	1,832	1,816	1,783
82	1,429	1,411	1,406	1,394	1,384	1,362
83	0,961	0,955	0,950	0,943	0,937	0,925
84	0,484	0,483	0,481	0,479	0,476	0,472
85	0,000	0,000	0,000	0,000	0,000	0,000

Table II. *Shewing the Value of an Annuity on the Joint Continuance of Two Lives, according to M. de Moivre's Hypotheſis.*

Age of the Youngeſt.	Age of the Eldeſt.	Value at 3 per Cent.	Value at 4 per Cent.	Value at 5 per Cent.
10	10	15.206	13.342	11.855
	15	14.878	13.093	11.661
	20	14.503	12.808	11.430
	25	14.074	12.480	11.182
	30	13.585	12.102	10.884
	35	13.025	11.665	10.537
	40	12.381	11.156	10.128
	45	11.644	10.564	9.646
	50	10.796	9.871	9.074
	55	9.822	9.059	8.391
	60	8.704	8.105	7.572
	65	7.417	6.980	6.585
	70	5.936	5.652	5.391
15	15	14.574	12.860	11.478
	20	14.225	12.593	11.266
	25	13.822	12.281	11.022
	30	13.359	11.921	10.736
	35	12.824	11.501	10.402
	40	12.207	11.013	10.008
	45	11.496	10.440	9.541
	50	10.675	9.767	8.985
	55	9.727	8.975	8.318
	60	8.632	8.041	7.515
	65	7.377	6.934	6.544
	70	5.932	5.623	5.364
20	20	13.904	12.341	11.067
	25	13.531	12.051	10.840
	30	13.098	11.711	10.565

Age of the Youngest.	Age of the Eldest.	Value at 3 per Cent.	Value at 4 per Cent.	Value at 5 per Cent.
20	35	12.594	11.314	10.278
	40	12.008	10.847	9.870
	45	11.325	10.297	9.420
	50	10.536	9.648	8.880
	55	9.617	8.879	8.233
	60	8.549	7.967	7.448
	65	7.308	6.882	6.495
	70	5.868	5.590	5.333
25	25	13.192	11.786	10.621
	30	12.794	11.468	10.367
	35	12.333	11.093	10.067
	40	11.770	10.655	9.708
	45	11.130	10.131	9.278
	50	10.374	9.509	8.761
	55	9.488	8.766	8.134
	60	8.452	7.880	7.371
	65	7.241	6.826	6.440
	70	5.826	5.551	5.294
30	30	12.434	11.182	10.133
	35	12.010	10.838	9.854
	40	11.502	10.428	9.514
	45	10.898	9.936	9.112
	50	10.183	9.345	8.620
	55	9.338	8.634	8.018
	60	8.338	7.779	7.280
	65	7.161	6.748	6.373
	70	5.777	5.505	5.254
35	35	11.632	10.530	9.600
	40	11.175	10.157	9.291
	45	10.622	9.702	8.913
	50	9.955	9.149	8.450
	55	9.156	8.476	7.879
	60	8.202	7.658	7.172
	65	7.066	6.662	6.294
	70	5.718	5.450	5.203
40	40	10.777	9.826	9.014
	45	10.283	9.418	8.671
	50	9.677	8.911	8.244
	55	8.936	8.283	7.710
	60	8.038	7.510	7.039
	65	6.951	6.556	6.198
	70	5.646	5.383	5.141
45	45	9.863	9.063	8.370
	50	9.331	8.619	7.987
	55	8.662	8.044	7.500
	60	7.831	7.332	6.875
	65	6.807	6.435	6.080
	70	5.556	5.300	5.063
50	50	8.892	8.235	7.660
	55	8.312	7.738	7.230
	60	7.568	7.091	6.664
	65	6.623	6.258	5.926
	70	5.442	5.193	4.964
55	55	7.849	7.332	6.873
	60	7.220	6.781	6.386
	65	6.379	6.036	5.724
	70	5.201	5.053	4.833
60	60	6.737	6.351	6.001
	65	6.043	5.730	5.444
	70	5.081	4.858	4.653
65	65	5.547	5.277	5.031
	70	4.773	4.571	4.385
70	70	4.270	4.104	3.952

Table III. *Shewing the Values of Annuities on Single Lives, among Males and Females, according to the Probabilities of the Duration of Life in the Kingdom of Sweden.*

	Males.		Females.		Lives in general.	
Ages.	4 per Ct.	5 per Ct.	4 per Ct.	5 per Ct.	4 per Ct.	5 per Ct.
1	16.503	14.051	16.820	14.271	16.661	14.161
2	17.355	14.778	17.719	15.034	17.537	14.906
3	17.935	15.279	18.344	15.571	18.139	15.425
4	18.328	15.624	18.780	15.951	18.554	15.787
5	18.503	15.786	18.927	16.088	18.715	15.937
6	18.622	15.901	19.045	16.203	18.833	16.052
7	18.693	15.977	19.131	16.291	18.912	16.134
8	18.725	16.021	19.162	16.335	18.943	16.178
9	18.715	16.030	19.151	16.343	18.933	16.186
10	18.674	16.014	19.109	16.325	18.891	16.169
11	18.600	15.970	19.041	16.286	18.820	16.128
12	18.491	15.896	18.952	16.229	18.721	16.062
13	18.378	15.819	18.840	16.153	18.609	15.986
14	18.246	15.724	18.707	16.059	18.476	15.891
15	18.105	15.624	18.568	15.960	18.336	15.792
16	17.958	15.517	18.424	15.856	18.191	15.686
17	17.803	15.404	18.290	15.761	18.046	15.582
18	17.643	15.285	18.151	15.662	17.897	15.473
19	17.492	15.175	18.013	15.563	17.752	15.369
20	17.335	15.059	17.872	15.462	17.603	15.260
21	17.192	14.955	17.725	15.356	17.458	15.155
22	17.042	14.846	17.573	15.245	17.307	15.045
23	16.887	14.732	17.414	15.129	17.150	14.930
24	16.742	14.627	17.252	15.009	16.997	14.818
25	16.592	14.517	17.087	14.886	16.839	14.701
26	16.436	14.402	16.915	14.757	16.675	14.579
27	16.274	14.282	16.751	14.636	16.512	14.459
28	16.105	14.156	16.588	14.515	16.346	14.335
29	15.930	14.024	16.427	14.396	16.178	14.210
30	15.751	13.889	16.261	14.272	16.006	14.080
31	15.575	13.756	16.104	14.156	15.839	13.956
32	15.395	13.619	15.941	14.035	15.668	13.827
33	15.208	13.477	15.787	13.923	15.497	13.700
34	15.014	13.327	15.629	13.806	15.321	13.566
35	14.812	13.170	15.465	13.684	15.138	13.427
36	14.601	13.006	15.278	13.542	14.939	13.274
37	14.382	12.833	15.070	13.382	14.726	13.107
38	14.154	12.652	14.854	13.213	14.504	12.932
39	13.916	12.462	14.629	13.036	14.272	12.749
40	13.668	12.261	14.401	12.856	14.034	12.558
41	13.426	12.065	14.185	12.687	13.805	12.376
42	13.196	11.880	13.994	12.538	13.595	12.209
43	12.984	11.710	13.798	12.387	13.391	12.048
44	12.763	11.532	13.596	12.229	13.179	11.880
45	12.535	11.347	13.383	12.061	12.959	11.704
46	12.297	11.153	13.151	11.876	12.724	11.514
47	12.051	10.951	12.894	11.668	12.472	11.309
48	11.795	10.738	12.620	11.443	12.217	11.090
49	11.528	10.516	12.333	11.205	11.930	10.860
50	11.267	10.298	12.049	10.970	11.658	10.634
51	11.030	10.100	11.769	10.737	11.399	10.418
52	10.785	9.895	11.492	10.507	11.138	10.201
53	10.531	9.682	11.220	10.280	10.875	9.981
54	10.269	9.460	10.937	10.042	10.603	9.751
55	9.998	9.229	10.642	9.792	10.320	9.510
56	9.717	8.988	10.334	9.529	10.025	9.258
57	9.425	8.736	10.012	9.253	9.718	8.994
58	9.140	8.489	9.692	8.976	9.416	8.732
59	8.845	8.232	9.358	8.687	9.101	8.458
60	8.540	7.963	9.039	8.406	8.789	8.184
61	8.241	7.700	8.739	8.144	8.490	7.922

Ages.	Males.		Females.		Lives in general.	
	4 per Ct.	5 per Ct.	4 per Ct.	5 per Ct.	4 per Ct.	5 per Ct.
62	7.950	7.442	8.453	7.895	8.201	7.668
63	7.669	7.193	8.166	7.643	7.917	7.418
64	7.382	6.938	7.870	7.382	7.626	7.160
65	7.090	6.676	7.566	7.111	7.328	6.893
66	6.792	6.408	7.252	6.831	7.022	6.619
67	6.489	6.134	6.930	6.541	6.709	6.337
68	6.201	5.872	6.596	6.239	6.398	6.055
69	5.933	5.628	6.253	5.926	6.093	5.777
70	5.670	5.389	5.897	5.599	5.783	5.494
71	5.418	5.158	5.564	5.293	5.491	5.225
72	5.180	4.940	5.261	5.013	5.220	4.976
73	4.940	4.719	4.998	4.770	4.969	4.744
74	4.724	4.521	4.792	4.581	4.758	4.551
75	4.487	4.302	4.582	4.388	4.534	4.345
76	4.253	4.084	4.367	4.189	4.310	4.136
77	4.024	3.871	4.145	3.983	4.084	3.927
78	3.768	3.631	3.913	3.767	3.840	3.699
79	3.512	3.390	3.668	3.536	3.590	3.463
80	3.260	3.152	3.402	3.285	3.331	3.218
81	3.017	2.921	3.145	3.041	3.081	2.981
82	2.792	2.706	2.905	2.812	2.848	2.759
83	2.600	2.523	2.699	2.615	2.649	2.569
84	2.473	2.403	2.559	2.480	2.516	2.441
85	2.371	2.306	2.552	2.476	2.461	2.391
86	2.281	2.222	2.518	2.446	2.399	2.334
87	2.154	2.103	2.431	2.365	2.292	2.338
88	1.955	1.912	2.294	2.236	2.124	2.074
89	1.698	1.664	2.108	2.059	1.903	1.861
90	1.417	1.392	1.873	1.833	1.645	1.612
91	1.154	1.136	1.628	1.596	1.391	1.366
92	0.835	0.824	1.349	1.325	1.092	1.074
93	0.477	0.471	1.071	1.054	0.774	0.762
94	0.240	0.238	0.799	0.788	0.519	0.513
95	0.000	0.000	0.544	0.537		
96	0.000	0.000	0.320	0.317		

TABLE IV. *Shewing the Value of Annuities on Two Joint Lives, according to the Probabilities of the Duration of Human Life among Males and Females collectively, reckoning Intereſt at* 4 per cent.

Intereſt 4 *per cent.*

Difference of 0, 6, 12, and 18 years.

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
1- 1	12.252	1- 7	13.989	1-13	13.894	1-19	13.389
2- 2	13.583	2- 8	14.780	2-14	14.557	2-20	14.008
3- 3	14.558	3- 9	15.323	3-15	14.988	3-21	14.417
4- 4	15.267	4-10	15.685	4-16	15.259	4-22	14.671
5- 5	15.577	5-11	15.817	5-17	15.326	5-23	14.725
6- 6	15.820	6-12	15.887	6-18	15.354	6-24	14.740
7- 7	16.003	7-13	15.914	7-19	15.351	7-25	14.727
8- 8	16.109	8-14	15.888	8-20	15.310	8-26	14.673
9- 9	16.152	9-15	15.824	9-21	15.244	9-27	14.590
10-10	16.141	10-16	15.729	10-22	15.149	10-28	14.484
11-11	16.087	11-17	15.617	11-23	15.033	11-29	14.357
12-12	15.982	12-18	15.477	12-24	14.889	12-30	14.202
13-13	15.855	13-19	15.327	13-25	14.736	13-31	14.045
14-14	15.701	14-20	15.164	24-26	14.566	14-32	13.874
15-15	15.535	15-21	15.001	15-27	14.392	15-33	13.700
16-16	15.361	16-22	14.832	16-28	14.216	16-34	13.520
17-17	15.196	17-23	14.665	17-29	14.042	17-35	13.340
18-18	15.023	18-24	14.491	18-30	13.860	18-36	13.141
19-19	14.854	19-25	14.320	19-31	13.687	19-37	12.934

Intereſt 4 *per cent.*

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
20-20	14.682	20-26	14.144	20-32	13.512	20-38	12.720
21-21	14.525	21-27	13.976	21-33	13.345	21-39	12.505
22-22	14.360	22-28	13.807	22-34	13.173	22-40	12.286
23-23	14.194	23-29	13.635	23-35	12.997	23-41	12.073
24-24	14.020	24-30	13.455	24-36	12.801	24-42	11.873
25-25	13.849	25-31	13.284	25-37	12.599	25-43	11.683
26-26	13.671	26-32	13.108	26-38	12.387	26-44	11.485
27-27	13.495	27-33	12.935	27-39	12.170	27-45	11.284
28-28	13.323	28-34	12.763	28-40	11.953	28-46	11.072
29-29	13.148	29-35	12.586	29-41	11.742	29-47	10.847
30-30	12.965	30-36	12.390	30-42	11.543	30-48	10.606
31-31	12.795	31-37	12.192	31-43	11.359	31-49	10.365
32-32	12.624	32-38	11.988	32-44	11.170	32-50	10.128
33-33	12.456	33-39	11.779	33-45	10.978	33-51	9.905
34-34	12.286	34-40	11.568	34-46	10.775	34-52	9.679
35-35	12.109	35-41	11.361	35-47	10.557	35-53	9.452
36-36	11.904	36-42	11.156	36-48	10.314	36-54	9.207
37-37	11.683	37-43	10.953	37-49	10.059	37-55	8.951
38-38	11.452	38-44	10.741	38-50	9.805	38-56	8.683
39-39	11.209	39-45	10.519	39-51	9.558	39-57	8.404
40-40	10.964	40-46	10.286	40-52	9.308	40-58	8.124
41-41	10.732	41-47	10.049	41-53	9.066	41-59	7.839
42-42	10.531	42-48	9.813	42-54	8.830	42-60	7.569
43-43	10.346	43-49	9.581	43-55	8.597	43-61	7.318
44-44	10.154	44-50	9.351	44-56	8.354	44-62	7.075
45-45	9.954	45-51	9.129	45-57	8.101	45-63	6.836
46-46	9.736	46-52	8.897	46-58	7.841	46-64	6.586
47-47	9.497	47-53	8.658	47-59	7.563	47-65	6.323
48-48	9.236	48-54	8.402	48-60	7.281	48-66	6.048
49-49	8.966	49-55	8.139	49-61	7.008	49-67	5.764
50-50	8.707	50-56	7.874	50-62	6.749	50-68	5.487
51-51	8.469	51-57	7.613	51-63	6.505	51-69	5.221
52-52	8.230	52-58	7.351	52-64	6.256	52-70	4.953
53-53	7.994	53-59	7.083	53-65	6.004	53-71	4.694
54-54	7.748	54-60	6.814	54-66	5.743	54-72	4.455
55-55	7.495	55-61	6.555	55-67	5.474	55-73	4.231
56-56	7.229	56-62	6.299	56-68	5.204	56-74	4.043
57-57	6.924	57-63	6.045	57-69	4.936	57-75	3.844
58-58	6.678	58-64	5.788	58-70	4.664	58-76	3.637
59-59	6.388	59-65	5.519	59-71	4.395	59-77	3.430
60-60	6.104	60-66	5.249	60-72	4.149	60-78	3.210
61-61	5.844	61-67	4.984	61-73	3.927	61-79	2.974
62-62	5.600	62-68	4.729	62-74	3.747	62-80	2.744
63-63	5.367	63-69	4.482	63-75	3.563	63-81	2.557
64-64	5.128	64-70	4.231	64-76	3.370	64-82	2.396
65-65	4.881	65-71	3.982	65-77	3.180	65-83	2.252
66-66	4.626	66-72	3.750	66-78	2.974	66-84	2.123
67-67	4.362	67-73	3.527	67-79	2.743	67-85	2.010
68-68	4.103	68-74	3.340	68-80	2.514	68-86	1.910
69-69	3.851	69-75	3.147	69-81	2.324	69-87	1.798
70-70	3.593	70-76	2.946	70-82	2.155	70-88	1.661
71-71	3.345	71-77	2.752	71-83	2.004	71-89	1.464
72-72	3.128	72-78	2.558	72-84	1.875	72-90	1.189
73-73	2.935	73-79	2.355	73-85	1.768	73-91	0.937
74-74	2.797	74-80	2.172	74-86	1.692	74-92	0.708
75-75	2.648	75-81	2.017	75-87	1.605	75-93	0.575
76-76	2.490	76-82	1.877	76-88	1.497	76-94	0.481
77-77	2.340	77-83	1.756	77-89	1.339	77-95	0.421
78-78	2.170	78-84	1.639	78-90	1.097		
79-79	1.967	79-85	1.524	79-91	0.863		
80-80	1.758	80-86	1.416	80-92	0.638		
81-81	1.600	81-87	1.320	81-93	0.511		
82-82	1.472	82-88	1.225	82-94	0.427		
83-83	1.364	83-89	1.094	83-95	0.379		
84-84	1.276	84-90	0.902				

Intereſt 4 *per cent.*

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
85-85	1.212	85-91	0.725				
86-86	1.172	86-92	0.556				
87-87	1.127	87-93	0.459				
88-88	1.071	88-94	0.396				
89-89	0.949	89-95	0.364				
90-90	0.718						
91-91	0.516						
92-92	0.326						
93-93	0.236						
94-94	0.190						
95-95	0.024						

Table V. *Shewing the Value of two Joint Lives, according to the Probabilities of the Duration of Human Life among Males and Females collectively.*

Intereſt 4 *per cent.*

Difference of age 24, 30, 36, and 42 years.

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
1-25	12.832	1-31	12.196	1-37	11.465	1-43	10.546
2 26	13.409	2-32	12.730	2-38	11.913	2-44	10.946
3-27	13.778	3-33	13.066	3-39	12.164	3-45	11.168
4 28	14.003	4-34	13.264	4 40	12.284	4-46	11.260
5-29	14.037	5-35	13.277	5-41	12.242	5-47	11.183
6-30	14.033	6-36	13.242	6-42	12.185	6-48	11.064
7-31	14.006	7-37	13.170	7-43	12.112	7-49	10.915
8-32	13.944	8-38	13.059	8-44	12.004	8-50	10.743
9-33	13.855	9-39	12.913	9-45	11.865	9-51	10.560
10-34	13.741	10-40	12.743	10-46	11.694	10-52	10.357
11-35	13.604	11-41	12.563	11-47	11.493	11-53	10.140
12-36	13.428	12-42	12.379	12-48	11.259	12-54	9.898
13-37	13.234	13-43	12.196	13-49	11.011	13-55	9.644
14-38	13.023	14-44	11.997	14-50	10.759	14-56	9.371
15-39	12.798	15-45	11.787	15-51	10.518	15-57	9.087
16-40	12.570	16-46	11.562	16-52	10.264	16-58	8.799
17-41	12.351	17-47	11.328	17-53	10.018	17-59	8.503
18-42	12.146	18-48	11.076	18-54	9.761	18-60	8.208
19-43	11.951	19-49	10.819	19-55	9.500	19 61	7.928
20-44	11.751	20-50	10.567	20-56	9.228	20 62	7.658
21 45	11.550	21-51	10.332	21-57	8.953	21-63	7.396
22-46	11.335	22-52	10.092	22-58	8.675	22-64	7.127
23-47	11.107	23-53	9.852	23-59	8.385	23-65	6.851
24-48	10.862	24-54	9.602	24-60	8.097	24-66	6.566
25-49	10.612	25-55	9.347	25-61	7.823	25-67	6.275
26-50	10.364	26-56	9 080	26-62	7.557	26-68	5.986
27-51	10.130	27-57	8.807	27-63	7.297	27-69	5.702
28-52	9.894	28-58	8.534	28-64	7.032	28-70	5.415
29-53	9.659	29-59	8.250	29-65	6.761	29-71	5.136
30 54	9.413	30-60	7.967	30-66	6.481	30-72	4.881
31-55	9.167	31-61	7.702	31-67	6.197	31-73	4.646
32-56	8.912	32-62	7.446	32-68	5.917	32-74	4.453
33-57	8.651	33-63	7.196	33-69	5.642	33-75	4.251
34-58	8.389	34-64	6.942	34-70	5.364	34-76	4.040
35-59	8.114	35-65	6.679	35-71	5.093	35-77	3.833
36-60	7.833	36-66	6.402	36-72	4.840	36-78	3.605
37-61	7.561	37-67	6.115	37-73	4.603	37-79	3.352
38-62	7.296	38-68	5.828	38-74	4.405	38-80	3.098
39-63	7.033	39-69	5.543	39-75	4.195	39-81	2.889
40-64	6.763	40-70	5.254	40-76	3.975	40-82	2.710
41-65	6.492	41-71	4.977	41-77	3.762	41-83	2.553
42-66	6.225	42-72	4.730	42-78	3.539	42-84	2.418
43-67	5.957	43-73	4.507	43-79	3.295	43-85	2.305
44-68	5.689	44-74	4.322	44-80	3.052	44-86	2.203

Intereſt 4 *per cent.*

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
45-69	5.426	45-75	4.128	45-81	2.854	45-87	2.083
46-70	5.153	46-76	3.921	46-82	2.684	46-88	1.933
47-71	4.884	47-77	3.715	47-83	2.533	47-89	1.708
48-72	4.633	48-78	3.489	48-84	2.396	48-90	1.385
49-73	4.398	49-79	3.238	49-85	2.277	49-91	1.090
50-74	4.205	50-80	2.990	50-86	2.171	50-92	0.818
51-75	4.008	51-81	2.792	51-87	2 050	51-93	0.662
52-76	3.803	52-82	2.623	52-88	1.901	52-94	0.551
53-77	3.605	53-83	2.475	53-89	1.681	53-95	0.468
54-78	3.389	54-84	2.344	54-90	1 366		
55-79	3.150	55-85	2.232	55-91	1.078		
56-80	2.909	56-86	2.130	56-92	0.810		
57-81	2.710	57-87	2.010	57-93	0.655		
58-82	2.539	58-88	1.864	58-94	0.546		
59-83	2.385	59-89	1.644	59-95	0.464		
60-84	2.248	60-90	1.333				
61-85	2.135	61-91	1.050				
62.86	2.037	62-92	0.789				
63-87	1.916	63-93	0.639				
64-88	1.790	64-94	0.533				
65-89	1.585	65-95	0.456				
66-90	1.290						
67-91	1.017						
68-92	0.764						
69-93	0.617						
70-94	0.514						
71-95	0.411						

The values of joint lives in theſe tables have been computed for only one rate of intereſt; and of ſingle lives in Table III. for only two rates of intereſt. The following rules will ſhow, that it would be a needleſs labour to compute theſe values (in ſtrict conformity to the obſervations) for any other rates of intereſt.

Account, of a method of deducing, from the correct values (according to any obſervations) of any ſingle or joint lives at one rate of intereſt, the ſame values at other rates of intereſt.

Preliminary Problems.

Prob. I. The expectation given of a ſingle life by any tables of obſervations, to find its value, ſuppoſing the decrements of life equal, at any given rate of intereſt.

Solution. Find the value of an annuity certain for a number of years equal to twice the expectation. Multiply this value by the perpetuity increaſed by unity, and divide the product by twice the expectation: The quotient ſubtracted from the perpetuity will be the value required.

Example. The expectation of a male life aged 10, by the Sweden obſervations, is 43.94. Twice this expectation is 87.88. The value of an annuity certain for 87.88 years is (reckoning intereſt at 4 *per cent.*) 24.200. The product of 24.200 into 26 (the perpetuity increaſed by unity) is 629.2, which, divided by 87.88, gives 7.159. And this quotient ſubtracted from 25 (the perpetuity) gives 17.84 years purchaſe, the value of a life aged ten, deduced from the expectation of life at that age, according to the Sweden obſervations. (See the Tables in Dr Price on Reverſions, vol. ii.).

Prob. II. Having the expectations given of any two lives by any table of obſervations, to deduce from thence the value of the joint lives at any rate of intereſt, ſuppoſing an equal decrement of life.

Solution. Find the difference between twice the expectation of the youngeſt life and twice the expectation of the oldeſt life increaſed by unity and twice the perpetuity. Multiply this difference by the value of an annuity certain for a time equal to twice the expectation of the oldeſt life; and by twice the ſame expectation divide the product, reſerving the quotient.

From twice the perpetuity ſubtract the reſerved quotient, and multiply the remainder by the perpetuity increaſed by unity. This laſt product divided by twice the expectation of the youngeſt life, and then ſubtracted from the perpetuity, will be the required value.

When twice the expectation of the youngeſt life is greater than twice the expectation of the oldeſt life increaſed by unity and twice the perpetuity, the reſerved quotient, inſtead of being ſubtracted from twice the perpetuity, muſt be added to it, and the ſum, not the difference, multiplied by the perpetuity increaſed by unity.

Example. Let the joint lives propoſed be a female life aged 10, and a male life aged 15; and let the table of obſervations be the Sweden table for lives in general, and the rate of intereſt 4 *per cent*. Twice the expectations of the two lives are 90.14 and 83.28.

Twice the expectation of the oldeſt life, increaſed by unity, and twice the perpetuity, is 134.28, which leſſens by 90.14 (twice the expectation of the youngeſt life,) leaves 44.14 for the reſerved remainder. This remainder multiplied by 24.045 (the value of an annuity certain for 83.28 years), and the product divided by 83.28 (twice the expectation of the oldeſt life), gives 12.744, the quotient to be reſerved; which ſubtracted from double the perpetuity, and the remainder (or 37.255) multiplied by the perpetuity increaſed by unity (or by 26) gives 968.630, which divided by 90.14 (twice the expectation of the youngeſt life) and the quotient ſubtracted from the perpetuity, we have 14.254 for the required value.

The value of an annuity certain, when the number of years is a whole number with a fraction added (as will be commonly the caſe) may be beſt computed in the following manner. In this example the number of years is 83.28. The value of an annuity certain for 83 years is 24.035. The ſame value for 84 years is 24.072. The difference between theſe two values is 0.37; which difference multiplied by .28 (the fractional part of the number of years), and the product (.0103) added to the leaſt of the two values, will give 24.045 the value for 83.28 years.

General Rule. Call the correct value (ſuppoſed to be computed for any rate of intereſt) the firſt value. Call the value deduced (by the preceding problems) from the expectations at the ſame rate of intereſt, the ſecond value. Call the value deduced from the expectations for any other rate of intereſt the third value.

Then the difference between the firſt and ſecond values added to or ſubtracted from the third value, juſt as the firſt is greater or leſs than the ſecond, will be the value at the rate of intereſt for which the third value has been deduced from the expectations.

The following examples will make this perfectly plain.

Example I. In the two laſt tables the correct values are given of two joint lives among mankind at large, without diſtinguiſhing between males and females, according to the Sweden obſervations, reckoning intereſt at 4 *per cent*. Let it be required to find from theſe values the values at 3 *per cent.* and let the ages of the joint lives be ſuppoſed 10 and 10.

The correct value by Table IV. (reckoning intereſt at 4 *per cent.*) is 16.141. The expectation of a life aged 10 is 45.07. The value deduced from this expectation at 4 *per cent.* by Prob. II. is 14.539. The value deduced by the ſame problem from the ſame expectation at 3 *per cent.* is 16.808. The difference between the firſt and ſecond values is 1.602, which, added to the third value (the firſt being greater than the ſecond), makes 18.410, the value required.

Example II. Let the value be required of a ſingle male life aged 10, at 3 *per cent.* intereſt, from the correct value at 4 *per cent.* according to the Sweden obſervations.

Firſt, or correct value at 4 *per cent.* (by Table III.) is 18.674. The expectation of a male life aged 10 is 43.94.

The ſecond value (or the value deduced from this expectation by Prob. I.) is 17.838.

The third value (or the value deduced from the ſame expectation at 3 *per cent.*) is 21.277.

The difference between the firſt and ſecond is .836; which (ſince the firſt is greater than the ſecond) muſt be added to the third; and the ſum (that is, 22.113) will be the value required.

The third value at 5 *per cent.* is 15.286; and the difference added to 15.286 makes 16.122 the value of a male life aged 10 at 5 *per cent.* according to the Sweden obſervations. The exact value at 5 *per cent.* is (by Table III.) 16.014.

Again: The difference between 16.014 (the correct value at 5 *per cent.*), and 15.286 (the value at the ſame intereſt deduced from the expectation), is .728; which, added (becauſe the firſt value is greater than the ſecond) to 13.335 (the value deduced at 6 *per cent.* from the expectation) gives 14.063, the value of the ſame life, reckoning intereſt at 6 *per cent.*

Theſe deductions, in the caſe of ſingle lives particularly, are ſo eaſy, and give the true values ſo nearly, that it will be ſcarcely ever neceſſary to calculate the exact values (according to any given obſervations) for more than one rate of intereſt.

If, for inſtance, the correct values are computed at 4 *per cent.* according to any obſervations, the values at 3, $3\frac{1}{2}$, $4\frac{1}{2}$, 5, 6, 7, or 8 *per cent.* may be deduced from them by the preceding rules as occaſion may require, without much labour or any danger of conſiderable errors. The values thus deduced will ſeldom differ from the true values ſo much as a tenth of a year's purchaſe. They will not generally differ more than a 20th or 30th of a year's purchaſe. In joint lives they will differ leſs than in ſingle lives, and they will come equally near to one another whatever the rates of intereſt are.

The preceding tables furniſh the means of determining the exact differences between the values of annuities, as they are made to depend on the ſurvivorſhip of any male or female lives; which hitherto has been a *deſideratum* of conſiderable conſequence in the doctrine of life-annuities. What has made this of conſequence is chiefly the multitude of ſocieties lately eſtabliſhed in this and foreign countries for providing annuities for widows. The general rule for calculating from theſe tables the value of ſuch annuities is the following.

Rule. "Find in Table III. the value of a female life at the age of the wife. From this value ſubtract the value in Table IV. of the joint continuance of two lives at the ages of the huſband and wife. The remainder will be the value in a ſingle preſent payment of an annuity for the life of the wife, ſhould ſhe be left a widow. And this laſt value divided by the value of the joint lives increaſed by unity, will be the value of the ſame annuity in annual payments during the joint lives, and to commence immediately."

Example. Let the age of the wife be 24, and of the huſband 30. The value in Table III. (reckoning intereſt at 4 *per cent.*) of a female life aged 24, is 17.252. The value in Table IV. of two joint lives aged 24 and 30, is 13.455, which ſubtracted from 17.252 leaves 3.797, the value in a ſingle preſent payment of an annuity of L. 1 for the life of the wife after the huſband; that is, for the life of the widow. The annuity, therefore, being ſuppoſed L. 20, its value in a ſingle payment is 20 multiplied by 3.797, that is, L. 75.94. And this laſt value divided by 14.455 (that is, by the value of the joint lives increaſed by unity), gives 5.25, the value in annual payments beginning immediately, and to be continued during the joint lives of an annuity of L. 20 to a wife aged 24 for her life, after her huſband aged 30.

SURYA, the orb of the ſun perſonified and adored by a ſect of Hindoos as a god. He ſeems to be the ſame divinity with the Phœbus of Greece and Rome; and the ſect who pay him particular adoration are called *Sauras*. Their poets and painters deſcribe his car as drawn by ſeven green horſes, preceded by Arun, or the *Dawn*, who acts as his charioteer, and followed by thouſands of genii worſhipping him and modulating his praiſes. He has a multitude of names, and among them twelve epithets or titles, which denote his diſtinct powers in each of the twelve months; and he is believed to have deſcended frequently from his car in a human ſhape, and to have left a race on earth, who are equally renowned in the Indian ſtories with the Heliadai of Greece: it is very ſingular, that his two ſons called *Aſwinau* or *Aſwinicumarau*, in the dual, ſhould be conſidered as twin-brothers, and painted like Caſtor and Pollux; but they have each the character of Æſculapius among the gods, and are believed to have been born of a nymph, who, in the form of a mare, was impregnated with the ſun-beams.

Aſiatic Reſearches, vol. i. p. 262 and 263.

SUS, the Hog, in zoology, a genus of quadrupeds belonging to the claſs of *mammalia* and order of *belluæ*. There are four cutting teeth in the upper jaw, whoſe points converge; and, for the moſt part, ſix in the lower jaw, which ſtand forwards: There are two tuſks in each jaw, thoſe in the upper jaw being ſhort, while thoſe of the under jaw are long, and extend out of the mouth. The ſnout is prominent, moveable, and has the appearance of having been cut off, or truncated. The feet are armed with divided or cloven hoofs. There are ſix ſpecies; the ſcrofa, æthiopicus, tajaſſu, babyruſſa, porcus, and africanus. The moſt remarkable are,

Gmelin's Animal Kingdom, by Kerr.

1. The *ſcrofa*, or common hog, having the body covered with briſtles; two large teeth above and below. In a wild ſtate, of a dark brinded colour, and beneath the briſtles is a ſoft ſhort hair; the ears ſhort, and a little rounded. TAME: the ears long, ſharp-pointed, and ſlouching; the colour generally white, ſometimes mixed with other colours. In a tame ſtate it is univerſal; except in the frigid zones, and in Kamtſchatka, where the cold is very ſevere. Since its introduction into America by the Europeans, it abounds to exceſs in the hot and temperate parts. It is found wild in moſt parts of Europe. In the foreſts of South America there are vaſt droves, which derive their origin from the European kind relapſed into a ſtate of nature; and are what Mr Bancroft, in his Hiſtory of Guiana, deſcribes as a particular ſpecies by the name of *Warree*. They cannot bear exceſſive cold; inhabit wooded countries; and are very ſwift. In America they are uſeful by clearing the country of rattle-ſnakes, which they devour without danger.

Of all quadrupeds, the hog is the moſt rude and brutal. The imperfections of his form ſeem to have an influence on his nature and diſpoſitions. All his habits are groſs; all his appetites are impure; all his ſenſations are confined to a furious luſt, and a brutal gluttony. He devours indiſcriminately every thing that comes in his way, even his own grogeny the moment after their birth. This voraciouſneſs ſeems to proceed from the perpetual cravings of his ſtomach, which is of an immoderate ſize; and the groſſneſs of his appetites, it is probable, ariſes from the bluntneſs of his ſenſes of taſte and of feeling. The rudeneſs of the hair, the hardneſs of the ſkin, and the thickneſs of the fat, render theſe animals leſs ſenſible to blows. Mice have been known to lodge upon a hog's back, and to eat his ſkin and fat, without his ſhowing any marks of ſenſibility. The other ſenſes of the hog are very good. It is well known to the hunters that the wild boar hears and ſmells at a great diſtance; for, in order to ſurpriſe him, they are obliged to watch him in ſilence during the night, and to place themſelves oppoſite to the wind, that he may not perceive the ſmell, which never fails to make him turn back.

Buffon's Natural Hiſtory, vol. iii.

But the hog, though the moſt impure and filthy of all quadrupeds, is yet uſeful by the very ſordidneſs of its manners; this alone devouring what is the refuſe of all others, and contributing not only to remove what would be a nuiſance to the human race, but alſo converting the moſt nauſeous offals into the richeſt nutriment: for this reaſon its ſtomach is capacious, and its gluttony exceſſive: not that its palate is inſenſible to the difference of eatables; for where it finds variety, it will reject the worſt with as diſtinguiſhing a taſte as other quadrupeds.

The parts of this animal are finely adapted to its way of life. As its method of feeding is by turning up the earth with its noſe for roots of different kinds, ſo nature has given it a more prone form than other animals; a ſtrong brawny neck; eyes ſmall, and placed high in the head; a long ſnout, noſe callous and tough, and a quick ſenſe of ſmelling to trace out its food. Its inteſtines have a ſtrong reſemblance to thoſe of the human ſpecies. The external form of its body is very unwieldy; yet, by the ſtrength of its tendons, the wild boar (which is only a variety of the common kind) is enabled to fly from the hunters with amazing agility: the back-toe on the feet of this animal prevents its ſlipping while it deſcends declivities, and muſt be of ſingular uſe when purſued. Yet, notwithſtanding its powers of motion, it is by nature ſtupid, inactive, and drowſy; much inclined to increaſe in fat, which is diſpoſed in a different manner from that of other animals, and forms a regular coat over the whole body. It is reſtleſs at a change of weather, and in certain high winds is ſo agitated as to run violently, ſcreaming horribly at the ſame time: it is fond of wallowing in the dirt, either to cool its ſurfeited body, or to deſtroy the lice, ticks, and other inſects with which it is infeſted. Its diſeaſes generally ariſe from foul feeding and intemperance; meaſles, impoſthumes, and ſcrophulous complaints, are reckoned among them. Theſe are beſt prevented by keeping the animals, as the ancients ſtrongly recommended, very clean in their ſties; allowing them air, exerciſe, and a ſufficiency of water. Linnæus obſerves, that its fleſh is wholeſome food for athletic conſtitutions, or thoſe that uſe much exerciſe; but bad for ſuch as lead a ſedentary life: it is, however, of moſt univerſal uſe; and furniſhes numberleſs materials for epicuriſm.

The boar, or male of theſe creatures, is choſen with great care, when intended for the propagation of his ſpecies; and is thus employed from the age of two to five years, and then either ſold or fatted. The males not allotted to this uſe are caſtrated, ſometimes at the age of ſix weeks, and ſometimes when they are ſix months old; and then fed to a great ſize either for ſale or for the uſe of the family. Sows are kept for breed generally from one year old to ſeven, and are then ſpayed and fatted. They have commonly more greaſe on their inteſtines than hogs, theſe being fatteſt on their backs.

As to the age of theſe animals, it is ſaid that the life of the wild boar may be extended to twenty-five or thirty years.

Ariſtotle ſays, that hogs in general live twenty years; and adds, that both males and females are fertile till they arrive at the age of fifteen. They can engender at the age of nine or twelve months; but it is better to reſtrain them till they be eighteen months or two years. The firſt litter of the ſow is not numerous; and, when only one year old, her pigs are weak, and even imperfect. She may be ſaid to be in ſeaſon at all times. Though full, ſhe ſolicits the approach of the male. This may be regarded as an exceſs among animals; for almoſt every other ſpecies refuſe the male after conception. The ardour of the ſow, though almoſt perpetual, is however marked by paroxyſms and immoderate movements, which always terminate by her wallowing in the mire. She, at the ſame time, emits a thick whitiſh fluid. She goes four months with young; brings forth in the beginning of the fifth; and ſoon afterwards ſolicits the male, is impregnated a ſecond time, and of courſe brings forth twice a-year. The wild ſow, which every way reſembles the domeſtic kind, produces only once a-year. This difference in fertility is probably owing to want of nouriſhment, and the neceſſity of ſuckling her pigs much longer than the domeſtic ſow, which is never allowed to nurſe her young above fifteen days or three weeks. Only eight or nine of the litter are kept longer; the reſt are ſold. In fifteen days, pigs are excellent food.

As theſe creatures, though exceedingly voracious, will feed almoſt on any thing, they are bred and kept everywhere, and are quickly and cheaply fatted. In miry and in marſhy grounds (from which they are not averſe) they devour worms, frogs, fern, ruſh, and ſedge roots. In drier and in woody countries, they feed on hips, haws, ſloes, crabs, maſt, cheſnuts, acorns, &c. and on this food they will grow fleſhy and fat. They are a kind of natural ſcavengers, will thrive on the traſh of an orchard, the outcaſts of the kitchen, the ſweepings of barns and granaries, the offals of a market, and moſt richly on the refuſe of a dairy. If near the ſea, they will ſearch the ſhores for ſhell-fiſh; in the fields, they eat graſs; and in cities and large towns they are kept in great numbers, and ſupported chiefly by grains. It is evident that the facility of feeding them everywhere at a ſmall expence is a national benefit, more eſpecially in a country where the people are accuſtomed to eat fleſh daily, and could not perhaps perform their daily labour if they did not. It is no leſs obſervable, that notwithſtanding this facility of feeding, and the multitudes of ſwine maintained, they ſeldom fail of coming to a good market. In no part of Europe is the management of theſe creatures better underſtood than in Britain. The time of farrowing is adjuſted to the nature of the farm, the food it can ſupply; and the number of pigs ſold and kept are in like manner adjuſted. New kinds of food, more wholeſome and nutritive than what were uſed formerly, have been introduced, ſuch as turnips, carrots, clover, &c. They are in moſt places regularly managed and cloſely attended. Tuſſer, many years ſince, affirmed from his own experience, that a ſow might bring as much profit as a cow. In ſome counties, it is ſaid, a ſow dependent on a dairy hath produced, all expences deducted, about 10 l. in the ſpace of a year. It may be ſome ſatiſfaction to the reader to know, that, on a nice calculation, the annual profits of a ſow in France are found to be between 50 and 60 livres.—In Britain, theſe animals in different counties are of very different ſizes. In Leiceſterſhire, Northamptonſhire, and Pembrokeſhire, they are very large. In Hampſhire, Wiltſhire, and wherever they can run in the woods, and feed on maſt and acorns, their fleſh is firmer and better. The Chineſe ſwine are common with us: they are ſmaller, blacker, and their legs ſhorter than ours: ſo that, when fat, their bellies literally touch the ground. They thrive exceedingly well with us, are very prolific, and their fleſh very fine and well taſted.

In conſidering the advantages derived from theſe creatures, it is to be obſerved, that the fleſh of all their different kinds, and at all ages, is looked upon as a very ſubſtantial and agreeable aliment; and of courſe, in their proper ſeaſons, the different ſorts of proviſions thus ſupplied are all of them very ſaleable. The wild boar was eſteemed a prime delicacy amongſt the Romans, and the fleſh of the tame was much more in favour with our anceſtors than with us; though BRAWN has ſtill many admirers, is made in the greateſt perfection, and conſidered as a rarity peculiar to Britain. Pork, though it might be wiſely prohibited in ſome warm countries, is found by experience equally nutritive and ſalutary here. As ſuch it furniſhes a very large proportion of that food which is vended in our markets. It takes ſalt better, and keeps longer, than the fleſh of any other animal; and the conſumption of it is prodigious when pickled or ſalted, more eſpecially in the foreign garriſons and in the ſea-ſervice. Our bacon is differently cured, ſo as to render it acceptable to all palates; and our hams are not at all inferior to thoſe of other countries. Freſh pork ſells nearly as dear as beef; the lard brings double or triple the price; the blood, the inteſtines, the feet, and the tongue, are all prepared as food. The fat of the inteſtines and web, which differs from common lard, is employed for greaſing axles of wheels, and for many other purpoſes. Sieves are made of the ſkin; and bruſhes, pencils, &c. of the briſtles. The dung is reputed next in value to that of ſheep. Mr Worlidge * propoſes that ſwine ſhould be turned into a cloſe well-paled, and planted with greens, pulſe, and roots, on which they may feed, and by their trampling and their dung raiſe a great quantity of excellent ſoil. Mr Mortimer † aſſures us that ſome, on poor light ſhallow land in Staffordſhire, ſow a ſmall white pea, which they never reap, but turn in ſo many hogs to eat them as they think they will fat; and there they lie day and night, and their dung will ſo enrich the land, that it will bring a good ſward upon it, and will graze many years afterwards. Our old huſbandmen had an ill opinion of this dung, as ſuppoſing it bred weeds, but it will probably not obtain much credit at preſent. In ſome places they waſh with hogs' dung for want of ſoap; which anſwers tolerably well, if the linen hangs long enough in the air to become thoroughly ſweet.

The wild boar was formerly a native of Britain as appears from the laws of Hoel dda, who permitted his grand huntſman to chace that animal from the middle of November to the beginning of December. William the Conqueror puniſhed with the loſs of their eyes any that were convicted of killing the wild boar, the ſtag, or the roebuck; and Fitz-Stephen tells us, that the vaſt foreſt that in his time grew on the north ſide of London, was the retreat of ſtags, fallow-deer, wild boars, and bulls. Charles I. turned out wild boars in the New Foreſt, Hampſhire; but they were deſtroyed in the civil wars.

On the continent the wild boar is hunted with dogs, or killed by ſurpriſe during the night, when the moon ſhines. As he runs ſlowly, leaves a ſtrong odour behind him, and defends himſelf againſt the dogs, and often wounds them dangerouſly, fine hunting dogs are unneceſſary, and would have their noſe ſpoiled, and acquire a habit of moving ſlowly by hunting him. Maſtiffs, with very little training, are ſufficient. The oldeſt, which are known by the tract of their feet, ſhould only be attacked: A young boar of three years old is difficult to hunt down; becauſe he runs very far without ſtopping. But the older boars do not run far, allow the

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* Survey of Huſbandry, p. 171.

† Art of Huſbandry vol. i. p. 117.

the dogs to run near, and often ſtop to repel them. During the day, he commonly remains in his ſoil, which is in the moſt ſequeſtrated part of the woods. He comes out in the night in queſt of food. In ſummer, when the grain is ripe, it is eaſy to ſurpriſe him among the cultivated fields, which he frequents every night. As ſoon as he is ſlain, the hunters cut off his teſticles, the odour of which is ſo ſtrong, that in a few hours it would infect the whole fleſh. The ſnout of an old boar is the only part that is eſteemed; but every part of the caſtrated and young boar, not exceeding one year fed, makes delicate eating. The pork of the domeſtic boar is ſtill worſe than that of the wild boar; and it can only be rendered fit for eating by caſtration and fattening. The ancients caſtrated the young boars which they could carry off from their mothers, and returned them to the woods, where they grew fat, and their pork was much better than that of domeſtic hogs. There are ſeveral varieties of the common hog.

2. The *æthiopicus*, or Ethiopian hog, with ſmall tuſks in the lower jaw, very large ones in the upper, in old boars bending towards the forehead in form of a ſemicircle: no fore teeth: noſe broad, depreſſed, and almoſt of a horny hardneſs: head very large and broad: beneath each eye a hollow, formed of looſe ſkin, very ſoft and wrinkled; under theſe a great lobe or wattle, lying almoſt horizontal, broad, flat, and rounded at the end, placed ſo as to intercept the view of any thing below from the animal. Between theſe and the mouth on each ſide, there is a hard callous protuberance. The mouth is ſmall: ſkin duſky: briſtles diſpoſed in faſciculi, of about five each; longeſt between the ears and on the beginning of the back, thinly diſperſed on the reſt of the back. Ears large and ſharp-pointed, inſide lined with long whitiſh hairs: tail ſlender and flat, not reaching lower than the thighs, and is covered with hairs diſpoſed in faſciculi. Body longer, and legs ſhorter, than in the common ſwine: its whole length 4 feet 9 inches; height before, 2 feet 2 inches: but in a wild ſtate, it grows to an enormous ſize.—Theſe animals inhabit the hotteſt parts of Africa, from Senegal to Congo, alſo the iſland of Madagaſcar. We know little of their nature; but they are repreſented as very fierce and ſwift, and that they will not breed with the domeſtic ſow.

3. The *tajaſſu*, pecary, or Mexican hog, with four cutting teeth above, and ſix below: two tuſks in each jaw; thoſe in the upper jaw pointing down, and little apparent when the mouth is ſhut; the others hid: length from noſe to the end of the rump about three feet: head not ſo taper as in common ſwine: ears ſhort and erect: body covered with briſtles, ſtronger than thoſe of the European kind, and more like thoſe of a hedge-hog; they are duſky, ſurrounded with rings of white; thoſe on the top of the neck and back are near five inches long, grow ſhorter on the ſides; the belly almoſt naked; from the ſhoulders to the breaſt is a band of white: no tail: on the lower part of the back is a gland, open at the top, diſcharging a fetid ichorous liquor; this has been by miſtake called a *navel*.—Inhabits the hotteſt parts of South America, and ſome of the Antilles: lives in the foreſts on the mountains: not fond of mire or marſhy places: leſs fat than the common hog. Theſe animals go in great droves. They are very fierce, and will fight ſtoutly with the beaſts of prey: the jaguar, or American leopard, is their mortal enemy; often the body of that animal is found with ſeveral of theſe hogs ſlain in combat. Dogs will ſcarce attack this animal: if wounded, it will turn on the hunters. They feed on fruits and roots; alſo on toads and all manner of ſerpents, which they hold with their fore-feet, and ſkin with great dexterity. The fleſh is reckoned very good food; but all writers agree that the dorſal gland muſt be cut out as ſoon as the animal is killed, or the fleſh will become ſo infected as not to be eatable. The Indian name of this ſpecies is *paquiras*, from whence ſeems to be derived that of *pecary*. There are more varieties of this ſpecies, the *tajaſſu minor* and the *patera*.

4. The *babyruſſa*, or Indian hog, with four cutting teeth in the upper, ſix in the lower jaw; ten grinders to each jaw; in the lower jaw two tuſks pointing towards the eyes, and ſtanding near eight inches out of their ſockets; from two ſockets on the outſide of the upper jaw two other teeth, twelve inches long, bending like horns, their ends almoſt touching the forehead: ears ſmall, erect, ſharp-pointed: along the back are ſome weak briſtles; on the reſt of the body only a ſort of wool, ſuch as is on the lambs: the tail long, ends in a tuft, and is often twiſted: the body plump and ſquare. Inhabits Buero, a ſmall iſle near Amboina: it is alſo found in Celebes, but neither on the continent of Aſia or Africa; what M. de Buffon takes for it is the Ethiopian boar. They are ſometimes kept tame in the Indian iſles: live in herds: have a very quick ſcent: feed on herbs and leaves of trees; never ravage gardens like other ſwine: their fleſh well taſted. When purſued and driven to extremities, they ruſh into the ſea, ſwim very well, and even dive, and paſs thus from iſle to iſle. In the foreſts they often reſt their heads, by hooking their upper tuſks on ſome bough. The tuſks, from their form, are uſeleſs in fight.

SUSA, the ancient royal reſidence of the kings of Perſia, built by Darius Hyſtaſpis, according to Pliny; though he probably only reſtored it, being a very ancient city, founded by Tithonus father of Memnon. It was in compaſs 120 ſtadia, of an oblong quadrangular form, with a citadel called *Memnoneum*. In Scripture it is called *Suſan*, the royal citadel, from the great number of lilies growing in that diſtrict (Athenæus); ſituate on the river Uhlai, or Eulæus (Daniel): and the Spaniards call at this day a lily *aſuſena* (Pinedo). Suſa was the winter, as Ecbatana was the ſummer, reſidence of the kings of Perſia, (Xenophon, Strabo, Plutarch). Here the kings kept their treaſure, (Herodotus.) Now called *Tuſter*.

SUSPENSION, in Scots law. See Law, nº clxxxv. 5, 6, and 7.

SUSSEX, a county of England, deriving its name from its ſituation in reſpect of the other Saxons, and called *Suſſex*, *i. e.* the country of the South Saxons, has Hampſhire on the weſt, the Britiſh channel on the ſouth, Surry on the north, and Kent on the eaſt. Its length is 65 miles, its breadth 30, and its circumference 170. It is divided into 6 rapes, and theſe into 65 hundreds, in which are 342 pariſhes, of which 123 are vicarages, one city, 16 market-towns, 1,140,000 acres, and about 120,000 ſouls. It has few good ports, though it lies along the channel for 65 miles, which is its greateſt length, the coaſt being encumbered in many places with rocks; and where it is more open, ſuch quantities of ſand are thrown upon it by the ſouth-weſt winds, and the harbours ſo choaked up, that they will not admit veſſels of any great draught or burden. The county is well watered by the rivers Arun, Adar, Ouſe, Rother, Lavant, Cuckmeer, Aſhburn, and Aſten, by which it is well ſupplied with fiſh, as well as from the ſea. Hence different places of the county are famed for different ſorts of fiſh, as the Arun for mullets which enter it from the ſea in ſummer in ſhoals, and by feeding upon a particular kind of herb become extremely delicious: Chicheſter for lobſters, Selſey for Cockles, Amberly for trout, Pulborough for eels, Rye for herrings, and the county in ge-

Gough's edition of Camden's Britannia, vol. i. p. 192.

general for carp. It is remarkable, that all the rivers abovementioned riſe and fall into the ſea within the county.

The air, as well as the ſoil, is various in different parts of the country. Upon the coaſt the air is aguiſh, upon the hills and downs pleaſant and wholeſome; but ſomewhat moiſt and foggy in the valleys, the ſoil being deep and rich, and the vegetation in ſummer very vigorous. The downs in ſome places are very fertile in corn and graſs; in others they feed great flocks of ſheep, whoſe fleſh and wool are very fine; but of the latter no inconſiderable quantity is clandeſtinely exported to France. In the Weald and the valleys the roads are very deep, eſpecially in winter. In the north quarter are many woods, and ſome foreſts in other places; whence the king's yards are ſupplied with the largeſt and beſt timber in England, beſide what is made into charcoal and conſumed in the iron-works; for on the eaſt ſide is plenty of iron ore, with furnaces, forges, and mills for manufacturing it. The gunpowder of this county is ſaid to excel that of any other. Thoſe delicious birds called *wheatears* are bred in this ſhire; they are no bigger than a lark, but almoſt an entire lump of fat. That part now called the *Wild* or *Weald* of Suſſex, was anciently a mere deſert for hogs and deer, of great extent, taking in a part of Kent and Surry; and was called *Anderida Silva*, *Coid Andred*, and *Andradſwald*, from Anderida an adjoining city. This county is in the home-circuit and dioceſe of Chicheſter, giving title of earl to the family of Yelverton, and ſends 28 members to parliament, viz, two for the county, two for the city of Chicheſter, and two for each of the following towns, Horſham, Lewes, Bramber, Eaſt-Grinſtead, Midhurſt, Shoreham, Staining, Arundel, Haſtings, Rye, Winchelſea, and Seaford; of which the four laſt are cinque-ports.

SUTHERLAND, one of the moſt northerly counties of Scotland. Including Strathnavern, it borders on Caithneſs to the north and north-eaſt, is bounded by the ocean on the north, the country of Aſſynt on the weſt, Roſs on the ſouth, and by the German ſea on the eaſt and ſouth-eaſt. It ſtretches about 70 miles in length, and 40 in breadth; is generally hilly, tho' in many parts arable; well watered with ſmall rivers and ſtreams replete with fiſh, and exhibiting about 60 lakes, the habitation of various fiſh, ſwans, ducks, geeſe, &c. One of the largeſt of theſe is Lochſhin, extending 18 miles in length. Some of them are interſperſed with ſmall verdant iſlands, which in ſummer yield a very agreeable proſpect. On the coaſt are many commodious harbours, and all the bays ſwarm with fiſh; nay, the ſea in this place produces ſome valuable pearls. Sutherland affords iron-ſtone, free-ſtone, lime-ſtone, and ſlate, in abundance. Here are alſo quarries of marble, and mines of coal, though the people uſe turf and peat for fuel. Lead ore, impregnated with ſilver, and even ſome gold, hath been found in this province, together with cryſtals and pebbles.

The air is ſo temperate, and the ſoil ſo good, that ſaffron has here been brought to perfection. Many parts of the country are remarkably fruitful in corn, and the paſturage is excellent everywhere. Beſides three great foreſts, there are many ſmaller woods in Sutherland, abounding with deer and other game. On the hills are fed numerous flocks of ſheep and black cattle; ſmall, yet ſweet and juicy. There is one bird peculiar to this ſhire, called *knag*, which reſembles a parrot, and digs its neſt with its beak in the trunks of oaks. The northern part, called *Strathnavern*, and ſeparated from the reſt by a ridge of mountains, is bounded on the north by the Deucaledonian ſea, on the weſt by the channel called the *Minch*, on the eaſt by Caithneſs, and on the ſouth by Aſſynt. The length of it, from eaſt to weſt, amounts to 34 miles: but the breadth from north to ſouth does not exceed 12 in ſome places. It is very hilly; and the mountains are ſo high, that the ſnow remains on the tops of them till midſummer. It is watered by Navern, from whence it derives its name: as this diſtrict gives a title to the eldeſt ſon of the earl of Sutherland. Here are ſeveral woods, frequented by deer and other game, which the people take great delight in hunting. Iron mines have been worked in ſome places, but to no great advantage. Strathnavern has many freſh water lakes or lochs; the chief of which are Loch Navern and Loch Lyel: there are ſeveral iſlands on the northern coaſt; and in various parts of the country we ſee monuments of victories obtained over the Danes or other foreign invaders. Sutherland boaſts of ſome towns, and a great many villages. The people are numerous, hardy, bold, and enterpriſing; courteous to ſtrangers; cheerful, open, frugal, and induſtrious. They, as well as their neighbours of Caithneſs, ſpeak the language, and wear the garb, uſed in the Lowlands of Scotland. They carry on a conſiderable ſalmon-fiſhery. They drive a traffic with their black cattle, ſheep, and horſes, at the neighbouring fairs; but export their corn, barley, ſalt, coal, ſalmon, ſalted beef, butter, cheeſe, wool-ſkins, hides, and tallow. Here are proviſions of all ſorts in plenty; and ſo cheap through all this country, that a gentleman may keep houſe and live much more ſumptuouſly for 200 l. a-year than he can live for three times the money in the ſouth of England.

SUTLER, in war, one who follows the army, and furniſhes the troops with proviſion. Sutlers pitch their tents, or build their huts, in the rear of each regiment, and about head-quarters.

SUTRIUM (anc. geog.), a famous city, and an ancient colony of the Romans, the key of Etruria: founded about ſeven years after the taking of Rome by the Gauls (Velleius). Now *Sutri* in St Peter's patrimony, on the river Pozzolo; ſurrounded on every ſide with rocks, 24 miles to the north-weſt of Rome.

SUTTON (Samuel), was born at Alfretton in Derbyſhire, and going into the army ſerved under the duke of Marlborough in Queen Anne's wars with great credit. He afterwards came to London, commenced brewer, and kept a coffee-houſe in Alderſgate-ſtreet, which was well frequented by the learned men of that time, by whom Mr Sutton was much reſpected, as a man of ſtrong natural parts and uncultivated genius. About the year 1740 he ſchemed a very ſimple and natural method for extracting the foul air from the wells of ſhips, by pipes communicating with the fire-places of the coppers; which operated as long as any fire was kept burning for the ſhip's uſe. He took out a patent in 1744, to ſecure the profits of his invention; and died about the year 1752.

Sutton's Air-pipes. See *Air pipes.*

SUTURE, in anatomy, a kind of articulation peculiar to the cranium or ſkull. See ANATOMY, Part I. Sect. ii. *paſſim.*

SUTURE, in ſurgery, a method of uniting the lips of wounds together. See SURGERY.

SWABBER, an inferior officer on board ſhips of war, whoſe employment it is to ſee that the decks are kept clean and neat.

SWABIA. See SUABIA.

SWALLOW, in natural hiſtory, is claſſed under the genus of HIRUNDO, under which article the different ſpecies have been already deſcribed. Concerning this bird, one curious queſtion, however, ſtill remains to be diſcuſſed, What becomes of it in the winter? Upon this ſubject there are three opinions. Some ſay that it migrates to a warmer climate;

1 Queſtion, What becomes of ſwallows in winter?

nate; ſome, that it retires to hollow trees and caverns, where it lies in a torpid ſtate; and others have affirmed, that it lies in the ſame ſtate in the bottom of lakes and under the ice. The firſt opinion is ſupported by Marſigli, Ray, Willoughby, Cateſby, Reaumur, Adanſon, Buffon &c. The firſt and ſecond opinion are both adopted by Pennant and White. The third is ſanctioned by Schæffer, Hevelius, Derham, Klein, Ellis, Linnæus, Kalm: and the ſecond and third have been ſtrongly defended by the honourable Daines Barrington.

Though we cannot help giving a preference to that opinion which appears the moſt probable, yet we do not think that any one of them is eſtabliſhed upon ſuch evidence as ſo curious a ſubject requires, and as the advanced ſtate of natural hiſtory would lead us to expect. We ſhall therefore ſtate the arguments upon which each opinion is founded as fairly and diſtinctly as we can, and as often as poſſible in the very words of their reſpective advocates. By doing ſo, we ſhall place the whole ſubject before the eyes of our readers, who will thus have an opportunity of examining it attentively, and of making ſuch obſervations and experiments as may lead to the truth.

2
Firſt opinion ſtated that they migrate to warm climates.

Thoſe who aſſert that the ſwallow migrates to a warmer country in winter, argue in this manner: That many birds migrate, is a fact fully proved by the obſervations of natural hiſtorians (ſee Migration). Is it not more probable, therefore, that ſwallows, which diſappear regularly every ſeaſon, retire to ſome other country, than that they lie in a ſtate of torpor in caverns or lakes? But this opinion does not reſt on probability, it is founded on facts.

We often ſee them collected in great flocks on churches, rocks, and trees, about the time when they annually diſappear. The direction of their flight has been obſerved to be ſouthward. Mr White, the ingenious hiſtorian of Selborne, travelling near the coaſt of the Britiſh Channel one morning early, ſaw a flock of ſwallows take their departure. At the beginning of his journey he was environed with a thick fog; but on a large wild heath the miſt began to break, and diſcovered to him numberleſs ſwallows, cluſtered on the ſtanding buſhes, as if they had rooſted there: as ſoon as the ſun burſt out, they were inſtantly on wing, and with an eaſy and placid flight proceeded towards the ſea. After this he ſaw no more flocks, only now and then a ſtraggler.

Natural Hiſtory of Selborne, p. 64.

Mr Laſkey of Exeter obſerved attentively the direction which a flock of ſwallows took in the autumn of 1793. On the 22d of September about ſeven o'clock in the morning, the wind being eaſterly, accompanied with a cold drizzling rain, Mr Laſkey's houſe was entirely covered with houſe-ſwallows. At intervals large flocks arrived and joined the main body, and at their arrival an unuſual chirping commenced. The appearance of the whole company was ſo lethargic, that he found it an eaſy matter to catch a conſiderable number of them, which he kept in a room all that day. By heating the room they all revived: he opened four of them, and found their ſtomachs quite full. The main body occupied the houſe top all day, except for two hours. About half an hour after nine on the morning of the 23d, there was a great commotion, with very loud chirping, and within a few minutes after, the whole multitude took their flight, in a direct ſouth-eaſt direction, having aſcended to a great height in the atmoſphere. He let go the birds which he had caught, at certain intervals till four o'clock, and they all flew toward the ſame quarter.

Gent. Mag. for 1796.

Not only has the direction of their flight been obſerved, but they have alſo been found on their paſſage at a great diſtance from land. Mr Adanſon informs us, that about 50 leagues from the coaſt of Senegal four ſwallows ſettled upon the ſhip on the 6th of October; that theſe birds were taken; and that he knew them to be European ſwallows, which, he conjectures, were returning to the coaſt of Africa. Sir Charles Wager's authority may alſo be appealed to: "Returning home (ſays he) in the ſpring of the year, as I came into ſoundings in our channel, a great flock of ſwallows came and ſettled on all my rigging: every rope was covered, they hung on one another like a ſwarm of bees; the decks and carving were filled with them. They ſeemed almoſt famiſhed and ſpent, and were only feathers and bones; but, being recruited with a night's reſt, took their flight in the morning." This vaſt fatigue proves that their journey muſt have been very great, conſidering the amazing ſwiftneſs of theſe birds: in all probability they had croſſed the Atlantic ocean, and were returning from the ſhores of Senegal, or other parts of Africa; ſo that this account from that moſt able and honeſt ſeaman, confirms the later information of Mr Adanſon.

Philoſophical Tranſactions, vol. liii.

Mr Kalm, who is an advocate for the opinion that ſwallows lie immerſed in lakes during the winter, acknowledges, that in croſſing the Atlantic from Europe a ſwallow lighted on the ſhip on the 2d September, when it had paſſed only two-thirds of the ocean. Since, therefore, ſwallows have been ſeen aſſembled in great flocks in autumn flying off in company towards ſouthern climes, ſince they have been found both in their paſſage from Europe and returning again, can there be any doubt of their annual migration?—For Mr Barrington's objections to this opinion, ſee Migration, p. 5.

Kalm's Voyage, vol. 1. p. 24.

3
Second opinion, that ſome lie in caverns in a torpid ſtate.

The ſecond notion (ſays Mr Pennant) has great antiquity on its ſide. Ariſtotle and Pliny give it as their belief, that ſwallows do not remove very far from their ſummer habitation, but winter in the hollows of rocks, and during that time loſe their feathers. The former part of their opinion has been adopted by ſeveral ingenious men; and of late ſeveral proofs have been brought of ſome ſpecies, at leaſt, having been diſcovered in a torpid ſtate. Mr Collinſon favoured us with the evidence of three gentlemen, eye-witneſſes to numbers of ſand martins being drawn out of a cliff on the Rhine, in the month of March 1762. And the honourable Daines Barrington communicated to us the following fact, on the authority of the late Lord Belhaven, That numbers of ſwallows have been found in old dry walls and in ſandhills near his Lordſhip's ſeat in Eaſt Lothian; not once only, but from year to year; and that when they were expoſed to the warmth of a fire, they revived. We have alſo heard of the ſame annual diſcoveries, near Morpeth in Northumberland, but cannot ſpeak of them with the ſame aſſurance as the two former: neither in the two laſt inſtances are we certain of the particular ſpecies.

Pennant's Britiſh Zoology, vol. ii. p. 250.

"Other witneſſes crowd on us to prove the reſidence of thoſe birds in a torpid ſtate during the ſevere ſeaſon. Firſt, In the chalky cliffs of Suſſex; as was ſeen on the fall of a great fragment ſome years ago. Secondly, In a decayed hollow tree that was cut down, near Dolgelli, in Merionethſhire. Thirdly, In a cliff near Whitby, Yorkſhire; where, on digging out a fox, whole buſhels of ſwallows were found in a torpid condition. And, laſtly, The reverend Mr Conway of Sychton, Flintſhire, was ſo obliging as to communicate the following fact: A few years ago, on looking down an old lead mine in that country, he obſerved numbers of ſwallows clinging to the timbers of the ſhaft, ſeemingly aſleep; and on flinging ſome gravel on them, they juſt moved, but never attempted to fly or change their place: this was between All Saints and Chriſtmas.

“ Theſe are doubtleſs the lurking places of the later hatches, or of thoſe young birds which are incapable of diſtant migrations. There they continue inſenſible and rigid; but like flies may ſometimes be reanimated by an unſeaſonable hot day in the midſt of winter: for very near Chriſtmas a few appeared on the moulding of a window of Merton college, Oxford, in a remarkably warm nook, which prematurely ſet their blood in motion, having the ſame effect as laying them before a fire at the ſame time of year. Others have been known to make this premature appearance; but as ſoon as the cold natural to the ſeaſon returns, they withdraw again to their former retreats.

“ The above are circumſtances we cannot but aſſent to, though ſeemingly contradictory to the common courſe of nature in regard to other birds. We muſt, therefore, divide our belief relating to theſe two ſo different opinions; and conclude, that one part of the ſwallow tribe migrate, and that others have their winter-quarters near home. If it ſhould be demanded, why ſwallows alone are found in a torpid ſtate, and not the other many ſpecies of ſoft-billed birds, which likewiſe diſappear about the ſame time? reaſons might be aſſigned:”

4
Third opinion, that ſome lie immerſed in water.

The third opinion we ſhall ſtate and ſupport in the words of Mr Kalm. “ Natural hiſtory (ſays he), as all other hiſtories, depends not always upon the intrinſic degree of probability, but upon facts founded on the teſtimony of people of noted veracity.—Swallows are ſeldom ſeen ſinking down into the water; ſwallows have not ſuch organs as frogs or lizards, which are torpid during winter; *ergo*, ſwallows live not, and cannot live, under water.—This way of arguing, I believe, would carry us, in a great many caſes, too far: for though it is not clear to every one, it may however be true; and lizards and frogs are animals of a claſs widely different from that of birds, and muſt therefore of courſe have a different ſtructure; hence it is they are claſſed ſeparately. The bear and the marmot are in winter in a torpid ſtate, and have, however, not ſuch organs as lizards and frogs; and nobody doubts of their being, during ſome time, in the moſt rigid climates, in a torpid ſtate: for the Alpine nations hunt the marmots frequently by digging their holes up; and find them ſo torpid, that they cut their throats, without their reviving or giving the leaſt ſign of life during the operation; but when the torpid marmot is brought into a warm room, and placed before the fire, it revives from its lethargy. The queſtion muſt therefore be decided by facts; nor are theſe wanting here. Dr Wallerius, the celebrated Swediſh chemiſt, informs us, That he has ſeen, more than once, ſwallows aſſembling on a reed, till they were all immerſed and went to the bottom; this being preceded by a dirge of a quarter of an hour's length. He atteſts likewiſe, that he had ſeen a ſwallow caught during winter out of a lake with a net, drawn, as is common in northern countries, under the ice; this bird was brought into a warm room, revived, fluttered about, and ſoon after died.

“ Mr Klein applied to many farmers-general of the king of Pruſſia's domains, who had great lakes in their diſtricts, the fiſhery in them being a part of the revenue. In winter the fiſhery thereon is the moſt conſiderable under the ice, with nets ſpreading more than 200 or 300 fathoms, and they are often wound by ſcrews and engines on account of their weight. All the people that were queſtioned made affidavits upon oath before the magiſtrates. Firſt, The mother of the counteſs Lehndorf ſaid, that ſhe had ſeen a bundle of ſwallows brought from the Friſhe-Haff (a lake communicating with the Baltic at Pillaw), which, when brought into a moderately warm room, revived and fluttered about. Secondly, Count Schileben gave an inſtrument on ſtamped paper, importing, that by fiſhing on the lake belonging to his eſtate of Gerdauen in winter, he ſaw ſeveral ſwallows caught in the net, one of which he took up in his hand, brought it into a warm room, where it lay about an hour, when it began to ſtir, and half an hour after, it flew about in the room. Thirdly, Farmer general (Amtman) Witkouſki made affidavit, that, in the year 1740, three ſwallows were brought up with the net in the great pond at Didlacken; in the year 1741 he got two ſwallows from another part of the pond, and took them home (they being all caught in his preſence); after an hour's ſpace they revived all in a warm room, fluttered about, and died in three hours after. Fourthly, Amtman Bonke ſays, that having had the eſtate of Kleſkow in farm, he had ſeen nine ſwallows brought up in the net from under the ice, all which he took into a warm room, where he diſtinctly obſerved how they gradually revived; but a few hours after they all died. Another time his people got likewiſe ſome ſwallows in a net, but he ordered them to be again thrown into the water. Fifthly, Andrew Rutta, a maſter fiſherman at Oletſko, made affidavit, in 1747, that 22 years ago, two ſwallows were taken up by him in a net, under the ice, and, being brought into a warm room, they flew about. Sixthly, Jacob Koſiulo, a maſter fiſherman at Stradauen, made affidavit, that, in 1736, he brought up in winter, in a net, from under the ice of the lake at Raſki, a ſeemingly dead ſwallow, which revived in half an hour's time in a warm room; and he ſaw, in a quarter of an hour after, the bird grow weaker, and ſoon after dying. Seventhly, I can reckon myſelf (ſays our author) among the eye-witneſſes of this paradox of natural hiſtory. In the year 1735, being a little boy, I ſaw ſeveral ſwallows brought in winter by the fiſhermen from the river Viſtula to my father's houſe; where two of them were brought into a warm room, revived, and flew about. I ſaw them ſeveral times ſettling on the warm ſtove (which the northern nations have in their rooms); and I recollect well, that the ſame forenoon they died, and I had them, when dead, in my hand. In the year 1754, after the death of my uncle Godefroy Wolf, captain in the Poliſh regiment of foot-guards, being myſelf one of his heirs, I adminiſtered for my co-heirs ſeveral eſtates called the *Staroſty of Diſchau*, in Poliſh Pruſſia, which my late uncle farmed under the king. In January, the lake of Lybſhaw, belonging to theſe eſtates, being covered with ice, I ordered the fiſhermen to fiſh therein, and in my preſence ſeveral ſwallows were taken, which the fiſhermen threw in again; but one I took up to myſelf, brought it home, which was five miles from thence, and it revived, but died about an hour after its reviving.

“ Theſe are facts atteſted by people of the higheſt quality, by ſome in public offices, and by others who, though of a low rank, however, made theſe affidavits upon oath. It is impoſſible to ſuppoſe indiſcriminately that they were prompted, by views of intereſt, to aſſert as a fact a thing which had no truth in it. It is therefore highly probable, or rather inconteſtably true, that ſwallows retire in the northern countries, during winter, into the water, and ſtay there in a torpid ſtate till the return of warmth revives them again in ſpring. The queſtion therefore, I believe, ought for the future to be thus ſtated: The ſwallows in Spain, Italy, France, and perhaps ſome from England, remove to warmer climates; ſome Engliſh ones, and ſome in Germany and other mild countries, retire into clefts and holes in rocks, and remain there in a torpid ſtate. In the colder northern countries the ſwallows immerſe in the ſea, in lakes, and rivers; and remain in a torpid ſtate, under ice, during winter. There are ſtill ſome objections to this latter aſſertion, which we muſt remove. It is ſaid, Why do not rapacious fiſh, and aquatic quadrupeds and birds, devour theſe ſwallows? The anſwer is obvious, ſwallows chooſe only ſuch places in the water for their winter-retreat as are near reeds and ruſhes; ſo that ſinking down there between them and their roots, they are by them ſecured againſt the rapaciouſneſs of their enemies. But others object, Why are not theſe birds caught in ſuch freſh waters as are continually haraſſed by nets? I believe the ſame anſwer which has been made to the firſt objection will ſerve for this likewiſe. Fiſhermen take care to keep off with their nets from places filled with reeds and ruſhes, for fear of entangling and tearing their net; and thus the ſituation of ſwallows under water, is the reaſon that they are ſeldom diſturbed in their ſilent winter-retreats. What confirms this opinion ſtill more is, that ſwallows were never caught in Pruſſia according to the abovementioned affidavits, but with thoſe parts of the net which paſſed near to the reeds and ruſhes; and ſometimes the ſwallows were yet faſtened with their feet to a reed, when they were drawn up by the net. As to the argument taken from their being ſo long under water without corruption, I believe there is a real difference between animals ſuffocated in water and animals being torpid therein. We have examples of things being a long time under water; to which we may add the intenſe cold of theſe nothern regions, which preſerves them. Who would have thought that ſnails and polypes might be diſſected, and could reproduce the parts ſevered from their bodies, if it was not a fact? Natural hiſtory ought to be ſtudied as a collection of facts, not as the hiſtory of our gueſſes or opinions. Nature varies in an infinite manner; and Providence has diverſified the inſtinct of animals and their economy, and adapted it to the various ſeaſons and climates."

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With Mr Kalm's concluding obſervations we heartily concur. Natural hiſtory ought to be ſtudied as a collection of facts; and it was from this very notion that we have ſtated the abovementioned opinions ſo fully, and brought together the facts which the beſt advocates for each opinion have judged moſt proper for ſupporting them. We are ſenſible of the great improbability of the third opinion, and know that many arguments have been uſed to prove its abſurdity: ſuch as theſe, The ſwallow is lighter than water, and therefore cannot ſink; if it moults at all, it muſt moult under water during its torpid ſtate, which is very improbable; there is no inſtance of land animals living ſo long under water without reſpiration. Many other arguments of the ſame ſort have been advanced, and certainly afford a ſhort way of deciding the queſtion; but unleſs they were ſufficient to prove the immerſion of ſwallows a phyſical impoſſibility, they are of no force when oppoſed to the evidence of teſtimony, if there be no cauſe to ſuſpect the witneſſes of inaccuracy or deſign. The true way to refute ſuch an opinion is by accurate obſervation and experiment. We have not heard of any accurate inquiries being made by philoſophers in thoſe northern countries where ſwallows are ſaid to paſs the winter under water. The count de Buffon, indeed, ſhut up ſome ſwallows in an ice-houſe by way of experiment, which died in a few days; but as he does not tell us what precautions he took to make the experiment ſucceed, it is not intitled to any attention.

Gentle-
an's Ma-
azine,
ay 1796.

Mr John Hunter made a very judicious experiment on the banks of the Thames, which is deſcribed by a correſpondent in the Gentleman's Magazine, who aſſerts that he had it from Mr Hunter himſelf.

One year in the month of September, he prepared a room, with every accommodation and convenience which he could contrive, to ſerve as a dormitory for ſwallows, if they were diſpoſed to ſleep in winter. He placed in the centre a large tub of water with twigs and reeds, &c. which reached to the bottom. In the corners of the room he contrived artificial caverns and holes, into which they might retire; and he laid on the floor, or ſuſpended in the air, different lengths of old wooden pipes, which had formerly been employed in conveying the water through the ſtreets, &c.

6
Mr Hunter's experiment ingenious,

When the receptacle was rendered as complete as poſſible, he then engaged ſome watermen to take by night a large quantity of the ſwallows that hung upon the reeds in the Thames about the time of their departure. They brought him, in a hamper, a conſiderable number; and had ſo nicely hit the time of their capture, that on the very day following there were none to be ſeen.

He put the ſwallows into the room ſo prepared, where they continued to fly about, and occaſionally perch on the twigs, &c. But not one ever retired into the water, the caverns, holes, or wooden pipes, or ſhewed the leaſt diſpoſition to grow torpid, &c. In this ſituation he let them remain till they all died but one. This, appearing to retain ſome vigour, was ſet at liberty; when it mounted out of ſight, and flew away. All the birds lay dead ſcattered about the room; but not one was found aſleep or torpid, or had, if the correſpondent remembers, ſo much as crept into any of the receptacles he had ſo provided.

7
But not deciſive with reſpect to northern climates.

This experiment was ingenious, and certainly does render the doctrine of immerſion much more improbable; but it is not deciſive; for it may ſtill be urged by the advocates for that doctrine, as Mr Kalm has done, that it may only be in the colder countries where ſwallows retire into the water. We formerly ſaid that none of the three opinions are ſupported by ſuch evidence as to ſatisfy the mind completely. Opinions which reſpect events which happen every year ought to be confirmed by a great number of obſervations, and not by a few inſtances diveſted of almoſt all their concomitant circumſtances. Can no better proofs be brought to prove the migration of ſwallows than thoſe of Adanſon and Sir Charles Wager, or the circumſtances mentioned by Mr White and Mr Laſkey reſpecting their diſappearing? We ought not merely to know that ſome ſwallows have taken a ſoutherly flight in autumn, that ſome have been found at a great diſtance from land in the ſpring, or in harveſt; but we ought to know to what countries they actually retire. Before we can reſt ſatisfied, too, that it is a general fact that ſwallows remain in a torpid ſtate during winter, either in caverns or in the bottom of lakes, &c. we muſt have more proofs; we muſt know what ſpecies of ſwallows they are ſaid to be, in what countries this event takes place, and ſeveral other circumſtances of the ſame kind.

8
Many things yet remain to be done in order to determine this point.

We cannot help being of opinion that much remains to be done in order properly to aſcertain what becomes of the ſwallows in Europe during winter. It would be neceſſary, in the firſt place, to know accurately what are the countries in which ſwallows are found. 2. Do they remain viſible the whole year? or, if they diſappear, at what ſeaſon does this happen, and when do they appear again? 3. Do they ever appear while a ſtrong north wind blows, or do they only come in great numbers with a ſouth wind? We will endeavour to anſwer ſome of theſe queſtions in part; but muſt regret, that all the information on this ſubject which we have been able to cull from the beſt writers in natural hiſtory is very ſcanty; and we merely give it by way of ſpecimen, hoping that future obſervations will ſoon render it more complete.

9
A few important facts ſtated.

There are five ſpecies which viſit Britain during the ſummer months; the common or chimney ſwallow, the martin, ſand martin, ſwift, and goat-ſucker. The chimney ſwallow frequents almoſt every part of the old continent; being known (ſays Dr Latham) from Norway to the Cape of Good Hope on the one ſide, and from Kamtſchatka to India and Japan on the other. It is alſo found in all parts of North America, and in ſeveral of the Weſt Indian Iſlands. In Europe it diſappears during the winter months. It appears generally a little after the vernal equinox; but rather earlier in the ſouthern, and later in the northern latitudes. It adheres to the uſual ſeaſons with much regularity; for though the months of February and March ſhould be uncommonly mild, and April and May remarkably cold, it never deviates from its ordinary time. In the cold ſpring of 1740 ſome appeared in France before the inſects on which they feed had become numerous enough to ſupport them, and great numbers died †. In the mild and even warm ſpring of 1774 they appeared no earlier than uſual. They remain in ſome warm countries the whole year. Kolben aſſures us that this is the caſe at the Cape of Good Hope; but (he ſays) they are more numerous in winter. Some birds of this ſpecies live, during winter, even in Europe; for example, on the coaſt of Genoa, where they ſpend the night in the open country on the orange ſhrubs.

† Buffon's Natural Hiſtory of Birds, vol. vi. p. 527.

2. The *martins* are alſo widely diffuſed through the old continent; but the countries where they reſide or viſit have not been marked by naturaliſts with much attention. 3. The *ſand martins* are found in every part of Europe, and frequently ſpend the winter in Malta ‡. Two birds of this ſpecies were ſeen in Perigord in France, on the 27th December 1775, when there was a ſoutherly wind, attended with a little rain ‖. 4. The *ſwift* viſits the whole continent of Europe; has alſo been obſerved at the Cape of Good Hope, and in Carolina in North America. 5. The *goat-ſuckers* are not very common birds, yet are widely ſcattered. They are found in every country between Sweden and Africa: they are found alſo in India. In April the ſouth-weſt wind brings them to Malta, and in autumn they repaſs in great numbers.

‡ Ibid. 527.

‖ Ibid. 484.

Mr Markwick of Catsfield, near Battle in Suſſex, has drawn up an accurate table, expreſſing the day of the month on which the birds, commonly called *migratory*, appeared in ſpring, and diſappeared in autumn, for 16 years, from 1768 to 1783 incluſive. The obſervations were made at Catsfield. From this table we ſhall extract the dates for five years, and add the very few obſervations which we have been able to collect reſpecting the time when the ſwallow appears and diſappears in other countries.

Tranſactions of the Linnæan Society, vol. i.

	Firſt ſeen.	*Laſt ſeen.*
	1779.	
Chim. Swal.	Ap. 14.	Oct. 29.
Martins	14.	15.
Sand Mart.	May 7.	
Swift	9.	
	1780.	
Chim. Swal		Nov. 3.
Martins	Ap. 29.	3.
Sand Mart.	8.	Sep. 8.
Swift	May 6.	8.
	1781.	
Chim. Swal.	Ap. 8.	Oct. 15.
Martins	May 12.	Sep. 7.
Sand Mart.	Ap. 26.	Sep. 1.
Swift	May 12.	1.
	1782.	
Chim. Swal.	Ap. 22.	Sep. 1.
Martins	26.	Nov. 2.
Sand Mart.	May 15.	Aug. 28.
Swift	18.	28.
	1783.	
Chim. Swal.	Ap. 13.	Nov. 6.
Martins	May 1.	6.
Sand Mart.	July 25.	Sep. 1.
Swift	May 13.	Nov. 6.

	Chim. Swal.	Swifts.	Martins.	S. Mart.
		Appear about		
In Burgundy †			Ap. 9.	Ap. 12.
In Selborne, Hampſhire ‡	Ap. 4.	Ap. 24.	Ap. 30.	
In South Zele, Devonſhire ‡	25.	May 1.	May 15.	
In Blackburn, Lancaſhire ‡	29.	Ap. 28.		
In Upſal in Sweden §			May 9.	

† Buffon, ibid.

‡ White's Natural Hiſtory of Selborne.

§ Buffon, ibid.

Were tables of the ſame kind made in every different country, particularly within the torrid zone, it would be eaſy to determine the queſtion which we have been conſidering. To many, perhaps, it may not appear a matter of ſuch importance as to be worth the labour. We acknowledge it to be rather a curious than an important inquiry; yet it is one which muſt be highly gratifying to every mind that can admire the wiſdom of the Great Architect of nature. The inſtinct of the ſwallow is indeed wonderful: it appears among us juſt at the time when inſects become numerous; and it continues with us during the hot weather, in order to prevent them from multiplying too much. It diſappears when theſe inſects are no longer troubleſome. It is never found in ſolitude; it is the friend of man, and always takes up its reſidence with us that it may protect our houſes and our ſtreets from being annoyed with ſwarms of flies.

Swallow-Wort, in botany. See Asclepias.

SWAMMERDAM (John), a celebrated and learned natural philoſopher, was the ſon of John James Swammerdam, an apothecary and famous naturaliſt of Amſterdam, and was born in 1637. His father intended him for the church, and with this view had him inſtructed in Latin and Greek; but he, thinking himſelf unequal to ſo important a taſk, prevailed with his father to conſent to his applying himſelf to phyſic. As he was kept at home till he ſhould be properly qualified to engage in that ſtudy, he was frequently employed in cleaning his father's curioſities, and putting every thing in its proper place. This inſpired our author with an early taſte for natural hiſtory; ſo that, not content with the ſurvey of the curioſities his father had purchaſed, he ſoon began to make a collection of his own, which he compared with the accounts given of them by the beſt writers. When grown up, he ſeriouſly attended to anatomical and medical ſtudies; yet ſpent part of the day and the night in diſcovering, catching, and examining the flying inſects proper to thoſe times, not only in the province of Holland, but in thoſe of Guelderland and Utrecht.—Thus initiated in natural hiſtory, he went to the univerſity of Leyden in 1651; and in 1663 was admitted a candidate of phyſic in that univerſity. His attention being now engaged by anatomy, he began to conſider how the parts of the body, prepared by diſſection, could be preſerved, and kept in conſtant order for anatomical demonſtration; and herein he ſucceeded, as he had done before in his nice contrivances for diſſecting and managing the minuteſt inſects. Our author afterwards made a journey into France, where he ſpent ſome time at Saumur, and where he became acquainted with ſeveral learned men. In 1667 he returned to Leyden, and took his degree of Doctor of Phyſic. The next year the grand duke of Tuſcany being in Holland in order to ſee the curioſities of the country, came to view thoſe of our author and his father; and on this occaſion Swammerdam made ſome anatomical diſſections of inſects in the preſence of that prince, who was ſtruck with admiration at our author's great ſkill in managing them, eſpecially at his proving that the future butterfly lay with all its parts neatly folded up in a caterpillar, by actually removing the integuments that covered the former, and extricating and exhibiting all its parts, however minute, with incredible ingenuity, by means of inſtruments of inconceivable fineneſs. On this occaſion the duke offered our author 12,000 florins for his ſhare of the collection, on condition of his removing them himſelf into Tuſcany, and coming to live at the court of Florence; but Swammerdam, who hated a court life, declined his highneſs's propoſal. In 1663, he publiſhed a General Hiſtory of Inſects. About this time, his father began to take offence at his inconſiderately neglecting the practice of phyſic, which might have ſupported him in affluence; and would neither ſupply him with money nor clothes. This reduced him to ſome difficulties. In 1675 he publiſhed his Hiſtory of the Ephemeras; and his father dying the ſame year, left him a fortune ſufficient for his ſupport;

Swan ‖ Sweden.

port: But he did not long ſurvive him, for he died in 1682. Gaubius gave a tranſlation of all his works from the original Dutch into Latin, from which they were tranſlated into Engliſh, in folio, in 1758. The celebrated Boerhaave wrote his life.

SWAN, in ornithology. See Anas.

SWANPAN, or Chineſe Abacus; an inſtrument for performing arithmetical operations, deſcribed by Du Halde in his Hiſtory of China.

Gent Mag. for 1748.

It is compoſed of a ſmall board, croſſed with 10 or 12 parallel rods or wires, each ſtrung with ivory balls, which are ſo divided by a partition in the middle, that two are on one ſide of it, and five on the other. The two in the upper part ſtand each for five units, and each of the five in the lower part for one. "In joining and ſeparating theſe balls, they reckon much as we do with counters; but, according to our author, more expeditiouſly than Europeans do even with figures." This is hardly credible; but if all the Chineſe weights and meaſures be decimally divided, as by his very lame deſcription of the *ſwanpan* they would appear to be, it is eaſy to conceive how computation may be made by this inſtrument very expeditiouſly. The inſtrument, too, may be ſo contrived as to ſuit any diviſion of weights and meaſures, and in that form be uſeful to the blind; but as we have elſewhere given deſcriptions of ſuperior inſtruments, for their accommodation (See Blind) it is needleſs to offer in this place any improvement of the *ſwanpan*.

SWANEMOTE, Swainmote, or Sweinmote. See *Forest-Courts*.

SWEARING. See Oath.

SWEAT, a ſenſible moiſture iſſuing from the pores of the ſkins of living animals.

The exceſs of it dries and weakens the body, deprives the humours of their watery parts, and induces the blood to an inflammatory and atrabiliary diſpoſition. A ſudden ſuppreſſion of it will equally hurt as well as a ſuppreſſion of perſpiration.

Valangin's Treatiſe on Diet, &c.

SWEATING sickness, a diſorder which appeared in England about the year 1481, and was by foreigners called the *Engliſh ſweat*. It returned again in 1485; then in 1506; afterwards in 1517. It appeared again in 1528, or 1529, at which time alone it ſpread itſelf to the Netherlands and Germany: a circumſtance which ſhews the impropriety of calling it *the Engliſh ſweat*, in Latin *ſudor Anglicanus*; beſides, Sennertus takes notice, that it ſpread as far as Denmark, Norway, and France. It raged again in 1548. And the laſt return of it in London was in 1551, when it was ſo violent as in one day to take off 120 of the inhabitants of Weſtminſter. Some were ſeized abroad, and cut off in the road, others at home. Some when awake, others when faſt aſleep. Some died in a moment, and others in one, two, three, four, or more hours after they began to ſweat.

SWEDEN, one of the moſt northerly kingdoms of Europe, lying between Lat. 55. 20. and 69. 30. north, and between 12° and 32° eaſt from London. On the ſouth it is bounded by the Baltic, on the north by Daniſh Lapland, on the eaſt by Muſcovy, and on the weſt by the mountains of Norway, being 800 miles in length and 350 in breadth.

1 Early hiſtory uncertain.

The early hiſtory of Sweden is no leſs involved in fables than that of moſt other nations. Some hiſtorians have pretended to give regular catalogues of the princes who reigned in Sweden in very early times: but they differ ſo much among themſelves, that no credit can be given to them. However, all agree that ancient Scandinavia was firſt governed by judges elected for a certain time by the voice of the people. Among theſe temporary princes the country was divided, until, in the year of the world 2054, according to ſome, or 1951, according to others, Eric, or, if we believe Puffendorf, Suenon was raiſed to the ſupreme power, with the prerogatives of all the temporary magiſtrates united in his perſon for life, or until his conduct ſhould merit depoſition.

Sweden.

From this very early period till the year 1366 of the Chriſtian era, the hiſtories of Sweden preſent us with nothing but what is common to all nations in their early periods, viz. the endleſs combats and maſſacres of barbarians, tending to no other purpoſe than the effuſion of blood. At the time juſt mentioned, however, Albert of Mecklenburg, having concluded a peace between Sweden and Denmark, which two kingdoms had been at violent war for ſome time before, was proclaimed king of Sweden. The peace was of ſhort duration, being broken in 1368; on which Albert entered into an offenſive and defenſive league with the earl of Holſtein, the Jutland nobility, the dukes of Selſwick, Mecklenburg, and the Hanſe-towns, againſt the kings of Denmark and Norway. Albert proved very ſucceſsful againſt Waldemar king of Denmark at that time, driving him entirely out of his dominions; but he himſelf was defeated by the king of Norway, who laid ſiege to his capital. Soon after this, a new treaty of peace was concluded, by which Albert was allowed to enjoy the crown of Sweden in peace. However, having formed a deſign of rendering himſelf abſolute, he fell under the diſpleaſure of his ſubjects, and Margaret of Norway was proclaimed queen of Sweden by the malecontents. A war immediately enſued, in which Albert was defeated and taken priſoner; but as the princes of Mecklenburg, the earls of Holſtein, and the Hanſe-towns, entered into a league in his favour, the war was ſo far from being extinguiſhed by this event, that it raged with more fury than ever.

2 Albert of Mecklenburg declared king in 1360.

3 War with Denmark and Norway.

4 Is defeated and taken priſoner by Margaret of Norway.

5 Set at liberty.

At length, in 1394, the contending parties came to an accommodation. Albert was ſet at liberty, on condition that he ſhould in three years ſurrender to Margaret all pretenſions to the city of Stockholm; and the Hanſe-towns engaged to pay the ſum of 60,000 marks of ſilver in caſe of Albert's breach of faith. Not long after this, Eric the ſon of Albert died; and he, having no other child, did not think it worth his while to contend for the kingdom of Sweden: he therefore acquieſced in the pretenſions of Margaret, and paſſed the remainder of his days at Mecklenburg.

6 Margaret is ſucceeded by Eric a cruel tyrant.

7 A general revolt takes place and Eric is depoſed.

Margaret died in 1415, and was ſucceeded by Eric of Pomerania. This prince's reign was cruel and oppreſſive to the laſt degree. The people were ruined by taxes; and the Danes being everywhere preferred to the offices of power, committed the greateſt cruelties. The conſequence of this was a revolt; and Charles Canutſon, grand mareſchal of Sweden and governor of Finland, having joined the malecontents, was declared commander in chief of their army. Eric was now formally depoſed, and commenced pirate: Canutſon was choſen regent: but beginning to oppreſs the people, and aſpiring openly at the crown, the Swedes and Danes revolted; in conſequence of which a revolution took place, and Chriſtopher duke of Bavaria, nephew to Eric, was choſen king of Denmark, Sweden, and Norway, in 1442.

On the acceſſion of the new prince, complaints againſt Canutſon were brought from all quarters; but, through the intereſt of his friends, he eſcaped the puniſhment due to him; and in 1448, Chriſtopher having died after a tyrannical reign of ſomewhat more than five years, he was raiſed to the throne at which he had ſo long aſpired. However, the kingdoms of Denmark and Norway refuſed to own allegiance to him; upon which a war immediately commenced.

8 The three kingdoms united under Chriſtian king of Denmark, who proves a tyrant, and is driven out.

In 1454 peace was concluded, and Denmark for the preſent freed from the Swediſh yoke. Neither did Canutſon long enjoy even the crown of Sweden itſelf. Having quarrelled with the archbiſhop of Upſal, the latter formed ſuch a ſtrong party that the king could not reſiſt him. Chriſtian king of Denmark was called to the throne of Sweden; and in 1459 once more united the three kingdoms. He enjoyed his dignity but a ſhort time; for having begun to oppreſs his ſubjects in an arbitrary manner, he was obliged to retire to Denmark in 1463. Katil biſhop of Lincoping, who had driven out the king, took upon himſelf the office of regent. Next year Chriſtian returned with a powerful army; but was defeated. The people then thought proper to recal Canutſon: but he, on his firſt acceſſion, having offended the warlike Biſhop Katil, was by him defeated, and obliged to renounce his right to the crown. After this the kingdom was rent into factions; between whom the moſt cruel civil wars took place, until the year 1467, when Canutſon was again recalled, and enjoyed the kingdom, though not without difficulty and oppoſition, till his death, which happened in 1470.

9 John king of Denmark obtains the Swediſh crown, but is driven out.

The confuſion in which the Swediſh affairs had been ſo long involved did not ceaſe on the death of Canutſon. Chriſtian again invaded Sweden; but was defeated by Steen Sture, nephew to the late king. After this the kingdom ſeems to have remained in peace till the year 1487, when the Ruſſians invaded Carelia, committing everywhere the greateſt ravages. Theſe were ſoon driven out: but in 1497, a rupture happening betwixt Sture and the ſenate, an offer was made of the Swediſh crown to John king of Denmark. This prince readily accepted the offer, and was crowned accordingly; but no ſooner was he ſeated on the throne than he became odious to the Swedes, from his partiality to the Danes. In a ſhort time he ſet out for Denmark, leaving his queen, with a ſtrong garriſon, in the citadel of Stockholm. He was no ſooner gone than the capital was inveſted: and though the queen made a noble defence, ſhe was at laſt obliged to capitulate, on condition of being allowed to paſs into Denmark. All the garriſon were made priſoners of war, and the queen herſelf was confined in a monaſtery till the following year.

10 Chriſtian king of Denmark invades Sweden, but is defeated and driven out.

11 He treacherouſly carries off ſix hoſtages, of whom Guſtavus Ericſon is one.

The Swediſh affairs continued to be involved in the ſame dreadful confuſion as we have already related, until the year 1520, when a great revolution was effected by Guſtavus Ericſon, a nobleman of the firſt rank, who reſtored the kingdom to its liberty, and laid the foundation of its future grandeur. The occaſion of this great revolution was as follows: In 1518, Chriſtian king of Denmark invaded Sweden, with a deſign to ſubdue the whole country; but being defeated with great loſs by young Steen Sture, the regent at that time, he ſet ſail for Denmark. But meeting with contrary winds, he made ſeveral deſcents on the Swediſh coaſt, which he ravaged with all the fury of an incenſed barbarian. The inhabitants, however, bravely defended themſelves, and Chriſtian was reduced to the utmoſt diſtreſs; one half of his forces having periſhed with hunger, and the other being in the moſt imminent danger by the approach of a rigorous winter. He then thought of a ſtratagem, which had almoſt proved fatal to the regent; for having invited him to a conference, at which he deſigned either to aſſaſſinate or take him priſoner, Sture was about to comply, had not the ſenate, who ſuſpected the plot, interpoſed and prevented him. Chriſtian then offered to go in perſon to Stockholm in order to confer with Sture, upon condition that ſix hoſtages ſhould be ſent in his room. This was accordingly done; but the wind happening then to prove favourable, he ſet ſail for Denmark with the hoſtages, of whom Guſtavus Ericſon was one. Next year he returned; and having drawn Sture into an ambuſh, the regent received a wound of which he died ſome time after. The kingdom being thus left without a head, matters ſoon came to the moſt deſperate criſis. The army diſbanded itſelf; and the ſenate, inſtead of taking proper meaſures to oppoſe the enemy, ſpent their time in idle debates. Chriſtian in the mean time advanced into the heart of the kingdom, deſtroying every thing with fire and ſword; but on his arrival at Stragnez, he granted a ſuſpenſion of arms, to give the people time to deliberate on their ſituation, and to reflect that they might eaſily get rid of their troubles by electing him king. This they accordingly did; and Chriſtian proved one of the moſt bloody tyrants that ever ſat on the throne of any kingdom. Immediately after his coronation, he gave grand entertainments for three days; during which time he prejected the diabolical deſign of extirpating at once all the Swediſh nobility, and thus for ever preventing the people from revolting, by depriving them of their proper leaders. As the tyrant had ſigned articles, by which he promiſed indemnity to all who had borne arms againſt him, it became neceſſary to invent ſome cauſe of offence againſt thoſe whom he intended to deſtroy. To accompliſh his purpoſe, Guſtavus Trolle, formerly archbiſhop of Upſal, but who had been degraded from that dignity, in an oration before his majeſty lamented the demolition of Stecka, his place of reſidence, and the loſſes ſuſtained by the ſee of Upſal, amounting to near a million of money. He then proceeded in a bitter accuſation againſt the widow and the ſon-in-law of Sture the late regent, comprehending in the ſame accuſation about 15 of the principal nobility, the whole ſenate, and the burgers of Stockholm. The conſequence of this was, that above 60 of the principal nobility and people of firſt rank in Sweden were hanged up as traitors. Innumerable other cruelties were committed; part of which are owned by the Daniſh hiſtorians, and minutely related by thoſe of Sweden. At laſt he departed for Denmark, ordering gibbets to be erected, and cauſing the peaſants to be hanged on them for the ſlighteſt offences, all the way as he paſſed along; and it is related of him, that at Jencoping he cauſed two boys, one of ſeven and the other of nine years of age, to be whipped to death.

12 Is choſen king, and proves a moſt bloody tyrant.

13 Maſſacres the nobility, and cauſes gibbets to be erected as he paſſes along.

14 Adventures of Guſtavus Vaſa or Ericſon.

15 He eſcapes from Denmark.

This monſtrous cruelty, inſtead of ſecuring him on the throne, exaſperated the whole nation againſt him. It has already been mentioned, that Guſtavus Ericſon, or, as he is commonly called, *Guſtavus Vaſa*, was among the number of the hoſtages whom Chriſtian had perfidiouſly carried to Denmark in 1519. Large promiſes had been made in order to reconcile him to Chriſtian, and threats had been uſed for the ſame purpoſe, but all in vain. Secret orders were given to ſtrangle him in priſon; but the officer to whom the aſſaſſination was committed remonſtrated to the king about the conſequences of it, and prevailed on him to change the ſentence of death into cloſe confinement in the caſtle of Copenhagen. Some of the hoſtages periſhed in conſequence of the rigorous treatment they met with; but Guſtavus withſtood all hardſhips. At laſt one Banner, a Daniſh nobleman, prevailed on the king to put him into his hands, in order to try whether or not he could prevail upon him to change his ſentiments. The king, however, told Banner, that he muſt pay 6000 crowns in caſe the priſoner ſhould make his eſcape. Banner generouſly aſſented; and having brought the noble priſoner to his fortreſs of Calo in Jutland, ſoon allowed him all the liberty he could deſire, and otherwiſe heaped favours upon him. All this, however, could not extinguiſh his remembrance of the cruelties of Chriſtian, and the deſire he had of being ſerviceable to his country. He therefore determined to make his eſcape; and the liberty he enjoyed ſoon put him in a capacity of effecting it. Having one day mounted his horſe, under pretence of hunting as uſual in the foreſt, when he got at a proper diſtance, he changed his dreſs to the habit of a peaſant; and quitting his horſe, he travelled for two days on foot through by-paths, and over mountains almoſt impaſſable, arriving on the third at Flenſburgh. Here no one was admitted without a paſſport; and Guſtavus dreaded preſenting himſelf to the governor or the officer upon guard, for fear of being diſcovered. Happily for him, it chanced to be on that ſeaſon of the year when the merchants of Lower Saxony drove a conſiderable trade in cattle, which they purchaſe in Jutland. Guſtavus hired himſelf to one of theſe merchants; and under favour of his diſguiſe eſcaped out of the Daniſh territories, and arrived at Lubec.

16 Arrives at Lubec.

17 Attempts in vain to draw the regency of Lubec over to his ſide.

18 He arrives at Calmar, but meets with an unfavourable reception.

Banner was no ſooner acquainted with his eſcape, than he ſet out after him with the utmoſt diligence, found him at Lubec, and reproached him with great warmth as ungrateful and treacherous; but he was ſoon appeaſed by the arguments urged by Guſtavus, and eſpecially by the promiſe he made of indemnifying him in the loſs of his ranſom. Upon this Banner returned, giving out that he could not find his priſoner. Chriſtian was enraged at his eſcape, apprehending that he might reverſe all his deſigns in Sweden; and gave orders to Otho his general to make the ſtricteſt ſearch, and leave no means untried to arreſt him. Guſtavus applied to the regency for a ſhip to convey him to Sweden, where he hoped he ſhould be able to form a party againſt the Danes. He likewiſe endeavoured to draw the regency of Lubec into his meaſures; and reaſoned with ſo much zeal and ability, that Nicholas Gemins, firſt conſul, was entirely gained; but the regency could never be prevailed on to declare for a party without friends, arms, money, or credit. However, before his departure, the conſul gave him aſſurances, that if he could raiſe a force ſufficient to make head againſt the enemy in the field, he might depend on the ſervices of the republic, and that the regency would immediately declare for him. Guſtavus deſired to be landed at Stockholm; but the captain of the ſhip, either having ſecret orders to the contrary, or buſineſs elſewhere, ſteered a different courſe, and put him on ſhore near Calmar; a city hitherto garriſoned by the troops of Chriſtina widow of the regent. In truth, the governor held this place for his own purpoſes, and only waited to make the beſt terms he could with the Danes. When Guſtavus arrived, he made himſelf known to him and the principal officers of the garriſon, who were moſtly Germans, and his fellow-ſoldiers in the late adminiſtrator's army. He flattered himſelf that his birth, his merit, and connexions, would immediately procure him the command. But the mercenary band, ſeeing him without troops and without attendants, regarded him as a deſperate perſon devoted to deſtruction, refuſed to embrace his propoſals, and even threatened to kill or betray him, if he did not inſtantly quit the city.

19 His friends refuſe to aſſiſt him.

Diſappointed in his expectations, Guſtavus departed with great expedition; and his arrival being now publicly known, he was again forced to have recourſe to his peaſant's diſguiſe to conceal him from the Daniſh emiſſaries diſperſed over the country to ſearch for him. In a waggon loaded with hay he paſſed through every quarter of the Daniſh army and at laſt repaired to an old family caſtle in Sudermania. From hence he wrote to his friends, notifying his return to Sweden, and beſeeching them to aſſemble all their forces in order to break through the enemy's army into Stockholm, at that time beſieged; but they, too, refuſed to embark in ſo hazardous and deſperate an attempt.

20 Applies in vain to the peaſants.

Guſtavus next applied himſelf to the peaſants: but they anſwered, that they enjoyed ſalt and herrings under the government of the king of Denmark; and that any attempts to bring about a revolution would be attended with certain ruin, without the proſpect of bettering their condition; for peaſants they were, and peaſants they ſhould remain, whoever was king. At length, after ſeveral vain attempts to throw himſelf into Stockholm, after that city was ſurrendered to the king, after the horrid maſſacre of the ſenate, and after running a thouſand dangers, and undergoing hardſhips and fatigues hardly to be ſupported by human nature, he formed the reſolution of trying the courage and affection of the Dalecarlians. While he was in the deepeſt obſcurity, and plunged in almoſt unſurmountable adverſity, he never relinquiſhed his deſigns nor his hopes. The news of the maſſacre had, however, very near ſunk him into deſpondency, as thereby he loſt all his friends, relations, and connections, and indeed almoſt every proſpect of ſafety to himſelf or deliverance to his country. It was this that inſpired the thought of going to Dalecarlia, where he might live with more ſecurity in the high mountains and thick woods of that country, if he ſhould fail in the attempt of exciting the inhabitants to revolt.

21 Arrives in Dalecarlia, is robbed by his guide, and obliged to work in the mines.

22 Is diſcovered and relieved.

Attended by a peaſant, to whom he was known, he travelled in diſguiſe through Sudermania, Nericia, and Weſtermania, and, after a laborious and painful journey, arrived in the mountains of Dalecarlia. Scarce had he finiſhed his journey, when he found himſelf deſerted by his companion and guide, who carried off with him all the money he provided for his ſubſiſtence. Thus forlorn, deſtitute, half ſtarved, he entered among the miners, and wrought like a ſlave under ground, without relinquiſhing his hopes of one day aſcending the throne of Sweden. His whole proſpect for the preſent was to live concealed, and gain a maintenance, until fortune ſhould effect ſomething in his favour: nor was it long before this happened. A woman in the mines perceived, under the habit of a peaſant, that the collar of his ſhirt was embroidered. This circumſtance excited curioſity; and the graces of his perſon and converſation, which had ſomething in them to attract the notice of the meaneſt of the vulgar, afforded room for ſuſpicion that he was ſome perſon of quality in diſguiſe, forced by the tyranny of the government to ſeek ſhelter in theſe remote parts. The ſtory came to the ears of a neighbouring gentleman, who immediately went to the mines to offer his protection to the unfortunate ſtranger; and was aſtoniſhed on recognizing the features of Guſtavus, whoſe acquaintance he had been at the univerſity of Upſal. Touched with compaſſion at the deplorable ſituation of ſo diſtinguiſhed a nobleman, he could ſcarce refrain from tears; but however had preſence of mind enough not to make the diſcovery. At night he ſent for Guſtavus, made him an offer of his houſe, and gave him the ſtrongeſt aſſurances of his friendſhip and protection. He told him, he would meet with better accommodations, and as much ſecurity as in the mines; and that, ſhould he chance to be diſcovered, he would, with all his friends and vaſſals, take arms in his defence.

This offer was embraced by Guſtavus with joy, and he remained for ſome time at his friend's houſe; but finding it impoſſible to induce him to take part in his deſigns, he quitted him, and fled to one Peterſon, a gentleman whom he had formerly known in the ſervice. By him he was received with all the appearance of kindneſs; and, on the very firſt propoſal made by Guſtavus, offered to raiſe his vaſſals. He even named the lords and peaſants whom he pretended to have engaged in his ſervice; but in a very few days after, he went ſecretly to a Daniſh officer, and gave him information of what had paſſed. The officer immedi-

23 Has a very narrow eſcape from the Danes.

ately cauſed the houſe to be ſurrounded with ſoldiers, in ſuch a manner that it ſeemed impoſſible for Guſtavus to make his eſcape. In the interval, however, he eſcaped, being warned by Peterſon's wife of the treachery of her huſband, and by her direction fled to the houſe of a clergyman, her friend. By him Guſtavus was received with all the reſpect due to his own birth and merit; and leſt the domeſtic who conducted him ſhould follow the treacherous example of his maſter, he removed him to the church, and conducted him to a ſmall cloſet, of which he kept the key. Having lived for ſome time in this manner, Guſtavus began to conſult with his friend concerning the moſt proper method of putting their ſchemes in execution. The prieſt adviſed him to apply directly to the peaſants themſelves; told him that it would be proper to ſpread a report, that the Danes were to enter Dalecarlia in order to eſtabliſh new taxes by force of arms; and as the annual feaſt of all the neighbouring villages was in a few days to be held, he could not have a more favourable opportunity: at the ſame time he promiſed to engage the principal perſons of the dioceſe in his intereſt.

24 His cauſe eſpouſed by the peaſants of Dalecarlia.

Agreeable to this advice Guſtavus ſet out for Mora, where the feaſt was to be held. He found the peaſants already informed of his deſigns, and impatient to ſee him. Being already prepoſſeſſed in his favour, they were ſoon excited to an enthuſiaſm in his cauſe, and inſtantly reſolved to throw off the Daniſh yoke. In this deſign they were more confirmed by their ſuperſtition; ſome of their old men having obſerved that the wind had blown from the north while Guſtavus was ſpeaking, which among them was reckoned an infallible omen of ſucceſs. Guſtavus did not give their ardour time to cool, but inſtantly led them againſt the governor's caſtle; which he took by aſſault, and put the garriſon to the ſword. This inconſiderable enterpriſe was attended with the moſt happy conſequences. Great numbers of the peaſants flocked to his ſtandard; ſome of the gentry openly eſpouſed his cauſe, and others ſupplied him with money. Christian was ſoon acquainted with what had paſſed; but deſpiſing ſuch an inconſiderable enemy, he ſent only a ſlender detachment under the command of one Soren Norby, to aſſiſt his adherents in Dalecarlia.

25 The Danes defeated.

Guſtavus advanced with 5000 men, and defeated a body of Danes commanded by one Meleen; but he was ſtrenuouſly oppoſed by the archbiſhop of Upſal, who raiſed numerous forces for king Chriſtian. The fortune of Guſtavus, however, ſtill prevailed, and the archbiſhop was defeated with great loſs. Guſtavus then laid ſiege to Stockholm; but his force being too inconſiderable for ſuch an undertaking he was forced to abandon it with loſs.

26 Horrid cruelty of King Chriſtian.

27 Succeſs of Guſtavus.

This check did not prove in any conſiderable degree detrimental to the affairs of Guſtavus; the peaſants from all parts of the kingdom flocked to his camp, and he was joined by a reinforcement from Lubec. Chriſtian, unable to ſuppreſs the revolt, wreaked his vengence on the mother and ſiſters of Guſtavus, whom he put to death with the moſt excruciating torments. Several other Swediſh ladies he cauſed to be thrown into the ſea, after having impoſed on them the inhuman taſk of making the ſacks into which they were to be incloſed. His barbarities ſerved only to make his enemies more reſolute. Guſtavus having aſſembled the ſtates at Wadſtena, he was unanimouſly choſen regent, the diet taking an oath of fidelity to him, and promiſing to aſſiſt him to the utmoſt. Having thus obtained the ſanction of legal authority, he purſued his advantages againſt the Danes. A body of troops appointed to throw ſuccours into Stockholm were totally cut in pieces; and the regent ſending ſome troops into Finland, ſtruck the Danes there with ſuch terror, that the archbiſhop of Upſal, together with Slahog and Baldenacker the Daniſh governors, fled to Denmark. Chriſtian received them but very coldly, apprehending that their flight might be prejudical to his affairs; and in a ſhort time the two governors were put to death, that the king might have an opportunity of charging them with being guilty of the cruelties which they had committed by his order. He then ſent expreſs orders to all his governors and officers in Finland and Sweden to maſſacre the Swediſh gentry without diſtinction. The Swedes made repriſals by maſſacring all the Danes they could find; ſo that the whole country was filled with bloodſhed and ſlaughter.

In the mean time Guſtavus had laid ſiege to the towns of Calmar, Abo, and Stockholm; but Norby found means to oblige him to raiſe all of them with great loſs. Guſtavus, in revenge, laid ſiege to the capital a third time, and petitioned the regency of Lubec for a ſquadron of ſhips and other ſuccours for carrying on the ſiege. This was complied with, but on very hard conditions, viz. that Guſtavus ſhould oblige himſelf, in the name of the ſtates, to pay 60,000 merks of ſilver as the expence of the armament; that, until the kingdom ſhould be in a condition to pay that ſum, the Lubec merchants trading to Sweden ſhould be exempted from all duties on imports or exports; that all other nations ſhould be prohibted from trading with Sweden, and that ſuch traffic ſhould be deemed illicit; that Guſtavus ſhould neither conclude a peace, nor even agree to a truce, with Denmark, without the concurrence of the regency of Lubec; and that in caſe the republic ſhould be attacked by Chriſtian, he ſhould enter Denmark at the head of 20,000 men Upon theſe hard terms did Guſtavus obtain aſſiſtance from the regency of Lubec; nor did his dear-bought allies prove very faithful. They did not indeed go over to the enemy; but in a ſea-fight, where the Danes were entirely in the power of their enemies, they ſuffered them to eſcape, when their whole force might have been entirely deſtroyed. This treachery had well nigh ruined the affairs of Guſtavus; for Norby was now making preparations effectually to relieve Stockholm; in which he would probably have ſucceeded: but at this critical period news arrived that the Danes had unanimouſly revolted, and driven Chriſtian from the throne; and that the king had retired into Germany, in hopes of being reſtored by the arms of his brother-in-law the emperor. On hearing this news, Norby retired with his whole fleet to the iſland of Gothland, leaving but a ſlender garriſon in Calmar. Guſtavus did not fail to improve this opportunity to his own advantage, and quickly made himſelf maſter of Calmar. Mean time Stockholm continued cloſely inveſted; but Guſtavus thought proper to protract the ſiege until he ſhould get himſelf elected king.

28 He is choſen king of Sweden.

Having for this purpoſe called a general diet, the firſt ſtep was to fill up the vacancy in the ſenate occaſioned by the maſſacres of Chriſtian. Guſtavus had the addreſs to get ſuch nominated as were in his intereſt; and of conſequence the aſſembly was no ſooner met, than a ſpeech was made, containing the higheſt encomiums on Guſtavus, ſetting forth in the ſtrongeſt light the many eminent ſervices he had done for his country, and concluding that the ſtates would ſhow themſelves equally ungrateful and blind to their own intereſt if they did not immediately elect him king. This propoſal was acceded to by ſuch tumultuous acclamations that it was impoſſible to collect the votes; ſo that Guſtavus himſelf acknowledged, that their affection exceeded his merit, and was more agreeable to him than the effects of their gratitude. He was urged to have the ceremony of his coronation immediately performed: but the king having ſome deſigns on the clergy, did not think proper to comply with their requeſt, as he would have been obliged to take an oath to preſerve them

29 Diſpleaſes the clergy, and favours the reformed doctrines.

in their rights and privileges.—Indeed he had not been long ſeated on the throne before he incurred the diſpleaſure of that body; for having large arrears due to the army, with ſeveral other incumbrances, Guſtavus found it neceſſary to raiſe large contributions on the clergy. On this he was accuſed of avarice and hereſy before the pope's nuncio. Guſtavus took the proper methods for defending himſelf againſt theſe accuſations; and in a ſhort time after ſhowed a great partiality for the doctrines of Luther, which by this time had been preached and received by many people in Sweden. This embroiled him more than ever with the eccleſiaſtics; and it ſoon appeared, that either Guſtavus muſt reſign his throne, or the clergy ſome part of the power they had aſſumed. Matters were driven to extremities by the king's allowing the Scriptures to be tranſlated into the Swediſh language. In 1526, the king, finding them entering into a combination againſt the reformiſts, went to Upſal, and publicly declared his reſolution of reducing the number of oppreſſive and idle monks and prieſts, who, under pretence of religion, fattened on the ſpoils of the induſtrious people.

30 Renounces the Popiſh religion and eſtabliſhes Proteſtantiſm.

At laſt, taking advantage of the war between the pope and Charles V. of Spain, he declared himſelf to be of the reformed religion, and eſtabliſhed it throughout his dominions; and at the ſame time, to humble the arrogance of the eccleſiaſtics, he gave the ſenators the precedency of them, and in many other reſpects degraded them from the dignities they formerly enjoyed. For ſome time the ſtates heſitated at ſupporting the king in his work of reformation; inſomuch, that at laſt he threatened to reſign the kingdom, which, he ſaid, was doomed to perpetual ſlavery either to its temporal or ſpiritual tyrants. On this the ſtates came into his meaſures, and retrenched the privileges of the eccleſiaſtics in the manner he propoſed.

31 Diſturbances in conſequence of this.

Several diſturbances, however, enſued. An impoſtor, who pretended to be of the family of Sture the former regent, having claimed the throne, the Dalecarlians revolted in his favour; but on the approach of a powerful army ſent by Guſtavus, they ſubmitted to his terms. Soon after, Lutheran profeſſors were eſtabliſhed in every dioceſe; upon which a new rebellion enſued. At the head of this was Thure Johanſon, who had married the king's ſiſter. Several of the nobility joined him; and the king of Denmark alſo acceeded to their cauſe, thinking, by means of theſe diſturbances, to reunite the three kingdoms of Sweden, Denmark, and Norway, as they had formerly been. But Guſtavus prevailed, and the rebels were obliged to take refuge in Denmark. A freſh accident, however, had like to have embroiled matters worſe than before. The ſubſidy granted to the regency of Lubec was ſtill due; and for the payment of it the ſtates granted to the king all the uſeleſs bells of the churches and monaſteries. The people were ſhocked at the ſacrilege; and the Dalecarlians again betook themſelves to arms. Intimidated, however, by the courage and vigorous conduct of the king, they again ſubmitted, and were taken into favour.

32 Unſucceſsful attempt of Chriſtian

But tranquillity was not yet reſtored. Chriſtian having eſtabliſhed a powerful intereſt in Norway, once more made an attempt to recover his kingdoms, and was joined by the Dalecarlians; but being defeated by the Swediſh forces, he was forced to return to Norway, where, being obliged to capitulate with the Daniſh generals, he was kept priſoner all his life.

33 The crown becomes hereditary.

In 1542, Guſtavus having happily extricated himſelf out of all his troubles, prevailed on the ſtates to make the crown hereditary in his family; after which he applied himſelf to the encouragement of learning and commerce.

34 Unſucceſsful negotiation for a marriage with Queen Elizabeth.

A treaty was ſet on foot for a marriage between his eldeſt ſon Eric and Elizabeth queen of England. The prince's brother, duke John, went over to England, and reſided for ſome time at the court of London with great ſplendour. He returned, full of expectations of ſucceſs; but bringing with him no ſort of proofs in writing, his father ſoon perceived that he had been the dupe of Elizabeth's ſuperior policy. However, at laſt he allowed Prince Eric to go in perſon to England; but before he could embark, the death of Guſtavus made him lay aſide all thoughts of the voyage and marriage.

35 Guſtavus dies, and is ſucceeded by Eric a weak and imprudent prince.

Guſtavus Vaſa died in 1560, and was ſucceeded by his ſon Eric XIV. The new king was a man poſſeſſed of all the exterior ornaments which give an air of dignity to the perſon; but he had neither the prudence nor the penetration of his father. He created the firſt nobility that were ever known in Sweden; which he had no ſooner done than he quarrelled with them, by paſſing ſome acts which they thought derogatory to their honour and dignity. The whole courſe of his reign was diſturbed by wars with Denmark, and diſputes with his own ſubjects. In the former he was unfortunate, and towards the latter he behaved with the greateſt cruelty.

36 Eric depoſed, and ſucceeded by his brother John.

At laſt, by the torments of his own conſcience, it is ſaid, he run mad. He afterwards recovered his ſenſes, but was thereupon dethroned by his brothers; of whom Duke John, who had been hitherto kept priſoner by Eric, ſucceeded him in the kingdom.

This revolution took place in the year 1568, but with no great advantage to Sweden. Diſputes about religion between the king and his brothers, and wars with Muſcovy, threw matters into the utmoſt confuſion.

37 Prince Sigiſmund choſen king of Poland.

At laſt prince Sigiſmund, the king's ſon, was choſen king of Poland which proved the ſource of much trouble to the kingdom. He was elected on the following conditions, viz. That there ſhould be a perpetual peace between the ſtates of Poland and Sweden; that, on the death of his father, prince Sigiſmund ſhould ſucceed to the throne of Sweden; that, on urgent occaſions, he might, with the conſent of the ſtates, return to Sweden; that he ſhould maintain, at his own expence, a fleet for the ſervice of Poland; that he ſhould cancel a debt which had been long due from the crown of Poland to Sweden; that, with the conſent of the ſtates, he ſhould build five fortreſſes on the frontiers of Poland; that he ſhould have liberty to introduce foreign ſoldiers into the kingdom, provided he maintained them at his own expence; that he ſhould not make uſe of Swediſh counſellors in Poland; that he ſhould have his body-guard entirely of Poles and Lithuanians; and that he ſhould annex to Poland that part of Livonia now ſubject to Sweden.

38 Succeeds to the crown of Sweden.

In 1590 king John died; and as Sigiſmund was at a diſtance, every thing fell into the utmoſt confuſion: the treaſury was plundered, and the wardrobe quite ſpoiled, before even duke Charles could come to Stockholm to take the adminiſtration into his hands until king Sigiſmund ſhould return. This, however, was far from being the greateſt diſaſter which befel the nation at this time. It was known that the king had embraced the Popiſh religion, and it was with good reaſon ſuſpected that he would attempt to reſtore it upon his arrival in Sweden. Sigiſmund alſo was obliged, on leaving Poland, to promiſe that he would ſtay no longer in Sweden than was neceſſary to regulate his affairs. Theſe circumſtances ſerved to alienate the minds of the Swedes from their ſovereign even before they ſaw him; and the univerſal diſſatisfaction was increaſed, by ſeeing him attended, on his arrival in Sweden in 1593, by Malaſpina the pope's nuncio, to whom he made a preſent of 30,000 ducats to defray the expences of his journey to Sweden.

What the people had foreſeen was too well verified: the king refuſed to confirm the Proteſtants in their religious privileges, and ſhowed ſuch partiality on all occaſions to the Papiſts, that a party was formed againſt him; at the head

39 A party formed againſt him.

of which was duke Charles his uncle. Remonſtrances, accompanied with threats, took place on both ſides; and at an interview between the king and Charles, the diſpute would have ended in blows, had they not been parted by ſome of the nobility. This, however, made ſuch an impreſſion upon Sigiſmund, that he was apparently reconciled to his brother, and promiſed to comply with the inclinations of the people in every reſpect, though without any inclination to perform what he had promiſed. The agreement, indeed, was ſcarce made, before Sigiſmund conceived the horrid deſign of murdering his uncle at the Italian comedy acted the night after his coronation. The duke, however, having notice of the plot, found means to avoid it. This enraged the king ſo much, that he reſolved to accompliſh his deſigns by force; and therefore commanded a Poliſh army to march towards the frontiers of Sweden, where they committed all the ravages that could be expected from an enraged and cruel enemy. Complaints were made by the Proteſtant clergy to the ſenate: but no other reply was made them, than that they ſhould abſtain from theſe bitter invectives and reproaches, which had provoked the Catholics, until the king's departure; at which time they would be at more liberty.

40 Forms a deſign of murdering his uncle.

In 1595 Sigiſmund ſet ſail for Dantzic, leaving the adminiſtration in the hands of duke Charles. The conſequence of this was, that the diſſenſions which had already taken place being continually increaſed by the obſtinacy of the king, duke Charles aſſumed the ſovereign power; and in 1604 Sigiſmund was formally depoſed, and his uncle Charles IX. raiſed to the throne. He proved a wiſe and brave prince, reſtoring the tranquillity of the kingdom, and carrying on a war with vigour againſt Poland and Denmark. He died in 1611, leaving the kingdom to his ſon, the celebrated Guſtavus Adolphus.

41 Sigiſmund depoſed, and is ſucceeded by Charles IX.

Though Charles IX. by his wiſe and vigorous conduct had in a great meaſure retrieved the affairs of Sweden, they were ſtill in a very diſagreeable ſituation. The finances of the kingdom were entirely drained by a ſeries of wars and revolutions; powerful armies were preparing in Denmark, Poland, and Ruſſia, while the Swediſh troops were not only inferior in number to their enemies but the government was deſtitute of reſources for their payment.

42 State of Sweden on the acceſſion of Guſtavus Adolphus.

Though the Swediſh law required that the prince ſhould have attained his 18th year before he was of age, yet ſuch ſtriking marks of the great qualities of Guſtavus appeared, that he was allowed by the ſtates to take upon him the adminiſtration even before this early period. His firſt act was to reſume all the crown-grants, that he might be the better able to carry on the wars in which he was unavoidably engaged; and to fill all places, both civil and military, with perſons of merit. At the head of domeſtic and foreign affairs was placed chancellor Oxenſtiern, a perſon every way equal to the important truſt, and the chooſing of whom impreſſed mankind with the higheſt opinion of the young monarch's penetration and capacity.

43 He is allowed to aſſume the adminiſtration while yet a minor.

44 He invades Denmark, and obliges the king to conclude a peace.

Soon after his acceſſion, Guſtavus received an embaſſy from James I. of Britain, exhorting him to make peace with his neighbours. This was ſeconded by another from Holland. But as the king perceived that the Daniſh monarch intended to take every opportunity of cruſhing him, he reſolved to act with ſuch vigour, as might convince him that he was not eaſily to be overcome. Accordingly he broke into Denmark with three different armies at once; and though the enemy's ſuperiority at ſea gave them great advantages, and the number of the king's enemies diſtracted his attention, he carried on the war with ſuch ſpirit, that in 1613 a peace was concluded upon good terms. This war being finiſhed, the king applied himſelf to civil polity, and made ſome reformations in the laws of Sweden. In 1615, hoſtilities were commenced againſt Ruſſia, on account of the refuſal of that court to reſtore ſome money which had been formerly lent them. The king entered Ingria, took Kexholm by ſtorm, and was laying ſiege to Pleſcow, when, by the mediation of James I. peace was concluded, on condition of the Ruſſians repaying the money, and yielding to Sweden ſome part of their territory. In this and the former war, notwithſtanding the ſhortneſs of their duration, Guſtavus learned the rudiments of the military art for which he ſoon became ſo famous. He is ſaid, indeed, to have catched every opportunity of improvement with a quickneſs of underſtanding ſeemingly more than human. In one campaign, he not only learned, but improved, all the military maxims of La Gardie, a celebrated general, brought the Swediſh army in general to a more ſteady and regular diſcipline than had formerly been exerciſed, and formed and ſeaſoned an invincible body of Finlanders, who had afterwards a very conſiderable ſhare in the victories of the Swedes.

45 Ruſſia invaded with ſucceſs.

46 Extraordinary military genius of the king.

Peace was no ſooner concluded with Ruſſia, than Guſtavus was crowned with great ſolemnity at Upſal. Soon after this, Guſtavus ordered his general La Gardie to acquaint the Poliſh commander Codekowitz, that as the truce between the two kingdoms, which had been concluded for two years, was now expired, he deſired to be certainly informed whether he was to expect peace or war from his maſter. In the mean time, having borrowed money of the Dutch for the redemption of a town from Denmark, he had an interview on the frontiers with Chriſtian the king of that country. At this interview, the two monarchs conceived the utmoſt eſteem and friendſhip for each other; and Guſtavus obtained a promiſe, that Chriſtian would not aſſiſt Sigiſmund in any deſigns he might have againſt Sweden. In the mean time, receiving no ſatiſfactory anſwer from Poland, Guſtavus began to prepare for war. Sigiſmund entered into a negotiation, and made ſome pretended conceſſions, with a view to ſeize Guſtavus by treachery; but the latter having intimation of his deſign, the whole negotiation was changed into reproaches and threats on the part of Guſtavus.

47 Has a friendly interview with the king of Denmark, and prepares for war with Poland.

Immediately after this, Guſtavus made a tour in diſguiſe through Germany, and married Eleonora the daughter of the elector of Brandenburg. He then reſolved to enter heartily into a war with Poland; and with this view ſet ſail for Riga with a great fleet, which carried 20,000 men. The place was well fortified, and defended by a body of veterans enthuſiaſtically attached to Sigiſmund. A dreadful bombardment enſued; the ſtreets were raked by the cannon, and the houſes laid in aſhes by the bombs; the moat was filled up, one of the half-moons taken by ſtorm, and the ſtrong fortreſs of Dunamund was reduced. The cannon having now effected a breach in another part of the walls, Guſtavus reſolved to make a general aſſault. For this purpoſe a flying bridge over the moat was contrived by his majeſty; for though the ditch was filled with faſcines and rubbiſh, it ſtill contained too much water to admit the paſſage of a large body of men. The ſoldiers, however, crowded on to the attack with ſo much impetuoſity, that the bridge gave way, and the attempt proved unſucceſsful. Next day the Swedes were repulſed in attempting to ſtorm another half-moon; and the king was obliged to proceed more ſlowly. By the middle of September, at which time the town had been inveſted for ſix weeks, two bridges were thrown over the river together with a ſtrong boom, while the Swedes had formed their mines under the ditch. The garriſon being now reduced to extremity, were obliged to capitulate;

48 Marries Eleonora daughter of the elector of Brandenburg.

49 Riga beſieged and taken.

capitulate; and Guſtavus treated the inhabitants with great clemency.

After the reduction of Riga, the Swediſh monarch entered Courland, where he reduced Mittau; but ceded it again on the concluſion of a truce for one year. Sigiſmund, however, no ſooner had time to recover himſelf, than he began to form new enterpriſes againſt the Swedes in Pruſſia; but Guſtavus ſetting ſail with his whole fleet for Dantzic, where the king of Poland then reſided, ſo broke his meaſures, that he was obliged to prolong the truce for another year. Sigiſmund, however, was not yet appriſed of the danger he was in, and refuſed to liſten to any terms of accommodation: upon which Guſtavus entering Livonia, defeated the Poliſh general, and took Derpt, Hockenhauſen, and ſeveral other places of leſs importance; after which, entering Lithuania, he took the city of Birſen.

50
The Poles defeated and ſeveral places taken.

Notwithſtanding this ſucceſs, Guſtavus propoſed peace on the ſame equitable terms as before; but Sigiſmund was ſtill infatuated with the hopes that, by means of the emperor of Germany, he ſhould be able to conquer Sweden. Guſtavus finding him inflexible, reſolved to puſh his good fortune. His generals Horn and Thurn defeated the Poles in Semigallia. Guſtavus himſelf with 150 ſhips ſet ſail for Pruſſia, where he landed at Pillaw. This place was immediately delivered up to him; as were alſo Braunſberck, Frawenberg, Elbing, Marienberg, Mew, and Dirſchau, Stum, Chriſtburg, &c. Sigiſmund, alarmed at the great ſucceſſes of Guſtavus, ſent a body of forces to oppoſe him, and to prevent Dantzic from falling into his hands. In this he was attended with as bad ſucceſs as before. His troops were defeated before Marienberg, Mew, and Dirſchau; and in May 1627, Guſtavus arrived with freſh forces before Dantzic, which he would probably have carried, had he not been wounded in the belly by a cannon-ſhot. The Poles in the mean time recovered Mew; and the States of Holland ſent ambaſſadors to mediate a peace between the two crowns. Sigiſmund, however, depending upon the aſſiſtance of the emperor of Germany and king of Spain, determined to hearken to no terms, and reſolved to make a winter-campaign; but Guſtavus was ſo well intrenched, and all his forts were ſo ſtrongly garriſoned, that the utmoſt efforts of the Poles were to no purpoſe (A). The city of Dantzic in the mean time made ſuch a deſperate reſiſtance as greatly irritated Guſtavus. In a ſea-engagement the Swediſh fleet defeated that of the enemy; after which Guſtavus, having blocked up the harbour with his fleet, puſhed his advances on the land-ſide with incredible vigour. He made a ſurpriſing march over a moraſs 15 miles broad, aſſiſted by bridges of a peculiar conſtruction, over which he carried a ſpecies of light cannon invented by himſelf. By this unexpected manœuvre he got the command of the city in ſuch a manner, that the garriſon were on the point of ſurrendering, when, by a ſudden ſwell of the Viſtula, the Swediſh works were ruined, and the king was obliged to raiſe the ſiege. In other reſpects, however, the affairs of Guſtavus went on with their uſual good fortune. His general Wrangel defeated the Poles before Brodnitz, of whom 3000 were killed, and 1000 taken priſoners, with five pieces of cannon and 2000 waggons loaded with proviſions. At Stum the king gained another and more conſiderable victory in perſon. The emperor had ſent 5000 foot and 2000 horſe under Arnheim, who joined the main army commanded by the Poliſh general Conieċſpolſki, in order to attack the Swediſh army encamped at Quidzin. The enemy were ſo much ſuperior in number, that the friends of Guſtavus repreſented to him the imminent danger of attacking them. But the king being determined, the engagement began. The Swediſh cavalry charged with ſuch impetuoſity, contrary to their ſovereign's expreſs order, that they were almoſt ſurrounded by the enemy; but Guſtavus, coming up to their aſſiſtance, puſhed the enemy's infantry with ſo much vigour, that they gave way, and retreated to a bridge they had thrown over the Werder. But here they were diſappointed; for the Swedes had already taken poſſeſſion of the bridge. On this a new action enſued more bloody than the former, in which the king was expoſed to great danger, and thrice narrowly eſcaped being taken priſoner; but at laſt the Poles were totally defeated, with the loſs of a great many men, 22 pair of colours, five ſtands, and ſeveral other military trophies. The ſlaughter of the German auxiliaries was ſo great, that Arnheim ſcarce carried off one half of the troops he brought into the field. This defeat did not hinder the Poliſh general from attempting the ſiege of Stum; but here again he was attended by his uſual bad fortune. The garriſon ſallied out, and he was defeated with the loſs of 4000 men. The blame of this misfortune was laid upon Arnheim; who was recalled, and ſucceeded by Henry of Saxe Lawenburg and Philip count Mansfeldt. The change of general officers, however, produced no good conſequences to the Poles; a famine and plague raged in their camp, ſo that they were at laſt obliged to conſent to a truce for ſix years, to expire in the month of June 1635. The conditions were, that Guſtavus ſhould reſtore to Sigiſmund the towns of Brodnitz, Stum, and Dirſchau; that Marienberg ſhould remain ſequeſtrated in the hands of the elector of Brandenburg, to be reſtored again to Sweden in caſe a peace was not concluded at the end of the ſix years. Guſtavus, on his ſide, kept the port and citadel of Memel, the harbour of Pillaw, the town of Elbing, Brunſberg, and all that he had conquered in Livonia.

51
The Poles again defeated, and a great number of towns reduced by Guſtavus.

52
The Poles defeated a third time.

53
The Poles defeated by ſea, and Dantzic inveſted.

54
The king obliged by an inundation of the Viſtula to raiſe the ſiege.

55
The Poles and Germans defeated with great ſlaughter in two engagements.

56
They are again defeated, and obliged to conſent to a truce of ſix years.

Guſtavus having thus brought the war with Poland to an honourable concluſion, began to think of reſenting the conduct of the emperor in aſſiſting his enemies and oppreſſing the Proteſtant ſtates. Before embarking in ſuch an important undertaking, it was neceſſary that he ſhould conſult the diet. In this the propriety of engaging in a war with Germany was warmly debated; but, after much altercation, Guſtavus in a very noble ſpeech determined the matter, and ſet forth in ſuch ſtrong terms the virtuous motives by which he was actuated, that the whole aſſembly wept, and every thing was granted which he could require.

57
Guſtavus reſolves on a war with the emperor.

It was not difficult for Guſtavus to begin his expedition. His troops amounted to 60,000 men, hardened by a ſucceſſion of ſevere campaigns in Ruſſia, Finland, Livonia, and Pruſſia. His fleet exceeded 70 ſail, carrying from 20 to 40 guns, and manned with 6000 mariners. Embarking his

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(A) In this campaign the practice of duelling became ſo prevalent in the Swediſh army, as to engage the king's attention, and to oblige him to ſuppreſs it by very rigorous edicts. Soon after theſe were paſſed, a quarrel aroſe between two general officers, who aſked his majeſty's permiſſion to decide their difference by the laws of honour. The king conſented, but wiſhed to be a ſpectator of their courage. He went to the place appointed, attended by a body of guards; and having ordered the executioner to be called, "Now gentlemen, ſaid he to the officers, fight until one dies;" adding to the executioner, "Do you immediately cut off the head of the other." On this the quarrel was dropped, and no more challenges were heard of in the camp.

58 Reduces Wolgaſt, Stetin, &c.

his troops, he landed at Uſedom on the 24th of June 1630, the Imperialiſts having evacuated all the fortreſſes they poſſeſſed there; and the iſle of Rugen had been before reduced by general Leſly, in order to ſecure a retreat if fortune ſhould prove unfavourable. Paſſing the frith, Guſtavus ſtormed Wolgaſt and another ſtrong fortreſs in the neighbourhood, leaving general Bannier with a garriſon for the defence of theſe conqueſts. He then proceeded to Stetin; which was no ſooner inveſted than it conſented to receive a Swediſh garriſon, and the king perſuaded the duke of Pomerania to enter into an alliance with him. In conſequence of this the Swediſh troops were received into ſeveral towns of Pomerania; and the moſt bitter enmity took place between the Imperialiſts and Pomeranians, each refuſing the other quarter.

59 Count Tilly choſen general by the emperor.

60 Cuts off 2000 Swedes.

61 Franckfort and Landſberg taken by Guſtavus.

Theſe ſucceſſes of Guſtavus ſtruck the empire with conſternation; for being already overwhelmed with civil diſſenſions, they were in no condition to reſiſt ſo impetuous an enemy. At this time alſo the Imperialiſts were without a general, the command of the army being diſputed by a number of canditates of very unequal merit; but at laſt count Tilly was fixed upon as the moſt proper perſon, and inveſted with the dignity of Veldt Mariſchal. In the mean time the king being reinforced by a conſiderable body of troops in Finland and Livonia under the conduct of Guſtavus Horn, defeated the Imperialiſts before Griffenhagen; taking the place ſoon after by aſſault. By this and ſome other conqueſts he opened a paſſage into Luſatia and Sileſia; but in the mean time count Tilly cut off 2000 Swedes at New Brandenburg, owing to the obſtinacy of their commander Kniphauſen, who had orders to evacuate the place and join the main army. This advantage, however, was ſoon overbalanced by the conqueſt of Franckfort on the Oder, which Guſtavus took, by aſſault, making the whole garriſon priſoners. Thus he commanded the rivers Elbe and Oder on both ſides, and had a fair paſſage not only to the countries already mentioned, but alſo to Saxony and the hereditary dominions of the houſe of Auſtria. Soon after this, Guſtavus laid ſiege to Landſberg, which he took by aſſault; though the number of ſoldiers he had with him was ſo inconſiderable, that he had thoughts of ſending to the main army for a reinforcement before the priſoners ſhould march out, being apprehenſive that they might give him battle in the open field, though they could not defend themſelves behind walls.

62 He reduces Pomerania, and reſtores the dukes of Mecklenburg.

About this time the Proteſtant princes held a diet at Leipſic; to which Guſtavus ſent deputies, and conducted his negotiations with ſuch addreſs, as tended greatly to promote his intereſts. Immediately after this he reduced Gripſwald, and with it all Pomerania. Then marching to Guſtrow, he reſtored the dukes of Mecklenburg to their dominions. Here the Imperialiſts had tyrannized in ſuch a manner that Guſtavus was received as the deliverer of the people; and the ceremony of the duke's inauguration was in a ſhort time performed with great ſolemnity.

63 Magdeburg taken by the Imperialiſts, and the inhabitants cruelly uſed.

64 Havelſburg and Werben reduced, and the cavalry of the Imperialiſts defeated by the Swedes.

65 Count Tilly defeated by Guſtavus.

All this time count Tilly was employed in the ſiege of Magdeburg; but now, being alarmed at the repeated ſucceſſes of the Swedes, he left Pappenheim with part of the army before that city, while he marched with the reſt into Thuringia, to attack the landgrave of Heſſe-Caſſel and the elector of Saxony. After a moſt obſtinate defence, Magdeburg fell into the hands of Pappenheim, where he committed all imaginable cruelties. Guſtavus formed a plan of recovering the city; but was obliged to abandon it, by Pappenheim's throwing himſelf into the place with his whole army, and by the progreſs which Tilly was making in Thuringia. Relinquiſhing this enterpriſe, therefore, he ordered Bannier to attack Havelſburg; which was done with ſuch reſolution, that the place was forced in a few hours, and all the garriſon made priſoners. Werben was next obliged to ſubmit after an obſtinate conflict, in which many fell on both ſides.—Theſe ſucceſſes obliged count Tilly to attempt in perſon to check the progreſs of the Swedes. He detached the vanguard of his army, compoſed of the flower of the Imperial cavalry, within a few miles of the Swediſh camp. An action enſued, in which Bernſtein the Imperial general was defeated and killed, with 1500 of his men. Guſtavus after this advantage, placed himſelf in a ſituation ſo much ſuperior to his enemies, that count Tilly was fired with indignation, and marched up to the Swediſh lines to give him battle. Guſtavus kept within his works, and Tilly attacked his camp, though almoſt impregnably fortified, keeping up a moſt terrible fire from a battery of 32 pieces of cannon; which, however, produced no other effect, than obliging the Swediſh monarch to draw up his army behind the walls of Werben. Tilly had placed his chief hopes in being able to nail up the enemy's cannon, or ſet fire to their camp in divers quarters; after which he propoſed making his grand attack. With this view he bribed ſome priſoners; but they betrayed him, and told his deſign to Guſtavus. The king ordered fires to be lighted in different parts of his camp, and his ſoldiers to imitate the noiſe of a tumultous diſorderly rabble. This had the deſired effect. The count led his army to the breach made by the cannon; where he was received with ſuch a volley of grape ſhot as cut off the firſt line, and put the whole body into diſorder, ſo that they could never be brought back to the charge. In this confuſion the Imperial army was attacked by Bauditzen, and, after an obſtinate conflict, obliged to quit the field.

66 A body of Britiſh ſoldiers comes to the aſſiſtance of the Swedes.

Soon after this action the queen arrived at the camp with a reinforcement of 8000 men; at the ſame time a treaty was concluded with Charles I. of England, by which that monarch allowed the marquis of Hamilton to raiſe 6000 men for the ſervice of Guſtavus. Theſe auxiliaries were to be conducted to the main army by a body of 4000 Swedes; and were in every thing to obey the king while he was perſonally preſent, but in his abſence were to be ſubject to the orders of the marquis. With theſe troops the king had reſolved to make a diverſion in Bremen: but the marquis finding it impoſſible for him to effect a junction with the Swediſh army, reſolved, without debarking his troops, to ſteer his courſe for the Oder, and land at Uſedom. Guſtavus was very much diſpleaſed at finding his project thus diſconcerted; however, making the beſt of the preſent circumſtances, he commanded the Britiſh troops to act on the Oder inſtead of the Weſer. The number of this little army was magnified exceedingly by report, inſomuch, that count Tilly had ſome thoughts of marching againſt them with his whole force; but on the departure of the marquis for Sileſia, he reinforced the army in that country with a large detachment, which was thought to contribute not a little to the defeat he ſoon after received.

Ever ſince the late action Guſtavus had kept within his intrenchments, where his army was well provided with every thing. Tilly made ſeveral attempts to ſurpriſe or draw him to an engagement; but finding all his endeavours fruitleſs, he marched into Saxony, and laid ſiege to Leipſic. This precipitate meaſure proved highly advantageous to the Swediſh monarch; as thus the elector, who had been wavering in his reſolutions, was now obliged to have recourſe to the Swedes, in order to preſerve himſelf from utter deſtruction. A treaty offenſive and defenſive was immediately concluded with Guſtavus: and the elector willingly promiſed every thing that was required of him; and among the reſt, that not only the prince his ſon, but he himſelf, ſhould reſide in the Swediſh camp, and engage his life and fortune in the common cauſe.

67 Saxony ravaged by count Tilly who takes Leipſic.

Tilly, in the mean time, carried fire and ſword into the unhappy electorate. At the head of an army of 44,000 veterans, he ſummoned the city of Leipſic to ſurrender; denouncing the ſame vengeance againſt it as had been executed on Magdeburg, in caſe of a refuſal. By this the governor was ſo much intimidated, that he inſtantly ſubmitted; and alſo ſurrendered the caſtle of Paſſenberg, which was in a condition to have ſtood out till the arrival of the Swediſh army. The elector, enraged at the loſs of theſe valuable places, ordered his army to join the Swedes with all expedition, and preſſed the king ſo warmly to engage, that at laſt he yielded to his deſire.

68 Battle of Leipſic.

On the 7th of September 1631, Guſtavus led out his army in the moſt beautiful order, the Swedes forming one column on the right, and the Saxons another on the left; each amounting to 15,000 men. Tilly drew up his men in one vaſt column, poſſibly with a view of ſurrounding the flanks of the king's army; but every officer of experience in his army, from the excellency of the Swediſh diſpoſition, prognoſticated the event of the engagement. Guſtavus led on the troops againſt that wing of the Imperialiſts commanded by Pappenheim, whom he drove back to ſuch a diſtance, that he gained a point of the wind; by which the ſmoke fell upon their enemies and conſiderably embarraſſed them, at the ſame time that the Swedes were got without the reach of a battery which played furiouſly on their flank. General Bannier in the mean time cut in pieces the troops of Holſtein, and mortally wounded the duke who commanded them. Pappenheim led on his troops ſeven times to the charge, in hopes of regaining his former ſituation; but was as often repulſed by the Swedes. Tilly all this while engaged with the Saxons; but having at laſt driven them off the field, the whole ſtrength of the Imperial army was turned upon the Swediſh left wing commanded by General Horn. The Swedes ſuſtained the attack with the greateſt firmneſs, until the king detached general Teuffel with the centre to aſſiſt them. The Imperialiſts then were no longer able to ſtand their ground; but gave way everywhere except in the centre, which was compoſed of 18 regiments of veterans accuſtomed to victory, and deemed invincible.

69 The Imperialiſts defeated with great ſlaughter.

They made incredible efforts to maintain the reputation they had acquired; and, though ſwept off in great numbers by the Swediſh artillery, never ſhrunk or fell into confuſion. Four regiments, after their officers had been killed, formed themſelves, and retired to the ſkirt of a wood; where they were all to a man cut in pieces, without demanding quarter. Tilly retired at the head of 600 men, and eſcaped by the coming on of the night. Seven thouſand Imperialiſts lay dead on the field of battle; 4000 were taken priſoners; a fine train of artillery was loſt, with upwards of 100 ſtandards, enſigns, and other military trophies.—On this occaſion it was that the Scots regiment in the Swediſh ſervice firſt practiſed the method of firing in platoons; to which ſome aſcribe the aſtoniſhment and confuſion that appeared in the Imperial army.

70 Conduct of Guſtavus cenſured.

It is thought, however, that the Swediſh monarch diſplayed greater abilities in gaining this victory than improving it afterwards; for had he marched immediately to Vienna, before his enemies had time to recover their conſternation, it is ſuppoſed that the emperor would have been obliged to abandon his capital, and leave his hereditary dominions to the mercy of the conqueror. But Guſtavus apprehended that Tilly might fall upon the Saxons while he was ravaging the Auſtrian hereditary dominions; which would have deprived him not only of an ally, but of the free quarters which the elector had promiſed to his troops in caſe of a retreat. For this and ſome other reaſons he determined to penetrate into Franconia, where he reduced ſeveral places, particularly the fortreſs of Workburg. Tilly having collected his ſcattered troops, which formed an army ſtill ſuperior in number to that of Guſtavus, marched to the relief of this place; but came too late. He then directed his march towards Rottenberg, where four regiments were cut in pieces by a Swediſh detachment. After this the king reduced Hanau, Franckfort on the Maine, and Mentz; deſtroying a body of Spaniards, who had thrown themſelves in his way to obſtruct his paſſage.

71 The Swedes take a number of towns and cut off four regiments of the enemy.

The court of Vienna was now thrown in the utmoſt confuſion; and ſent everywhere begging aſſiſtance, and ſoliciting the Catholic princes to arm in defence of their religion. The emperor was moſt embarraſſed in finding out a general capable of oppoſing Guſtavus in the field; for the late misfortunes of count Tilly had entirely ſunk his reputation.

72 Walleſtein choſen general by the emperor.

Walleſtein, an old experienced officer, was made choice of; but as he had formerly been diſgraced, it was apprehended that he would not accept of the command of which he had once been deprived. This objection, however, was got over; and Walleſtein not only accepted of the command, but, at his own expence, augmented the army to 40,000 men.

73 A great number of towns taken by the Swedes.

During the whole winter the Swediſh army kept the field; and before the approach of ſummer had reduced Crantznach, Bobenhauſen, Kirchberg, Magdeburg, Gozlar, Northeim, Gottingen, and Dunderſtadt; while the landgrave William made great progreſs in Weſtphalia. Guſtavus Horn was repulſed before Bamberg; but ſoon had his revenge, by entirely deſtroying two regiments of Imperialiſts. To prevent the troops from being affected by the loſs before Bamberg, the king reſolved to give battle to Tilly, who was marching into Bavaria to prevent the Swedes from gaining a footing in that electorate. He purſued the Imperial general through a vaſt tract of country, defeated his rear-guard, and having reduced a variety of towns and fortreſſes on the Danube, penetrated as far as Ulm.

74 Count Tilly defeated and killed.

Advancing to the river Leck, count Tilly poſted himſelf in a wood on the oppoſite ſide, to diſpute his paſſage. Guſtavus endeavoured to diſlodge him by a regular fire from 70 pieces of cannon. The ſlaughter was dreadful; and Tilly himſelf, being wounded by a cannon-ball in the knee, died a few days before he was to have been ſuperſeded by Walleſtein. The following night the Imperial army evacuated the poſt; part retiring to Ingoldſtadt, and others to Newburg. Guſtavus immediately croſſed the river, and ſeized the towns of Rain and Newburg, which the enemy had abandoned. Augſburg next ſubmitted; and from the inhabitants of this place Guſtavus exacted an oath of fidelity, not only to himſelf but to the crown of Sweden. This meaſure gave the greateſt offence to many of the Germanic body, and made them imagine that the king of Sweden had other views than the defence of the Proteſtant cauſe.

From Augſburg the Swedes advanced towards Ratiſbon; but were diſappointed in their deſign of getting poſſeſſion of that city, by reaſon of the Bavarians having thrown a very numerous garriſon into the place.—In the mean time, ambaſſadors arrived from Denmark, offering the mediation of that crown for obtaining a laſting peace between the contending parties. Guſtavus, however, replied, that no ſuch peace could take place till the Catholic princes thought proper to grant the Proteſtants full and ample ſecurity for their enjoyment of future tranquillity. But the ambaſſadors had no inſtructions to propoſe any thing farther, and thus the negotiation vaniſhed.

75 Three towns laid in aſhes by the Swedes.

Guſtavus now, reſolving to retort upon themſelves the cruelties which the Bavarians had inflicted on the Proteſtants, laid the towns of Morzbourg, Frieſengen, and Landſhut, in aſhes. The inhabitants of Munich ſaved themſelves by ſubmiſſion; but as the peaſants in that neighbourhood had collected themſelves into bodies in order to murder the ſtragglers from the Swediſh army, Guſtavus burnt their houſes, and defeated the forces of the elector, who had been joined by a conſiderable body of militia.

While Guſtavus was thus employed, Walleſtein had aſſembled a vaſt army. He was ſtrongly ſolicited by the elector of Bavaria to come to his aſſiſtance; but, in revenge of the elector's having formerly obtained the command for count Tilly in preference to himſelf, he drew off towards Bohemia to encounter the Saxons.

76
The Saxon troops defeated by Walleſtein.

Arnheim, who commanded the Saxon forces in that place, was the enemy of Guſtavus, who had formerly rallied him for his cowardice. He therefore permitted Walleſtein to gain an eaſy victory, in hopes that his maſter, the elector of Saxony, a prince entirely devoted to his pleaſures, might be induced to relinquiſh the friendſhip of ſuch a reſtleſs and warlike ally as Guſtavus; and indeed he uſed all the eloquence of which he was maſter to detach him from the Swediſh cauſe. Several advantages, in the mean time, were gained by the Imperialiſts. Pappenheim defeated the archbiſhop of Bremen's cavalry at Werden; and three Swediſh regiments were cut off near Kadingen. Pappenheim, however, was forced to retire, and withdraw his forces from Stade; of which the Swedes took poſſeſſion. Walleſtein and the elector of Bavaria, who had now joined their forces, threatened Guſtavus with greatly ſuperior numbers. At laſt, however, the king, being reinforced with 15,000 men, no longer declined the engagement; but Walleſtein was too wiſe to truſt the fate of the empire to a ſingle engagement againſt ſuch an enemy as the king of Sweden.

77
Guſtavus attacks his camp, and is repulſed with loſs.

Guſtavus attacked his camp, but was repulſed with the loſs of 2000 men; which cauſed a general murmuring and diſcontent againſt his raſhneſs. Several other misfortunes happened to the Swedes; and at laſt, after various manœuvres, Walleſtein bent his courſe towards Miſnia, in order to oblige the elector of Saxony to declare againſt the Swedes, and to draw them out of Bavaria. Guſtavus, notwithſtanding the inconſtancy of Auguſtus, immediately ſet out to aſſiſt him. With incredible diligence he marched to Miſnia, where the Imperialiſts were aſſembling their whole ſtrength. Hearing that the enemy were encamped at Weſenfells, and that Pappenheim had been detached with a ſtrong corps, Guſtavus reſolved to engage them before they could effect a junction.

78
Battle of Lutzen.

With this view he marched to Lutzen, where he attacked Walleſtein with incredible fury. The Swediſh infantry broke the Imperialiſts in ſpite of their utmoſt efforts, and took all their artillery. The cavalry not being able to paſs the river ſo expeditiouſly as the king thought neceſſary, he led the way, attended only by the regiment of Smaaland and the duke of Saxe-Lauwenburg. Here, after charging impetuouſly, he was killed, as Puffendorff alleges, by the treachery of the duke;

79
Guſtavus killed.

who, being corrupted by the emperor, ſhot him in the back during the heat of the action. The news of his death was in an inſtant ſpread over both armies. The courage of the Imperialiſts revived, and they now made themſelves ſure of victory. But the Swedes, eager to revenge the death of their beloved monarch, charged with ſuch fury that nothing could reſiſt them. The Imperialiſts were defeated a ſecond time, juſt as Pappenheim, with his freſh corps, came up to their aſſiſtance.

80
The Imperialiſts totally defeated.

On this the battle was renewed, but the Swedes were ſtill irreſiſtible. Pappenheim was mortally wounded, and his army finally routed, with the loſs of 9000 killed in the field and in the purſuit.

81
Chriſtina, an infant, proclaimed queen of Sweden.

The victory of Lutzen proved more unfortunate to Sweden than the greateſt defeat. The crown devolved upon Chriſtina, an infant of ſix years old; the nation was involved in an expenſive foreign war, without any perſon equal to the arduous taſk of commanding the armies, or regulating domeſtic affairs, as Guſtavus had done. However, Chriſtina the daughter of Guſtavus was immediately proclaimed queen. The regency devolved on the grand bailiff, the mariſchal, the high-admiral, the chancellor, and the treaſurer of the crown. Oxenſtiern was inveſted with the chief management of affairs, and conducted himſelf with the greateſt prudence. He was greatly embarraſſed indeed by the diviſions among the Proteſtant princes, which became more violent after the death of Guſtavus; but, in ſpite of all difficulties, he went on purſuing the intereſt of his country, and planning the means of retaining the Swediſh conqueſts.

82
The Swedes receive a great overthrow at Nordlingen.

Matters went on pretty ſucceſsfully till the year 1634, when, through the raſhneſs of the Swediſh ſoldiers, they were defeated at Nordlingen, with the loſs of 6000 men killed on the ſpot, a number of priſoners, and 130 ſtandards, with other military trophies, taken by the enemy. Oxenſtiern's conſtancy was ſhaken by this dreadful blow; but he applied himſelf diligently to repair the loſs, by recruiting the army, and rendering the allies faithful. The latter proved the moſt difficult taſk. The death of Guſtavus, and the defeat at Nordlingen, had thrown them into deſpair; and every one was deſirous of making the beſt terms he could with the emperor.

83
The Saxons declare againſt Sweden.

The Saxons not only renounced their alliance with Sweden, but openly commenced war againſt it; and though the regency would gladly have conſented to an honourable peace, the enemy were now too much fluſhed with ſucceſs to grant it. Oxenſtiern had no other reſource than an alliance with France, and the bravery of his generals. In 1635, he went in perſon to the court of Louis, and concluded a treaty; which, however, anſwered no purpoſe, as it was never obſerved.

84
Succeſſes of the Imperialiſts.

The enemy, in the mean time, puſhed their good fortune. They ſurpriſed Philipſburg, where the French had laid up vaſt magazines; and reduced Spires, Augſburg, Treves, Wurtſburg, Cobourg, and ſome other places. To complete the misfortunes of Sweden, it was expected that the Poles would immediately invade Pruſſia. To prevent this, La Gardie was diſpatched thither with a powerful army; but as it was impoſſible to reſiſt ſo many enemies at once, the chancellor purchaſed the friendſhip of Poland for 26 years by ceding that duchy to the republic.

85
The Saxons defeated by general Bannier.

Thus he got rid of a powerful enemy; and the Swediſh affairs began to revive by a victory which general Bannier gained over the Saxons, in conſequence of which they were driven beyond the Elbe.

Early in the ſpring of 1636, the Saxons made ſome motions as if they intended to cut off Bannier's communication with Pomerania. This he prevented by a ſtratagem; defeated a body of the enemy; and obliged the Saxons to retire. Soon after this he drove them out of their winter-quarters with conſiderable loſs; at which time alſo a conſiderable body of Imperialiſts who came to their aſſiſtance were diſperſed.

86
The Imperialiſts defeated by Kniphauſen.

In Weſtphalia general Kniphauſen beat the Imperialiſts with the loſs of 1500 men, but he himſelf was killed in the purſuit, and his army obliged to repaſs the Weſer.

87
And by the duke of Saxe-Weymar.

Some advantages were alſo gained in the neighbourhood of Minden by General Leſly, who had aſſembled a conſiderable army. In Alſace, Bernard duke of Saxe-Weymar defeated count Gallas the Imperial general, and diſperſed his army. But when every thing ſeemed thus ſucceſsful for the Swedes, the city of Magdeburg, contrary to the expectation of every body, ſurrendered for want of powder, which the garriſon had wantonly conſumed. The Saxons alſo made ſome conqueſts on the Elbe, which obliged Bannier to recal general Leſly from Weſtphalia to march againſt them. The Saxons fixed on a moſt convenient ſituation, whence they hoped to deſtroy the Swediſh army without coming to a battle. But Bannier, reſolving to hazard every thing rather than ſuffer his army to be waſted by famine, advanced towards Perleberg, a place cloſely blocked up by the enemy. Here he drove from an advantageous poſt four regiments of Saxon cuiraſſiers, having killed or taken priſoners 400 men; after which he ſoon forced them to 88 The Saxons entirely defeated by Bannier. a general engagement. The numbers were very unequal, Bannier's army amounting to 9000 horſe and 7000 foot, and the Saxons to 15,000 horſe and 13 battalions of foot. The battle began with great fury; the right wing of the Swedes was almoſt oppreſſed by numbers before the left could come to their aſſiſtance. They were ten times driven back, and as often returned to the charge. At laſt they made ſuch a deſperate effort, that the enemy were entirely broken and defeated. Five thouſand were killed on the ſpot, 3000 wounded, and as many taken priſoners, together with 150 colours and ſtandards, and ſeveral pieces of cannon.

Thus ended the campaign of 1636, in a manner highly honourable to the Swedes. Some fruitleſs negotiations were ſet on foot during the winter; but theſe coming to 89 Eight regiments of Saxons taken priſoners. nothing, Bannier quitted his winter-quarters very early in the ſeaſon; and falling upon eight regiments of Saxons cantoned at Eulenburg, purſued them to Torgau, where he obliged them to ſurrender at diſcretion. Another party of Saxons was defeated in the neighbourhood of Leipſic; after which he propoſed inveſting that city. But in this project he was diſappointed by the Imperialiſts penetrating into 90 Bannier defeats the Imperialiſts but is obliged to retire. Thuringia. He then called in all his detachments, with a view to prevent them from croſſing a river named *Sala*; but in this alſo he was diſappointed. However, he had the good fortune to defeat 2000 Imperialiſts near Pegau, and to deſtroy ſeveral detachments that attempted to obſtruct his march. Yet, notwithſtanding all theſe ſucceſſes, Bannier found his ſituation every day more ſtraitened from the continual increaſe of the enemy's forces; which obliged him at laſt to retreat into Pomerania, out of which he ſoon drove count Gallas.

The affairs of the Swedes were now once more reduced to the brink of ruin, through the unguarded conduct of general Wrangel, who had alſo an army in Pomerania. After Bannier had driven count Gallas out of the province as abovementioned. Wrangel, imagining himſelf perfectly ſecure, cantoned his troops, and extended his quarters, the bet- 91 Pomerania ravaged by the Imperialiſts. ter to accommodate his army. But Gallas, being informed of this proceeding, ſuddenly returned, ravaged all Upper Pomerania, and reduced the towns of Uſedom, Dernmin, and Wollin; after which, leaving garriſons in the fortreſſes, he returned to his winter-quarters in Saxony.

This unfortunate campaign counterbalanced all the advantages of the former. Wrangel was ſo ſtruck with the ſuddeneſs, of the blow that he could take no meaſures for oppoſition. 92 The Imperialiſts defeated by Bannier. Some of the Swediſh allies again fell off, and took up arms againſt them. In 1638, the Swediſh affairs again began to revive in this quarter, through the excellent conduct of Bannier, who defeated count Gallas with the loſs of 3000 men killed and taken priſoners. Purſuing his good fortune, he ſo haraſſed the count, that he obliged him in great haſte to repaſs the Elbe, and take ſhelter in the hereditary dominions of Auſtria. Great as Bannier's exploits had been, however, they were eclipſed by thoſe of duke 93 Exploits of the duke of Saxe-Weymar. Bernard. That general had ſo increaſed his army in the Proteſtant cantons of Switzerland, and in Franche Comte, that he found himſelf in a condition to act without the aſſiſtance of the French, who indeed were but treacherous allies. Advancing to the Rhine, he ſeized on Seckingen and Laſſuburg, and laid ſiege to Rheinfield. The Imperialiſts, in conjunction with the troops of Bavaria, advanced to the relief of the place. An engagement enſued, in which the victory was diſputed: the enemy threw ſuccours into the city, and the duke withdrew his army. Within a month he gave them battle a ſecond time; and ſo completely defeated them, that only one Imperial officer above the rank of a captain eſcaped being killed or taken priſoner. He then renewed the ſiege of Rheinfield; which he reduced, as well as ſeveral other important places. Advancing to Briſac, he blocked it up with a deſign of forcing the garriſon to ſurrender by famine. General Gotz, with 12,000 men, attempted to throw in 1000 waggons of proviſions; but he was defeated, with the loſs of all his men except 2500. Duke Charles of Lorrain, with 4000 men, joined the remains of Gotz's army, in order to relieve the town; but being ſurpriſed by Bernard, his whole army was cut in pieces. A third attempt was made by Gotz, but it proved as unſucceſsful as the former; and the place being reduced to great ſtraits, was obliged to capitulate.

In January 1639, the two victorious generals Bernard and Bannier prepared to attack the enemy on their own ground. Bannier made an irruption into the territories of Anhalt and Halberſtadt. Leaving his infantry behind, he puſhed on with his cavalry, and ſurpriſed Salis, grand-maſter of the Imperial artillery. After a bloody conflict, the 94 Bannier defeats the enemy in ſeveral engagements. Swedes gained a complete victory, ſeven regiments of the enemy being cut in pieces. Next entering Saxony, he defeated four regiments of the enemy, obliging a much larger body to take ſhelter under the cannon of Dreſden. Hearing that the Saxons were encamped near Chemnitz, where they waited to be joined by the Imperialiſts, he reſolved to attack them before this junction could be effected. The ſame good fortune ſtill attended his arms, and the Saxons were almoſt all killed or taken. Bannier next entering into Bohemia, laid the country under contribution; after which, returning croſs the Elbe, he fell on general Hoſskirk, who was encamped near Brandeiz with 10 regiments of horſe and ſeveral battalions of foot. Him he defeated with the loſs of 2000 men. The remains of the Imperial forces were purſued to the walls of Prague, and the generals Hoſskirk and Montecuculi were taken priſoners. Yet, notwithſtanding theſe conſtant ſucceſſes, the enemies of Bannier multiplied daily. He had expected an inſurrection in his favour in Sileſia or Bohemia; but no ſuch event took place. The Proteſtant princes, overawed by the enemy, did not ſend him the neceſſary aſſiſtance. Undiſmayed, however, by difficulties or danger, Bannier performed wonders. He defeated a body of Imperialiſts at Glatz; three times he drove the Saxons from their camp at Firn; and yet was forced to evacuate the place, becauſe he could not ſpare a garriſon. His army being deſtitute of the means of recruiting, was conſiderably diminiſhed in number; yet with it he reduced a number of towns, and obtained a variety of other important advantages, when on a ſudden all his hopes were blaſted by the death of the duke of Saxe-Weymar; poiſoned, 95 Death of the duke of Saxe-Weymar. as was ſuppoſed, by the French, who were deſirous of getting the town of Briſac into their hands, from which the duke prevented them.

The difficulties to which Bannier was now reduced proved extreme. 96 Treachery of the French. The French monarch took upon him to diſpoſe of the army and conqueſts of Bernard as he thought proper. Briſac, and other places of importance, he kept to himſelf; after getting poſſeſſion of which, the French endeavoured, as much as poſſible, to ruin the army. In the mean time, the Imperial army under Piccolomini, in the Netherlands, was prodigiouſly augmented; and the archduke Leopold-William, in quality of generaliſſimo, was aſſembling his whole ſtrength to cruſh the Swedes at once. Bannier, however, did not deſpair. George duke of Lunenburg having conceived ſome diſguſt at the emperor, Bannier hoped to gain him over: he therefore approached nearer to his country; by which alſo he drew towards the armies of Waymar and Heſſe. In his way he cut in pieces a body of 3000 Croats.

97 Imperialiſts defeated by Konigſmark.

General Konigſmark routed the Imperialiſts at Gera; a ſecond time at Scholen; and a third time entirely defeated them near Leipſic. Bannier was very preſſing on the allies to join him; and at laſt, in 1640, he was joined by the Weymar army under the dukes of Longueville and Gubrien, a body of Ruſſians led by general Melander and the troops or Lunenburgh commanded by general Klitzing. The army now amounted to 22 battalions of infantry and 22,000 horſe; ſo that they were much more than a match for their enemies had they been under the ſole direction of Bannier. But unanimity was wanting; every one would be ſupreme in the command; and Bannier, the beſt general of them all, had the leaſt influence. Inſtead of thoſe maſterly and deciſive ſtrokes by which the Swedes had hitherto diſtinguiſhed themſelves, the armies continued looking at one another, each ſuffering the rigours of famine. At laſt Bannier, reſolving to expoſe his troops no longer, ſet out for Thuringia, through Franconia, to ſeize an advantageous poſt on the Maine; but as he advanced to the Sala, he found the Imperialiſts entrenched on the other ſide. Finding it impoſſible to force a paſſage, he took the road through Heſſe, where his troops ſuffered greatly by famine. Here he propoſed to fight the enemy; but the Landgrave and duke of Lunenburg refuſed their conſent. Upon this he threatened to leave them to the mercy of the confederates, and thus obliged them to be ſomewhat more pliant. None of thoſe brilliant ſucceſſes, however, now attended the operations of the Proteſtant allies: the campaigns of 1640 and 1641 were ſpent in uſeleſs marches and countermarches; ſerving only to bring the army into the greateſt dangers, from which they were as conſtantly relieved by the active and intrepid Bannier.

98 Death of Bannier.

At laſt this brave general, worn out with perpetual fatigues, died of a fever in the year 1641, leaving the Swediſh army in a worſe ſituation than ever.

99 A Swediſh detachment cut in pieces.

The Imperialiſts were too well acquainted with the abilities of Bannier, not to take advantage of the opportunity offered by his death. A Swediſh detachment was cut in pieces at Quidlenberg. The Swediſh army, accuſtomed only to be obedient to Bannier, became mutinous, and Piccolomini reſolved to fall upon them with his whole force. But the four generals, Wrangel, Konigſmark, Wittemberg, and Pful, having convinced the ſoldiers of the neceſſity of defending themſelves, made ſuch excellent diſpoſitions, that the Imperialiſts durſt not attack them. Piccolomini then detached part of his army to attack the Heſſians in their quarters; but Wrangel and Konigſmark threw themſelves in their way, and defeated them with the loſs of 2000 men.

100 The Imperialiſts defeated.

This victory, however, did not retrieve the Swediſh affairs. Diſſentions and mutiny began again to take place in the army to ſuch a degree as threatened its diſſolution.

101 General Torſtenſon takes the command of the Swediſh army.

In 1642 general Toſtenſon was ſent from Sweden, with a large ſum of money and a ſtrong reinforcement, to take upon him the ſupreme command. This general was inferior in abilities to none of his predeceſſors, and deſigned without loſs of time to come to an engagement; but the Weymar army ſeparating from him, put an end to that deſign, and obliged him to remain for a conſiderable time inactive. He was alſo confined to his chamber for ſome time by a dangerous gout; and thus a report of his death being ſpread, the Imperialiſts were encouraged to begin a long march through roads ſcarce paſſable, in hopes of ſurpriſing the Swediſh army without a general. Torſtenſon having intelligence of this, ſeized an advantageous poſt, which could not be forced; and thus obliged the enemy to retreat, after having ſuffered as much by their fatiguing march as if they had fought a bloody battle.

102 Ruduces ſeveral towns.

Then joining general Stalhanch, who had been driven by the Imperialiſts out of Sileſia, he reduced the town of Great Glogau, with a number of other important places; after which he laid ſiege or Schweidnitz. The duke of Saxe-Lawenburgh, at the head of all his cavalry, endeavoured to throw in ſuccours; but was defeated with the loſs of 3000 men. He himſelf was taken priſoner, and died of chagrin a few days after. In conſequence of this defeat Schweidnitz ſurrendered at diſcretion; and Torſtenſon having ſent a detachment to inveſt the city of Neiſſe, proceeded with the reſt to drive the enemy entirely out of Sileſia.

103 Drives the Imperialiſts out of Sileſia, and takes Olmutz, &c.

This he effectually performed; obliging them to retire over barren mountains, almoſt famiſhed for want of proviſions, and haraſſed by his light troops; ſo that this lately formidable army was almoſt entirely ruined. With his victorious troops the Swediſh general then poured into Moravia; where, in five days, he reduced the ſtrong town of Olmutz (which not long ago ſuſtained a ſiege of as many weeks by the late king of Pruſſia). Litta and Newſtadt ſhared the ſame fate; after which, the Swedes, returning ſuddenly to Sileſia, made themſelves maſters of Oppelein and Brieg, and laid ſiege to Breſlau. Here the garriſon made ſuch an obſtinate defence, that the Imperialiſts had time to aſſemble under the conduct of the archduke Leopold, and come to their relief. As Torſtenſon was greatly inferior in number, he raiſed the ſiege; but appeared ſo formidable in his retreat, that the enemy durſt neither attack him, nor attempt to prevent his encamping in a very advantageous ſituation. The Imperialiſts took this opportunity of laying ſiege to Glogau; but after having loſt a great number of men, they were forced to abandon the enterpriſe on the junction of Wrangel with Torſtenſon; by which means the Swedes were once more in a condition to face their enemies in the field.

Torſtenſon now projected an irruption into Bohemia, and putting his army into winter-quarters in that country; but in this he was prevented by the vigilance of the enemy: however, he reduced the city of Zittau, where, for the firſt time, a cartel for priſoners was eſtabliſhed; by which means the Swediſh army was conſiderably augmented. Thus diſappointed in his deſigns on Bohemia, Torſtenſon directed his courſe to Leipſic, which he intended to inveſt. The Imperial generals aſſembled their whole force, and ſet out to relieve that important place.

104 Entirely defeats them at Leipſic.

The two armies ſoon came in ſight of each other; and a furious cannonading was the prelude to a general engagement. A ſingle bullet had almoſt proved fatal to the Swediſh cauſe. It carried away the furniture of Torſtenſon's horſe, killed the count Palatine's horſe, pierced general Rabenau through the body, took off the head of a celebrated counſellor named *Crabbe*, and carried away the leg of a private ſoldier. The Swedes, as ſoon as the armies came up, behaved with their wonted reſolution, and after an obſtinate conflict obtained a complete victory; 5000 of the enemy being killed on the ſpot, 3000 wounded, and as many taken priſoners. This victory was followed by the immediate ſurrender of Leipſic; and in all probability the Swedes would have finally triumphed over all their enemies, had not a rupture with Denmark enſued.

105 War with Denmark.

Torſtenſon and Horn behaved with their uſual valour in Holſtein and Schonen, while general Konigſmark diſtinguiſhed himſelf in Germany; but the ruin of the Weymar army, which was totally defeated with the loſs of one half its number at Dettingen by the Bavarians, proved a dreadful blow, from which the Swedes could ſcarce recover themſelves.

106 The Swede defeated a Dettingen

Indeed, notwithſtanding the valour and ſucceſs of the Swedes, their affairs in Germany muſt have gone to wreck in the campaigns of 1643 and 1644, had not the

French under Condé and Turenne made a moſt powerful diverſion, and performed ſuch exploits as immortalized the names of theſe two generals.

107 An advantageous peace with Denmark.

108 The imperialiſts entirely defeated at Jancowitz.

109 Torſtenſon reſigns the command to Wrangel.

In 1645, the war againſt Denmark was puſhed with ſuch vigour, that a peace, very honourable and advantageous for Sweden, was concluded; and thus Torſtenſon was again at liberty to act againſt the Imperialiſts. He now took meaſures for carrying the war into the heart of the Auſtrian dominions. Hatfield aſſembled a conſiderable army to oppoſe the Swedes; and the emperor came in perſon to Prague to animate his troops. The two armies came in ſight at Jancowitz, and both prepared for an engagement. The valour of the Swedes once more prevailed; and they totally defeated their enemies. Four thouſand of the Imperialiſts were killed on the ſpot, among whom were general Hatfield and a great number of officers; and near 5000 were taken priſoners. No great advantages, however, were derived from this victory. Some towns indeed were reduced; but at laſt Torſtenſon was obliged to retire into Moravia, where he put his army into winter-quarters; and in the beginning of the year 1646 reſigned the command to Wrangel.

110 Treaty of Weſtphalia.

The new general conducted the Swediſh affairs with great ability and ſucceſs; till at laſt the Imperialiſts, finding themſelves finally unable to drive the Swedes out of Germany, concluded a peace with them in 1648. This was the memorable treaty of Weſtphalia, by which the Germanic conſtitution was ſettled upon its ancient principles, and thoſe implacable diſputes which had ſo long torn the empire were ended; the duchies of Bremen and Verden, all the Upper and part of Lower Pomerania, the city of Wiſmar and the iſle of Rugen, were aſſigned to Sweden, and a gratification of five millions of crowns was given to the army.

111 Charles Guſtavus appointed heir to the crown of Sweden.

Sweden now enjoyed ſome years of repoſe. Charles Guſtavus, count Palatine, having gained the favour of Chriſtina, was appointed generaliſſimo of the forces, and heir-apparent to the crown. A marriage was propoſed between them; but the queen would never liſten to this or any other propoſal of the kind. In 1650, the ceremony of the queen's coronation was performed; but in four years thereafter, ſhe reſigned the crown in favour of Guſtavus. (See the article CHRISTINA).

112 State of Sweden on the acceſſion of Charles.

113 War with Poland reſolved on.

114 The Poles defeated, and the kingdom reduced.

The new king found himſelf involved in conſiderable difficulties on his acceſſion to the throne. The treaſury was quite exhauſted; great part of the revenue was appointed for the ſupport of Chriſtina's houſehold; the people were oppreſſed with taxes; and the nation having been diſarmed for ſeveral years, began to loſe its reputation among foreigners. To remedy theſe evils, Charles propoſed to reſume all the crown lands which had been alienated by grants to favourites during the late reign; to repeal a duty which had been laid upon ſalt; to put the kingdom in a poſture of defence; and to enter upon a war with ſome neighbouring ſtate. Under a pretence, therefore, that Caſimir king of Poland had queſtioned his title to the throne, he began to make preparations for invading that kingdom. Several embaſſies were ſent from Poland to Stockholm; but ſome point of ceremony always diſappointed them of an audience of the king; ſo they were obliged to return without their errand. As ſoon as matters were in readineſs, General Wittemberg made an irruption into Poland from the ſide of Pomerania. The Poles oppoſed him with an army of 15,000 men; but inſtead of fighting, they began to negotiate, and in a ſhort time entirely diſperſed themſelves. Charles himſelf ſoon followed with a powerful army, and purſued his march without obſtruction, all the cities throwing open their gates to him as he approached, and offering to ſupply him with neceſſaries. As he advanced to Cracow, Caſimir reſolved to make one effort to ſave his capital. His army amounted only to 10,000 men; and theſe were unfortunately ſuch as had never ſtood fire. After a feeble reſiſtance, they fled with precipitation, having loſt 1000 men killed and taken priſoners. A few days after this Charles defeated the Poles a ſecond time, about eight leagues from Cracow; upon which Caſimir fled with his family to Oppelen in Sileſia. The capital was then inveſted; and though defended with the utmoſt valour by Stephen Czarneſki, was in a ſhort time obliged to capitulate. Thus in leſs than three months Charles apparently became maſter of Poland; but it ſoon became evident that the Poles had no intention of abandoning their former ſovereign.

115 War with the elector of Brandenburg.

116 The Poles revolt.

117 Charles gains a victory, but is obliged to retire.

118 Concludes a treaty with the Dutch and the elector of Brandenburg.

In 1656 a war took place with the elector of Brandenburg. While Charles was employed in the conqueſt of Poland, that prince had invaded the Royal and Ducal Pruſſia, and reduced the moſt conſiderable towns with little oppoſition. The king of Sweden took umbrage at his progreſs; and having marched againſt him, defeated his forces in ſeveral ſlight encounters, and obliged him to own that he was a vaſſal of Sweden. Theſe rapid conqueſts alarmed all Europe; and the different powers ſought for means of driving the Swedes out of Poland, which they had ſo unexpectedly and unjuſtly ſeized. The Poles were no ſooner aſſured that they ſhould be aſſiſted, than they everywhere revolted and maſſacred the Swedes. Caſimir returned from Sileſia; and thoſe very troops and generals who had before ſubmitted to Charles without oppoſition, now ranged themſelves under the banners of his antagoniſt. Charles immediately marched from Pruſſia to chaſtiſe the inſolence of the Poles, and totally defeated a body of 12,000 men under the command of Czarneſki. This did not hinder all the Poles incorporated with his troops to deſert; which conſiderably reduced his army; and the campaign being performed in the depth of winter, he was at laſt obliged to retreat to Pruſſia. In his march he was haraſſed by the Poles; and a body of 4000 Swedes was ſurpriſed and defeated by them at Warka. This loſs, however, was ſoon after recompenſed by a complete victory gained by Adolphus the king's brother and General Wrangel over Czarneſki. In the mean time the king was taking meaſures for laying ſiege to Dantzic; but was prevented by the Dutch, who threatened to oppoſe him, unleſs a proper regard was paid to their intereſt. Charles accordingly granted them advantageous terms; and afterwards gained over the elector of Brandenburg, by ceding to him the ſovereignty of Pruſſia, that he might be at liberty to turn his whole ſtrength againſt Poland.

119 The Poles and Tartars defeated with great ſlaughter.

By the treaty juſt concluded with the elector, the latter was to aſſiſt Charles in his war with Poland; but the elector had ſo procraſtinated matters, that the Poles, having obtained aſſiſtance from the Tartars, had reduced the city of Warſaw. The two princes, however, now marched in concert againſt their enemies, who were encamped in a ſtrong ſituation in the neighbourhood of the city abovementioned, their camp being fronted by the Viſtula. The Poles were driven from their entrenchments with prodigious ſlaughter, and a vaſt number taken priſoners. The Poles and Tartars then laboured to break the alliance; with which view they entered Ducal Pruſſia, and defeated the electoral army, taking prince Radzivil and other perſons of diſtinction priſoners. The Swedes ſoon had their revenge. General Steinboeck attacked the ſame Poliſh army at Philippowa, and overthrew it with ſuch ſlaughter as obliged the Poles for that ſeaſon to quit the field. A more formidable enemy than the Poles now began to make their appearance. The Ruſſians invaded the provinces of Carelia, Ingermania, and Livonia;

120 The Ruſſians invade the Swediſh dominions.

121 Are defeated before Riga.

Livonia; while the elector of Brandenburg began to waver in his fidelity. To preſerve this only ally at ſuch a critical juncture, Charles was obliged to give him more advantageous terms than thoſe already mentioned; while the Ruſſians were repulſed in the provinces of Carelia and Ingermania. But in Lavonia they had better ſucceſs, two important fortreſſes falling into their hands; after which they laid ſiege to Riga. For ſeven months they battered the walls of this city, without once venturing to paſs the ditch or ſtorm the practicable breaches. The beſieged, under the command of Magnus de la Gardie and Simon Helmfield, defended themſelves with the greateſt intrepidity; cutting off many thouſands of the enemy in the ſallies they made. At laſt they attacked the Ruſſian camp, drove them out of it with great ſlaughter, and obliged them to raiſe the ſiege with precipitation.

122 Charles enters into an alliance with Ragotſki. prince of Tranſylvania.

Charles, notwithſtanding the number of his enemies, was now become ſo formidable by the valour and diſcipline of his troops, that whole armies often fled on the very news of his approach. At laſt, in 1657, the Poles, finding they could not reſiſt him in the field, contented themſelves with haraſſing the Swedes on their march, and cutting off the foragers and convoys. This proved much more deſtructive to the Swedes than their former method; ſo that Charles was obliged to enter into an alliance with Ragotſki prince of Tranſylvania, by aſſigning him certain provinces in his neighbourhood, in order to furniſh himſelf with irregular troops, who might fight the Poles in their own way. This, however, proved of no real advantage; for the confederates, after ſpending a whole campaign in Luthuania, were obliged to return without accompliſhing more than the reduction of a ſingle fortreſs; upon which Charles returned with the Swediſh army to Pruſſia.

123 Leopold king of Hungary declares againſt Sweden.

124 Ragotſki's army deſtroyed by the Poles and Tartars.

125 He is defeated and killed by the Turks.

Leopold, the young king of Hungary, having beheld for a long time the Swedes with a jealous eye, now reſolved to declare for Poland. The more effectually to curb the ambition of the Swediſh monarch, he ſolicited the king of Denmark to come to a rupture with him. This was inſtantly complied with, and the Danes invaded Bremen. Charles haſtened to oppoſe this new enemy; which gave ſuch offence to Ragotſki, that he neglected to take the proper meaſures for his own defence in the abſence of the Swedes, and ſuffered his army to be deſtroyed by the Poles and Tartars. At the ſame time the Turks invaded Tranſylvania, under pretence that Ragotſki, being a vaſſal of the Grand Signior, had no right to invade Poland without his leave. Ragotſki oppoſed them in the field; where he was defeated and killed, leaving Charles deſtitute of the only ally on whom he could have depended.

126 Bravery and ſucceſs of general Wrangel.

127 The houſe of Auſtria declares againſt Sweden.

The king, however, not diſmayed by this misfortune, traverſed Pomerania and the duchy of Mecklenburg; after which he fell upon Holſtein, while general Wrangel with another corps entered the duchy of Bremen. The latter executed his meaſures with the utmoſt vigour and intrepidity. In 15 days he retook all the towns which the enemy had reduced; defeated and drove the Daniſh army out of the country, killing 3000 of their beſt ſoldiers. In Holſtein the king reduced ſeveral fortreſſes, laid Itzehoe in aſhes, defeated a body of Danes, and laid ſiege to Frederic-Udda, into which the Danes had thrown a ſtrong garriſon. The conduct of this ſiege he left to Wrangel, he himſelf retiring to Wiſmar in order to obſerve the ſituation of affairs in Poland; but no ſooner was he gone than Wrangel attacked the place with ſuch fury, that he became maſter of it in two hours. In the province of Halland the Swedes were defeated; but the enemy derived no advantage from their victory: at ſea the fleets met, and maintained a hot engagement for two days, without any conſiderable advantage on either ſide. In Poland matters went on much worſe. The houſe of Auſtria had now declared for Caſimir; a German army entered Poland, and reduced Cracow, though not without great loſs to themſelves. Czarneſki entered Pomerania, where he butchered the unhappy peaſants without mercy; but on the approach of Charles he fled as uſual, having gained nothing by his expedition but the character of a cruel barbarian.

128 Charles invades Denmark with great ſucceſs.

129 Peace concluded.

The king of Sweden was now ſurrounded by enemies. The elector of Brandenburg had declared againſt him; and he had beſides to engage the armies of Auſtria, Poland, Ruſſia, and Denmark, in the field. In this dangerous ſituation he reſolved to attack Denmark, in ſuch a manner as ſhould oblige that power to come to a ſpeedy accommodation. His deſigns were forwarded by a very early froſt, which enabled him to tranſport his troops without the expence and trouble of ſhipping. Having paſſed over on the ice to the iſland of Funen, he cut in pieces a body of 4000 Daniſh ſoldiers and 500 peaſants. The whole iſland was reduced in a few days; after which he paſſed to Langland, then to Laaland, after that to Falſtre, and laſtly to Zealand. The Danes were terrified at this unexpected invaſion, and were giving themſelves up to deſpair, when Charles offered to conclude a peace upon equitable terms. The king of Denmark very gladly conſented; but with a deſign to renew the war as ſoon as he thought it could be done with ſafety. By this treaty, called the *treaty of Roſchild*, concluded on the 12th of March 1658, the provinces of Schonen, Halland, and Bleking, Lyſter, and Huwen, the iſle of Bornholm, the baillages of Bahadus and Drontheim in Norway, were yielded to Sweden, and a free paſſage through the Sound was granted to the Swediſh ſhips.

130 The war renewed, and Copenhagen beſieged.

131 Death of Charles Guſtavus.

No ſooner was Charles retired, than the king of Denmark began to act againſt him in an underhand manner; on which, reſolving to anticipate him in his deſigns, he appeared unexpectedly with a fleet before Copenhagen. Had he given the aſſault immediately, before the inhabitants had time to recover from their ſurpriſe, it would probably have ſurrendered at once; but, by landing at the diſtance of 17 miles, he gave them time to prepare for their defence: the ſiege proved extremely tedious, and at laſt the place was relieved by a Dutch fleet. On this Charles converted the ſiege into a blockade, which continued till the end of the war. Wrangel reduced the ſtrong fortreſs of Cronenburg; and the Swediſh forces were ſo judiciouſly poſted, that all Denmark was in a manner blocked up; when, in 1660, king Charles died of an epidemical fever: and thus an end was put, for that time, to all the ambitious deſigns of Sweden.

132 Charles XI.

133 Treaty of Oliva.

134 War with Brandenburg.

135 The Swedes defeated by land and ſea.

The new king Charles XI. was a minor at the time of his father's death; and as the kingdom was involved in a dangerous war with ſo many enemies, the regency determined to conclude a peace, if it could be obtained on reaſonable terms. A treaty was accordingly concluded at Oliva; by which Caſimir renounced his pretenſions to the crown of Poland, and that republic gave up all pretenſions to Livonia. Bornholm and Drontheim were ceded to Denmark; and an equivalent in Schonen remained with Sweden. During the minority of the king, nothing remarkable occurs in the hiſtory of Sweden. In 1672 he entered into alliance with Louis XIV. which two years after involved him in a war with the elector of Brandenburg. At firſt the Swedes carried all before them; and general Wrangel having fallen ſick, they continued their conqueſts under another named *Mardenfeldt*. Almoſt all the towns in Brandenburg were reduced, when the elector arrived with an army to the relief of his diſtreſſed ſubjects. He retook ſeveral towns, defeated Mardenfeldt in a general engagement, and ſoon after forced them to abandon all their conqueſts. In conjunction

136 Their affairs every-where go to wreck.

with the Danes, he then invaded the Swediſh dominions: many places of importance were reduced; and, in 1676, Sweden received a moſt deſtructive blow by the defeat of her fleet in an engagement with the combined fleets of Denmark and Holland. Soon after this the king took the government into his own hands, and in ſome degree reſtored the fortune of Sweden; but though matters went on in a more proſperous way where the king commanded in perſon, the ſame loſſes and diſgrace attended the Swediſh arms in every other quarter. In Pomerania, count Kongiſmark loſt every place of importance excepting Stralſund, Stetin, and Gripſwald. In 1678, the Swediſh fleet was defeated in two engagements. At Landſcroon a moſt obſtinate battle was fought from ten in the morning till ſix at night; when both parties were obliged, by their fatigue, to retire to their reſpective camps. At Oldeval in Norway, the Swedes were defeated; and the Danes laid deſolate the iſlands of Oeland Smaaland, Unno, and Kuno; while the electoral troops and Imperialiſts reduced count Kongiſmark to the utmoſt diſtreſs in the neighbourhood of Stralſund.

In this deplorable ſituation of affairs count Konigſmark found an opportunity of attacking his enemies to ſuch advantage, that he obtained a complete victory; after which he ravaged the duchy of Mecklenburg. Yet notwithſtanding this ſucceſs, he could not prevent the elector from reducing Stalſund; after which he was obliged to evacuate Pomerania; and, to complete his diſtreſs, the fleet which tranſported the Swediſh army from Pomerania was wrecked on the coaſt of Bornholm; by which accident 2000 perſons were drowned and the remainder plundered and taken priſoners by the Danes, though they had been furniſhed with paſſports from king Frederic.

137 Peace concluded.

138 Charles becomes abſolute.

139 Diſguſts many of his ſubjects.

140 Boldneſs and misfortunes of Captain Patkul.

In this unproſperous ſituation of affairs a peace was concluded at St Germain's between France and her enemies, by which the Swedes and Danes were left to decide their quarrel by themſelves. Denmark was by no means a match for Sweden, even in the diſtreſſed ſituation to which ſhe was reduced: for which reaſon a treaty was inſtantly concluded, on terms much more favourable to Sweden than could have been expected; and the peace was confirmed by a marriage between Charles and Ulrica Eleonora, daughter to the king of Denmark. From this time the Swediſh monarch applied himſelf to the reformation of the ſtate; and by artfully managing the diſputes between the nobility and peaſants, he obtained a decree of the ſtates empowering him to alter the conſtitution as he pleaſed. Being thus inveſted with abſolute power he proceeded to take ſome very extraordinary meaſures. In 1685 it was projected to liquidate the public debts by raiſing the nominal value of money, without adding any thing to its intrinſic value. This was put in execution the following year, by which the creditors of the government loſt upwards of nine millions of crowns. This, with ſome other arbitrary ſteps taken about the ſame time, diſguſted all the nobility, merchants, and crown-creditors. In Livonia they were highly reſented; and remonſtrances were repeatedly ſent by the hands of deputies, who had orders to inſiſt upon their privileges confirmed by many acts of the king's predeceſſors. The deputies could obtain nothing, ſo that the diet was aſſembled. On their report the body of nobility reſolved to draw up a ſtronger remonſtrance than any of the former, to be preſented to the king by captain Patkul one of the deputies, who had already diſtinguiſhed himſelf by his boldneſs and attachment to liberty. His public ſpirit, however, produced no other effect than to procure his own deſtruction. An accuſation was drawn up againſt all the remonſtrants, but eſpecially Patkul. He was ſentenced to loſe his right hand, then to be deprived of his life, honours, and eſtates; to have the latter confiſcated to the crown, and his papers burnt by the hands of the common executioner. The accuſation was declared unjuſt by the univerſity at Leipſic: but notwithſtanding this, Patkul was obliged to fly his country, to avoid the execution of his rigorous ſentence; which, however, fell upon him with redoubled fury in the ſubſequent reign, of which an account is given under the article PATKUL.

141 Charles XI. dies and is ſucceeded by his ſon Charles XII.

142 He takes the government into his own hands at the age of 15.

143 A powerful combination formed againſt him.

144 Holſtein ravaged by the Danes.

145 They are repulſed at Tonningen.

On the 15th of April 1697, died Charles XI. leaving his crown to his ſon, the celebrated Charles XII. at that time a minor. On his acceſſion he found himſelf under the tuition of his grandmother Eleonora, who had governed the kingdom during the minority of the late king. Though Charles was at that time only 15 years of age, he inſtantly ſhowed a deſire of taking the government into his own hands. His counſellors, count Piper and Axel Sparre, ſignified his deſire to the queen-regent. They were by her referred to the ſtates; and there all were unanimous: ſo that the queen, finding that oppoſition would be vain, reſigned her power with a good grace; and Charles was inveſted with abſolute authority in three days after he had expreſſed his deſire of reigning alone. He was ſcarce ſeated on the throne when a powerful combination was formed againſt him. King Auguſtus of Poland formed deſigns on Livonia; the king of Denmark revived the diſputes he had with the duke of Holſtein, as a prelude to a war with Sweden; and Peter the Great of Muſcovy began to form deſigns upon Ingria, formerly a province of Ruſſia. In 1699 the king of Denmark marched an army into Holſtein. Charles ſent a conſiderable body of troops to the duke's aſſiſtance; but before their arival the Danes had ravaged the country, taken the caſtle of Gottorp, and laid cloſe ſiege to Tonningen. Here the king of Denmark commanded in perſon; and was aſſiſted by the troops of Saxony, Brandenburg, Wolſenbuttle, and Heſſe-Caſſel. England and Holland, as guarantees of the laſt treaty with Denmark, in concert with Sweden, joined Charles againſt this confederacy, and ſent fleets to the Baltic. They propoſed a termination of the war upon equitable terms; but theſe were haughtily refuſed by the Daniſh monarch, who deſpiſed the youth and inexperience of Charles, and relied too much upon the alliance he had formed with Saxony, Brandenburg, Poland, and Ruſſia. The town of Tonningen, however, reſiſted all his efforts; and when he ordered the place to be ſtormed, he had the mortification to ſee his troops driven headlong from the walls by a handful of Swedes under general Bannier.

146 Charles ſets out from Stockholm, and defeats the fleet of the allies.

147 Obliges th Danes to make peace.

148 Marches againſt the Ruſſians.

In the year 1700, Charles, having entruſted the affairs of the nation with a council choſen out of the ſenate, ſet out on the 8th May from his capital, to which he never afterwards returned. He embarked at Carlſcroon, and defeated the fleet of the allies. Having made a deſcent on the iſland of Zealand, he defeated a body of cavalry that oppoſed his march, and then proceeded to inveſt Copenhagen by ſea and land. The king of Denmark then ſaw the neceſſity there was either of having his capital deſtroyed, or of doing juſtice to the duke of Holſtein. He choſe the latter; and a treaty was concluded in eleven days, upon much the ſame terms as formerly. Charles, being thus at liberty to turn his arms againſt the other princes who had conſpired his deſtruction, reſolved to lead his army againſt Auguſtus king of Poland; but on his way he received intelligence that the czar of Muſcovy had laid ſiege to Narva with 100,000 men. On this he immediately embarked at Carlſcroon, though it was then the depth of winter, and the Baltic ſcarce navigable; and ſoon landed at Pernaw in Livonia with part of his forces, the reſt being ordered to Reval. His army did not exceed 20,000 men; but they were the beſt ſoldiers in Europe, while the Ruſſians were only an undiſciplined multitude. The czar, however, had thrown very poſſible obſtruction in the way of his antagoniſt. Thirty thouſand men were poſted in a defile on the road, to oppoſe his paſſage; and this corps was ſuſtained by a body of 20,000 others, poſted ſome leagues nearer Narva. The czar himſelf had ſet out to haſten the march of a reinforcement of 40,000 men, with whom he intended to attack the Swedes in flank and rear.

149 Defeats two Ruſſian armies, and attacks the Czar's camp.

But the celerity and valour of the Swedes baffled every endeavour. With 4000 foot and an equal number of horſe the king ſet out, leaving the reſt of the army to follow him at their leiſure. With theſe he attacked and defeated the Ruſſian armies one after another, puſhing his way to the czar's camp, which he give immediate orders for attacking. This camp was fortified by lines of circumvallation and contravallation, by redoubts, by 150 pieces of braſs cannon placed in front; and was defended by an army of 80,000 men: yet ſo violent was the attack of the Swedes, that in three hours the entrenchments were carried; the king with 4000 men that compoſed the wing he commanded in perſon, purſued a flying army of 50,000 to the river Narva. The bridge broke down by the weight of the fugitives, and the river was inſtantly covered with their bodies. Great numbers returned in deſpair to their camp, where they defended themſelves for a while;

250 The camp forced, and the Ruſſians defeated with great ſlaughter

but at laſt the generals Gallowin and Frederowitz, who commanded them, ſurrendered. Thirty thouſand were killed in the intrenchments and in the purſuit, or drowned in the river; 20,000 ſurrendered at diſcretion, and were diſmiſſed unarmed; while the reſt were totally diſperſed. An hundred and fifty pieces of fine cannon 28 mortars, 151 pair of colours, 20 ſtandards, and all the baggage of the enemy, were taken. Among the priſoners were the duke de Croy, the prince of Georgia, and ſeven other generals.

151 Generoſity of Charles.

Charles behaved with the greateſt generoſity to the conquered. Being informed that the tradeſmen of Narva had refuſed credit to the officers whom he detained priſoners, he ſent 1000 ducats to the duke of Croy, and to every other officer a proportionable ſum.

Peter was advancing with 40,000 men to ſurround the Swedes, when he received intelligence of the dreadful defeat at Narva. He was greatly chagrined; but, comforting himſelf when the hopes that the Swedes would in time teach the Ruſſians to beat them, he returned to his own dominions, where he applied himſelf with the utmoſt diligence to the raiſing of another army. He evacuated all the provinces which he had invaded, and for a time abandoned all his great projects, thus leaving Charles at liberty to proſecute the war againſt Poland.

152 Treaty between the Czar and king of Poland.

As Auguſtus had expected an attack, he endeavoured to draw the czar into a cloſer alliance with him. The two monarchs had an interview at Birſen, where it was agreed that Auguſtus ſhould lend the czar 50,000 German ſoldiers, to be paid by Muſcovy; that the czar ſhould ſend an equal number of his troops to be trained up to the art of war in Poland; and that he ſhould pay the king three millions of rix-dollars in the ſpace of two years. Of this treaty Charles had notice, and by means of his miniſter count Piper entirely fruſtrated the ſcheme.

153 Charles marches againſt the Saxons.

In 1701, as early as the ſeaſon permitted, Charles, having received a reinforcement from Sweden, took the field, and appeared ſuddenly on the banks of the Duna, along which the Saxon army was poſted to receive him. The king of Poland at that time being ſick, the army was commanded by Ferdinand duke of Courland, mariſchal Stenau, and general Paykel, all officers of valour and experience. They had fortified certain iſlands in the mouth of the river, and taken every other precaution againſt an attack; the ſoldiers were hardy, well diſciplined, and nearly equal to the Swedes in number; yet Charles, having paſſed the river in boats with high ſides to ſcreen the men from the fire of the enemy, attacked them with ſuch fury, that they were entirely defeated, with the loſs of 2500 killed on the ſpot, and 1500 taken priſoners. All the Saxon baggage, 36 pieces of cannon, five pair of colours, and ſix ſtandards, fell into the hands of the Swedes.

154 And entirely defeats them.

This victory was followed by the ſurrender of all the towns and fortreſſes in the duchy of Courland. The king then paſſed into Lithuania; where every town opened its gates to him. At Birſen, an army of 20,000 Ruſſians retired with the utmoſt percipitation on the news of his approach.

154 Forms a ſcheme for dethroning Auguſtus.

Here Charles preceiving that the kingdom of Poland was greatly diſaffected to Auguſtus, began to project the ſcheme of dethroning him by means of his own ſubjects. This ſcheme he executed with more policy than he ever ſhowed on any other occaſion. The manner of putting it in execution was concerted between Radziewiſchi, cardinal primate of Poland, and count Piper. Intrigues and cabals were held at the houſe of the treacherous eccleſiaſtic, while he was publiſhing circular letters to keep the people in their duty to the king.

156 Confuſions in Poland.

The diet being filled with Swediſh partiſans, became tumultuous, and broke up in confuſion. The affairs of the kingdom then fell into the hands of the ſenate; but here the Swediſh party was as ſtrong as in the diet. It was agreed that they ſhould ſend an embaſſy to Charles; that the poſpolite ſhould mount, and be ready againſt all events; but the chief regulations reſpected the king's authority, which it was determined at any rate to retrench.

157 Auguſtus attempts to treat, but in vain.

Auguſtus, reſolving rather to receive laws from the victorious Charles than from his own ſubjects, ſent an embaſſy to him, committing the management of the whole to the counteſs of Konigſmark, a native of Sweden, and a lady famous for her wit and beauty. But the king refuſed to ſee her; on which ſhe returned chagrined and diſappointed, to Warſaw. The ambaſſadors of the ſenate inſtantly obtained an audience; and were aſſured by Charles, that he took arms againſt the Saxons in defence of the liberties of the Poles, whom he ſhould always regard as his beſt friends. Conferences were appointed to be held at Kinſchin; but Charles ſoon after altered his mind, and told the ambaſſadors he would hold them at Warſaw.

158 Makes a ſecond application to no purpoſe.

Auguſtus, in the mean time, finding his ſcheme of peace fruſtrated had recourſe to the ſenate; but met with ſuch a rough anſwer from them, that he determined once more to apply to Charles. To him therefore he ſent his chamberlain; but a paſſport being forgot the ambaſſador was arreſted.

195 Warſaw taken.

Charles continued his march to Warſaw, which ſurrendered on the firſt ſummons; but the citadel held out for ſome days. Auguſtus, finding at laſt that no dependence was to be had on the Poles, determined to truſt his fortune wholly to the Saxon army and the nobility of the palatinate of Cracow, who offered to ſupport him to the utmoſt of their power. The Saxon army was now advanced to the frontiers, and Auguſtus immediately put himſelf at the head of it. Being joined by the nobility of Cracow, he found his forces to amount to 30,000 men, all brave and well-diſciplined. With theſe he marched in queſt of his enemy; who did not decline the combat, though he had with him only 12,000 men.

160 The Saxons entirely defeated.

Though the Saxons were ſtrongly poſted, having their front covered by a moraſs, beſides being fortified with palliſadoes and chevaux de friſe, they were attacked with irreſiſtible impetuoſity, and entirely defeated, with the loſs of 4000 killed, 2000 made priſoners, and all their baggage and cannon.

161 Cracow taken.

This victory was followed by the loſs of Cracow: after which Charles ſet out in purſuit of the flying army, with a deſign of preventing them from reaſſembling; but his horſe falling under him, he had the misfortune

fortune to break his thigh, by which he was confined ſix weeks; and thus Auguſtus obtained ſome reſpite. The interval he made the beſt uſe of. Having convoked a diet firſt at Marienburg, and then at Lublin, from them he obtained the following reſolutions; that an army of 50,000 men ſhould be raiſed by the republic for the ſervice of the prince; that ſix weeks ſhould be allowed the Swedes to determine whether they were for war or peace; and that the ſame time ſhould be granted to the turbulent and diſcontented nobles of Poland to make their conceſſions. To counteract the effects of theſe reſolutions, Charles aſſembled another diet at Warſaw; and while the two aſſemblies diſputed concerning their rights and privileges, he recovered of his wound, received a ſtrong reinforcement from Pomerania, and utterly defeated and diſperſed the remains of the Saxon army.

162
Remains of the Saxon army entirely defeated.

163
Auguſtus formally depoſed, and Staniſlaus raiſed to the throne.

The ill fortune of Auguſtus continued ſtill to perſecute him. In 1704 he was formally depoſed by the diet, and the crown conferred by Charles on Staniſlaus Lecſinſky palatine of Poſnania. Auguſtus, however, did not yet tamely give up his kingdom. His adherents daily ſkirmiſhed with the Swedes; and Auguſtus himſelf, being reinforced by 9000 Ruſſians, retook Warſaw, and was very near ſurpriſing the new king, who lived in perfect ſecurity in the city while Charles fought in his cauſe.

164
Warſaw retaken by Auguſtus.

Count Horn, with 1500 Swedes, vigorouſly defended the citadel; but at laſt, finding it no longer tenable, he was obliged to ſurrender at diſcretion. The reduction of Warſaw was among the laſt advantages gained by Auguſtus in the courſe of this war. His troops were now compoſed of Saxon recruits and undiſciplined Poles, who had no attachment to his perſon, and were ready on all occaſions to forſake him. Charles and Staniſlaus advanced with the victorious army; the Saxons fled before them, and the towns for ſeveral miles round ſent their ſubmiſſions.

165
Excellent conduct of his general Schullemberg.

The Poles and Saxons were under the command of Schullemberg, a moſt ſagacious and experienced general, who uſed every expedient to check the progreſs of the Swedes, by ſeizing on the advantageous poſts, ſacrificing ſmall parties to the ſafety of the whole, and to miſlead the enemy, &c. However, with all his conduct and caution, he found himſelf outwitted, and Charles in the neighbourhood of his camp ready to fall upon him, while he thought him at 50 leagues diſtance.

166
His engagement with the Swedes.

The Swediſh monarch attacked him with a ſuperior army, but entirely compoſed of horſe. Schullemberg had poſted his men in ſuch a manner as rendered it impoſſible to ſurround them. His firſt rank being armed with pikes and fuſees, preſented a kind of rampart of bayonets; the ſecond line ſtooping over the firſt who kneeled, fired over their heads, while the third rank, who ſtood upon their feet, kept up an inceſſant fire, by which the Swediſh horſe were exceedingly galled and put in diſorder. Charles loſt the opportunity of cutting off the whole Saxon army, by omitting to order his men to diſmount. This was almoſt the firſt time that infantry had been regularly oppoſed to cavalry, and the ſuperiority of the former was evident.

167
His fine retreat.

After the engagement had continued about three hours, the Saxons retreated in good order; which no enemy had ever done before in any engagement with Charles. The Swedes purſued their enemies towards the Oder, and forced them to retreat through thick woods, almoſt impervious even to infantry. The Swediſh horſe, however, puſhed their way, and at laſt incloſed Schullemberg between a wood and the river, where Charles had no doubt of obliging him to ſurrender at diſcretion, or die ſword-in-hand, as having neither boats nor bridges; but the genius of Schullemberg ſupplied every defect. In the night he ordered planks and floats of trees to be faſtened together; upon which he carried over his troops, while the Swedes were employed in diſlodging 300 men, which he had placed in a wind mill, for the purpoſe of defending his flank and keeping the enemy in play. Charles ſpoke of this retreat with admiration, and ſaid he had been conquered by Schullemberg.

168
Auguſtus leaves Poland.

No material advantage, however, reſulted from this to Auguſtus; who was again obliged to leave Poland, and fortify the capital of his hereditary dominions, which he expected every moment to ſee inveſted.

169
The Ruſſians take ſeveral towns in Livonia, and invade Poland.

In the mean time, however, the Ruſſians having recovered their ſpirits, fell upon the Swedes in Livonia with the utmoſt fury. Narva, Dorpt, and ſeveral other towns, were taken, and the inhabitants and garriſons treated with great barbarity. Soon after, an army of 100,000 Ruſſians entered Poland. Sixty thouſand Coſſacks under Mazeppa entered the country at the ſame time, and ravaged every thing with the fury of barbarians. Schullemberg too, perhaps more formidable than either, advanced with 14,000 Saxons and 7000 Ruſſians, diſciplined in Germany, and reputed excellent ſoldiers. Could numbers have determined the event of war, the Swedes muſt certainly have been at this time overpowered. Inſtead of this, however, Charles ſeemed to triumph over his enemies with more eaſe the more numerous they were. The Ruſſians were defeated ſo faſt, that they were all diſperſed before one party had notice of the miſfortunes of another.

170
Aſtoniſhing ſucceſs of Charles againſt them.

The defeating an army of 40,000 men ſcarcely obſtructed the march of the Swedes, while their aſtoniſhed enemies looked upon theſe actions as the effects of witchcraft, and imagined that the king of Sweden had dealings with infernal ſpirits. With theſe apprehenſions they fled beyond the Boriſthenes, leaving the unhappy Auguſtus to his ill fate.

171
Schullemberg entirely defeated by Renſchild.

Schullemberg, with all his ſkill and experience, ſucceeded no better. The Swediſh general Renſchild engaged and defeated him in half an hour, though the Swedes were vaſtly inferior in number, and their enemies poſted in a moſt advantageous ſituation. Nothing could be more complete than this victory. Whole regiments of Saxons threw down their arms, and begged their lives in the moſt ſuppliant poſture. Six thouſand were ſlain in the field, and 7000 taken priſoners. Thirty-ſix pieces of cannon, 11,000 muſkets, 40 pair of colours and ſtandards, with all the Saxon baggage, fell into the hands of the Swedes: and the conſequences were ſtill more important; for now a paſſage was opened into Saxony, and Auguſtus ſeemed to be in as great danger of loſing his hereditary dominions as he had been of loſing Poland. This extraordinary victory, indeed, is ſaid to have been owing to a panic which ſeized the troops of Schullemberg: however, it was looked upon with admiration, and thought to make the renown of Renſchild equal to that of his ſovereign. Charles himſelf was jealous, and could not help exclaiming, "Surely Renſchild will not compare himſelf with me!"

172
Cruelty of the Swediſh general.

But the cruelty of this general ſullied his reputation; for ſix hours after the engagement, he cauſed 1000 Ruſſians to be maſſacred in cold blood, to revenge, as he ſaid, the cruelties they had committed in Poland.

173
Charles invades Saxony.

Soon after this victory, which was gained on the 12th of February 1706, Charles entered Saxony at the head of 24,000 men. The diet at Ratiſbon declared him an enemy to the empire if he croſſed the Oder. But to this declaration no regard was paid. Charles purſued his march; while Auguſtus was reduced to the condition of a vagrant in Poland, where he poſſeſſed not a ſingle town beſides Cracow. Into this city he threw himſelf with a few Saxon, Poliſh, and Ruſſian regiments, and began to erect ſome fortifications for its defence; but the approach of the Swediſh general Meyerfeldt, and the news of the invaſion of Saxony, diſconcerted all his meaſures, and threw him into deſpair. The Ruſſians indeed were his faithful allies; but he dread-

174 Auguſtus begs for peace on any terms.

175 Charles's anſwer.

ed them almoſt as much as the Swedes: ſo that he was reduced to the neceſſity of writing a letter to Charles with his own hand, begging for peace on whatever terms he thought proper to grant. However, as he was then at the mercy of the Ruſſians, this tranſaction was concealed with the greateſt care. His emiſſaries were introduced to the Swediſh court in the night-time; and being preſented to Charles, received the following anſwer: That king Auguſtus ſhould for ever renounce the crown of Poland, acknowledge Staniſlaus, and promiſe never to reaſcend the throne, ſhould an opportunity offer; that he ſhould releaſe the princes Sobieſki, and all the Swediſh priſoners made in the courſe of the war; ſurrender Patkul, at that time reſident at his court as ambaſſador for the Czar of Muſcovy, and ſtop proceedings againſt all who had paſſed from his into the Swediſh ſervice. Theſe articles Charles wrote with his own hand, and delivered to count Piper, ordering him to finiſh them with the Saxon ambaſſadors.

176 Auguſtus, in conjunction with the Ruſſians, defeats and takes priſoners a whole Swediſh army.

Auguſtus all this time was obliged to continue a ſhow of war, though he had neither ability nor inclination to carry it on. He was joined by prince Menzikoff with 30,000 Ruſſians; which obliged him, contrary to his inclination, to come to an engagement with Meyerfeldt, who commanded 10,000 men, one half of whom were Swedes. As at this time no diſparity of numbers whatever was reckoned an equivalent to the valour of the Swedes, Meyerfeldt did not decline the combat, though the army of the enemy was four times as numerous as his own. With his countrymen he defeated the enemy's firſt line, and was on the point of defeating the ſecond, when Staniſlaus, with the Poles and Lithuanians, gave way. Meyerfeldt then perceived that the battle was loſt; but he fought deſperately, on purpoſe to avoid the diſgrace of a defeat. At laſt, however, he was oppreſſed by numbers, and forced to ſurrender; ſuffering the Swedes, for the firſt time to be conquered by their enemies. The whole army were taken priſoners excepting major-general Kraſſau; who having repeatedly rallied a body of horſe formed into a brigade, at laſt broke through the enemy, and eſcaped to Poſnania.—Auguſtus had ſcarce ſung *Te Deum* for this victory, when his plenipotentiary returned from Saxony with the articles of the treaty abovementioned. The king heſitated and ſcrupled, but at laſt ſigned them; after which he ſet out for Saxony, glad at any rate to be freed from ſuch an enemy as the king of Sweden, and from ſuch allies as the Ruſſians.

177 But is obliged to reſign the crown of Poland.

178 Czar Peter complains to all the ſtates in Europe.

The Czar Peter was no ſooner informed of this extraordinary treaty, and the cruel execution of his plenipotentiary Patkul *, than he ſent letters to every court in Chriſtendom, complaining of this groſs violation of the law of nations. He intreated the emperor, the queen of Britain, and the States-General, to revenge this inſult on humanity. He ſtigmatized the compliance of Auguſtus with the opprobrious name of *puſillanimity;* exhorted them not to guarantee a treaty ſo unjuſt, but to deſpiſe the menaces of the Swediſh bully. So well, however, was the proweſs of the king of Sweden known, that none of the allies thought proper to irritate him, by refuſing to guarantee any treaty he thought proper. At firſt, Peter thought of revenging Patkul's death by maſſacring the Swediſh priſoners at Moſcow; but from this he was ſoon deterred, by remembering that Charles had many more Ruſſian priſoners than he had of Swedes. Giving over thoughts of revenging himſelf in this way, therefore, in the year 1707 he entered Poland, at the head of 60,000 men. Advancing to Leopold, he made himſelf maſter of that city, where he aſſembled a diet and ſolemnly depoſed Staniſlaus with the ſame ceremonies which had been uſed with regard to Auguſtus. The country was now reduced to the moſt miſerable ſituation; one party through fear, adhered to the Swedes; another was gained over, or forced by Peter to take part with him; a violent civil war took place between the two, and great numbers of people were butchered, while cities, towns, and villages, were laid in aſhes by the frantic multitude. The appearance of a Swediſh army under king Staniſlaus and general Lewenhaupt put a ſtop to theſe diſorders, Peter himſelf not caring to ſtand before ſuch enemies. He retired, therefore, into Lithuania, giving as the cauſe of his retreat, that the country could not ſupply him with proviſions and forage neceſſary for ſo great an army.

179 Invades Poland, and formally depoſes Staniſlaus.

180 Retires into Lithuania.

181 Imperious behaviour of Charles.

182 Submiſſive behaviour of the emperor to him.

In the mean time Charles had taken up his reſidence in Saxony, where he gave law to the court of Vienna, and in a manner intimidated all Europe. He declared himſelf the protector of the Proteſtant intereſt in Germany, particularly of the emperor's Proteſtant ſubjects in Sileſia. He deſired, or rather *commanded,* the emperor to renew and confirm to them all the liberties granted by the treaties of Weſtphalia, but ſince that time reclaimed or eluded at the treaty of Ryſwick. The emperor durſt not refuſe; and upwards of 100 churches were given to the Proteſtants. On this occaſion the emperor is reported to have ſaid, that "had Charles deſired him to become a Lutheran, he did not know whether he could have refuſed." One would indeed have imagined that Charles had ſome thoughts of converting, or at leaſt dethroning, the Pope himſelf; for being incenſed at the conſtant oppoſition of the court of Rome, whoſe weakneſs and intrigues he deſpiſed, he one day told the emperor's miniſter, that "the Swedes had conquered Rome before now, and he might one day demand an inventory of the effects left there by queen Chriſtina." At laſt, ſatiated with the glory of having dethroned one king, ſet up another, and ſtruck all Europe with terror and admiration, Charles began to evacuate Saxony, in purſuit of his great plan, the dethroning Czar Peter, and conquering the vaſt empire of Ruſſia. While the army was on full march in the neighbourhood of Dreſden, he took the extraordinary reſolution of viſiting king Auguſtus with no more than five attendants. Though he had no reaſon to imagine that Auguſtus either did or could entertain any friendſhip for him, he was not uneaſy at the conſequences of thus putting himſelf entirely in his power. He got to the palace door of Auguſtus before it was known that he had entered the city. General Fleming having ſeen him at a diſtance, had only time to run and inform his maſter. What might be done in the preſent caſe immediately occurred to the miniſter; but Charles entered the elector's chamber in his boots before the latter had time to recover from his ſurpriſe. He breakfaſted with him in a friendly manner, and then expreſſed a deſire of viewing the fortifications. While he was walking round them, a Livonian, who had formerly been condemned in Sweden, and ſerved in the troops of Saxony, thought he could never have a more favourable opportunity of obtaining pardon. He therefore begged of king Auguſtus to intercede for him, being fully aſſured that his majeſty could not refuſe ſo ſlight a requeſt to a prince in whoſe power he then was. Auguſtus accordingly made the requeſt; but Charles refuſed it in ſuch a manner, that he did not think proper to aſk it a ſecond time. Having paſſed ſome hours in this extraordinary viſit, he returned to his army, after having embraced and taken leave of the king he had dethroned.

183 Charles viſits king Auguſtus.

184 Marches againſt the Ruſſians.

The armies of Sweden, in Saxony, Poland, and Finland, now exceeded 70,000 men; a force more than ſufficient to have conquered all the power of Muſcovy, had they met them on equal terms. Peter, who had his army diſperſed in ſmall parties, inſtantly aſſembled it on receiving notice of the king of Sweden's march, was making all poſſible preparations for a vigorous reſiſtance, and was on the point of attacking Staniſlaus, when the approach of Charles ſtruck his whole army with terror. In the month of January 1708 he paſſed the Niemen, and entered the ſouth gate of Grodno juſt as Peter was quitting the place by the north gate. Charles at this time had advanced to ſome diſtance before the army at the head of 600 horſe.

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* See the article Patkul.

185 Defeats and drives them out of Lithuania.

The Czar having intelligence of his ſituation, ſent back a detachment of 2000 men to attack him: but they were utterly defeated; and this diſappointment was followed by the total evacuation of Lithuania. The king purſued his flying enemies in the midſt of ſnow and ice, over mountains, rivers, moraſſes, and through almoſt every obſtacle that could be ſurmounted by human power. He had foreſeen all difficulties, and determined to ſurmount them all. As he knew that the country could not furniſh proviſions ſufficient for the ſubſiſtence of his army, he had provided a great quantity of biſcuit, on which his men chiefly ſubſiſted till they came to the banks of the Berezine, in view of Boriſlow. Here the Czar was poſted, and Charles deſigned to bring him to a battle; after which he could penetrate with the greater eaſe into Ruſſia. Peter, however, did not think proper to come to an action; but retreated towards the Boriſthenes, whither he was purſued by Charles as ſoon as he had refreſhed his army.

186 Gains a remarkable victory.

The Ruſſians had deſtroyed the roads and deſolated the country; nevertheleſs the Swediſh army advanced with great celerity, and in their way defeated 20,000 of the enemy, though entrenched to the teeth. This victory, conſidering the circumſtances in which it was gained, was one of the moſt glorious the Swedes ever obtained. The memory of it is preſerved by a medal ſtruck in Sweden, with this inſcription, *Sylvæ, Paludes, Aggeres, Hoſtes, victi.*

187 The Czar ſues for peace, but receives an haughty anſwer.

When the Ruſſians had repaſſed the Boriſthenes, which ſeparates Poland from Muſcovy, the Czar, finding himſelf cloſely purſued by an enemy with whom he was not able to cope, determined at laſt to propoſe peace. Propoſals were accordingly made; but Charles returned no other anſwer than that he would treat at Moſcow; which being reported to Peter, he coolly replied, "My brother Charles affects to play Alexander, but he will not find in me a Darius." However, he did not think proper to venture an engagement, but continued his retreat; and Charles purſued ſo cloſe, that he was daily ſkirmiſhing with the rear of the enemy. In theſe actions the Swedes had generally the advantage, though in the main theſe victories proved detrimental, by weakening the army in a country where it was impoſſible to recruit.

188 Another deſperate engagement.

Near Smolenſko, the king, with only ſix regiments, defeated a body of 10,000 horſe and 6000 Calmucks. In this engagement he was expoſed to the utmoſt danger, the enemy having ſeparated him from his troops. With one regiment only, he fought with ſuch fury as diſperſed the enemy, and drove them before him, at the time they thought themſelves ſure of taking him priſoner. Two aids-de-camp that fought near him were killed; his horſe was killed, as was alſo an equerry while he preſented another. The enemy had broke through the regiment, and got quite up to the king; who is ſaid to have on this occaſion killed 12 men with his own hand without receiving a wound.

189 Charles arrives within 100 leagues of Moſcow, but finds the roads impaſſable.

184 Marches againſt th Ruſſians.

By the 3d of October 1708 Charles was within 100 leagues of Moſcow; but the Czar had made the roads impaſſable, either by laying them under water, digging deep ditches, or covering them with the wood of whole foreſts. He had alſo deſtroyed the villages on every ſide, and taken away every poſſibility of ſubſiſting an army. The ſeaſon was alſo far advanced; the intenſe ſevere weather was approaching; ſo that the Swedes were threatened with all the miſeries of cold and famine, at the ſame time that they were expoſed to the attacks of an enemy greatly ſuperior in number, who, from their knowledge of the country, had almoſt conſtant opportunities of haraſſing and attacking them by ſurpriſe.

190 Reſolves to paſs thro' the Ukrain.

For theſe reaſons the king reſolved to paſs thro' the Ukrain, where Mazeppa, a Poliſh gentleman, was general and chief of the nation. Mazeppa having been affronted by the Czar, readily entered into a treaty with Charles, whom he promiſed to aſſiſt with 30,000 men, great quantities of proviſions and ammunition, and with all his treaſures, which were immenſe.

191 Meets with great difficulties.

The Swediſh army advanced towards the river Diſna, where they had to encounter the greateſt difficulties; a foreſt above 40 leagues in extent, filled with rocks, mountains, and marſhes. To complete their misfortunes, they were led 30 leagues out of the right way; all the artillery was ſunk in bogs and marſhes; the proviſion of the ſoldiers, which conſiſted of biſcuit, was exhauſted; and the whole army ſpent and emaciated when they arrived at the Diſna. Here they expected to have met Mazeppa with his reinforcement; but inſtead of that, they perceived the oppoſite banks of the river covered with a hoſtile army, and the paſſage itſelf almoſt impracticable. Charles, however, was ſtill undaunted; he let his ſoldiers by ropes down the ſteep banks; they croſſed the river either by ſwimming or on rafters haſtily put together; drove the Ruſſians from their poſt, and continued their march.

192 Defeats the Ruſſians, and is joined by Mazeppa in great diſtreſs.

Mazeppa ſoon after appeared, having with him about 6000 broken remains of the army he had promiſed. The Ruſſians had got intelligence of his deſigns, defeated and diſperſed his adherents, laid his towns in aſhes, and taken all the proviſions collected for the Swediſh army. However, he ſtill hoped to be uſeful by his intelligence in an unknown country; and the Coſſacks, out of revenge, crowded daily to the camp with proviſions.

193 Deſperate encounters between General Lewenhaupt and the Ruſſians.

Greater misfortunes ſtill awaited the Swedes. When Charles entered the Ukrain, he had ſent orders to general Lewenhaupt to meet him with 15,000 men, 6000 of whom were Swedes, and a large convoy of proviſions. Againſt this detachment Peter now bent his whole force, and marched againſt him with an army of 65,000 men. Lewenhaupt had received intelligence that the Ruſſian army conſiſted only of 24,000; a force to which he thought 6000 Swedes ſuperior, and therefore diſdained to entrench himſelf. A furious conteſt enſued; in which the Ruſſians were defeated with the loſs of 15,000 men. The Swedes continued their march; but, by the treachery of their guide, were led into a marſhy country, where the roads were made impaſſable by deep ditches and trees laid acroſs. Here he was again attacked by the Czar with his whole army. Lewenhaupt had ſent a detachment of two battalions to diſpute the paſſage of the enemy over a moraſs; but finding they were likely to be overpowered, he marched at the head of the whole infantry to their relief. Another deſperate battle enſued; when at laſt the Ruſſians were put in diſorder, and on the point of being totally defeated, when the Czar gave orders to the Coſſacks and Calmucks to fire upon all the Ruſſians who fled. "Even kill me (ſaid he) if I ſhould be ſo cowardly as to turn my back." On this the battle was renewed with great vigour; but notwithſtanding theſe poſitive orders, and the example of the Czar himſelf, the Ruſſians were a third time put in diſorder, after loſing 6000 men, when general Baver arrived with a ſtrong reinforcement of freſh Ruſſian troops. The engagement was again renewed, and continued without intermiſſion till night. The Swedes took poſſeſſion of an advantageous poſt; but were next morning attacked by the Ruſſians.

194 All the Swediſh proviſions burnt or taken by the Ruſſians.

Lewenhaupt had formed a kind of rampart of his waggons, but was obliged to ſet fire to them, in order to prevent their falling into the hands of the enemy, and at the ſame time to cover his retreat by the ſmoke. The Ruſſians, however, came ſoon

195 Lewenhaupt joins the main army in ſpite of all oppoſition.

enough to ſave 5000 waggons of thoſe proviſions deſigned for the diſtreſſed Swedes. A ſtrong detachment was ſent to purſue Lewenhaupt; but ſo terrible did he appear, that the Ruſſian general offered him an honourable capitulation. This was refuſed with diſdain; and the battle renewed with the ſame vigour as before. The Swedes, though reduced to 4000, again defeated their enemies, and killed 5000 on the ſpot. After this, Lewenhaupt was ſuffered to purſue his march without moleſtation, but alſo without cannon or proviſions. Prince Menzikoff, indeed, was detached to haraſs him; but ſuch was the formidable appearance of the Swedes even in their diſtreſs, that he was afraid to attack them: ſo that at laſt the 4000 arrived ſafe in the camp of Charles, after having killed upwards of 30,000 of the enemy on their march.

196 Extreme diſtreſs of the Swedes.

197 Charles beſieges Pultowa.

198 A detachment of 8000 Swedes entirely defeated and cut off.

This, we may ſay, was the laſt effort of Swediſh valour. The difficulties they had now to undergo exceeded what human nature could bear; yet ſtill they hoped, by conſtancy and courage, to overcome every obſtacle. In the ſevereſt winter known for a long time even in Ruſſia, they made long marches, clothed like ſavages in the ſkins of wild beaſts; all the draught-horſes periſhed; thouſands of ſoldiers dropped dead with cold and hunger: ſo that by the month of February 1709, the whole army was reduced to 18,000 Swedes. Amidſt numberleſs difficulties theſe penetrated at laſt to Pultowa, a town on the eaſtern frontier of the Ukrain, where the Czar had laid up magazines; and of theſe Charles reſolved to get poſſeſſion. Mazeppa adviſed the king to inveſt the place, in conſequence of his having correſpondence with ſome of the inhabitants, by whoſe means he hoped it would be ſurrendered. However, he was deceived; the beſieged made an obſtinate defence, the Swedes were repulſed in every aſſault, and 8000 of them were defeated, and almoſt entirely cut off, in an engagement with a party of Ruſſians. To complete his misfortunes, Charles received a ſhot from a carabine in his heel, which ſhattered the bone. For ſix hours after he continued calmly on horſeback, giving orders, till he fainted with the loſs of blood; after which he was carried into his tent. It was imagined that amputation would be neceſſary, as the wound had already begun to mortify; but one Newman undertook to ſave the limb. It was told the king that deep inciſions would be neceſſary. "Fall to work then (ſaid he), cut boldly and fear nothing." He held out his leg while the operation was performing; never changed countenance; and while the dreſſing was laid on, ordered an aſſault for the next morning.

199 The Swedes haraſſed by an army of 70,000 Ruſſians.

For ſome days the Czar, with an army of 70,000 men, had lain at a ſmall diſtance, haraſſing the Swediſh camp, and cutting off the convoys of proviſion; but now intelligence was received, that he was advancing as if with a deſign of attacking the lines. In this ſituation, Charles, wounded, diſtreſſed, and almoſt ſurrounded by enemies, is ſaid to have, for the firſt time, aſſembled a grand council of war; the reſult of which was, that it was expedient to march out and attack the Ruſſians. Voltaire, however, totally denies that the king relaxed one jot of his wonted obſtinacy and arbitrary temper: but that, on the 7th of July, he ſent for general Renſchild, and told him, without any emotion, to prepare for attacking the enemy next morning.

203 Battle of Pultowa.

The 8th of July 1709 is remarkable for the battle which decided the fate of Sweden. Charles having left 8000 men in the camp to defend the works and repel the ſallies of the beſieged, began to march againſt his enemies by break of day with the reſt of the army, conſiſting of 26,000 men, of whom 18,000 were Coſſacks. The Ruſſians were drawn up in two lines behind their intrenchments, the horſe in front, and the foot in the rear, with chaſms to ſuffer the horſe to fall back in caſe of neceſſity. General Slippenbach was diſpatched to attack the cavalry; which he did with ſuch impetuoſity, that they were broken in an inſtant. However, they rallied behind the infantry, and returned to the charge with ſuch vigour, that they diſordered the Swedes in their turn, and took Slippenbach priſoner. Charles was now carried in his litter to this ſcene of confuſion. The troops were animated by his preſence, and returned to the charge; the battle became doubtful, when general Creuk was diſpatched by Charles to attack the enemy in flank. Creuk miſtook his way, or, according to others, who had the beſt opportunities of information, was bribed by Ruſſian gold, which occaſioned the loſs of the battle. Peter now diſpatched prince Menzikoff with a ſtrong detachment, to poſt himſelf between the Swedes and Pultowa, to cut off their communication with their camp, and to fall upon their rear. He executed his orders with great ſucceſs; cut off a corps de reſerve of 3000 men; and thus decided the fortune of the day. The king, however, had ranged his remaining troops in two lines; the foot in the centre, and the horſe in the two wings. They had already been twice rallied, and were now attacked with fury on all ſides. Charles, in his litter, with his ſword drawn in one hand, and a piſtol in the other, ſeemed to be everywhere preſent. New misfortunes, however, awaited him. A cannon ball killed both horſes in the litter; and ſcarce were others put in their place, when a ſecond broke the litter itſelf in pieces, and overturned the king. The ſoldiers now believing him killed, fell back in conſternation. The firſt line was broke, and the ſecond fled. Charles did every thing in his power to reſtore order; but the Ruſſians preſſed ſo hard, that rallying was impoſſible, eſpecially as powder was alſo wanting. Renſchild and ſeveral other general officers were taken priſoners; and the king himſelf muſt have fallen into the hands of the enemy, had not count Poniatowſki drawn up 500 horſe, ſurrounded the royal perſon, and with deſperate fury broke through ten regiments of the enemy. With theſe the king arrived on the banks of the Boriſthenes. The Ruſſians forced the Swediſh camp, where they found ſix millions in ſpecie; but could not hinder Lewenhaupt, with 4000 foot and all the remaining cavalry, from retreating to the banks of the Boriſthenes. This, however, availed them but little; for being purſued by prince Menzikoff, they were obliged, for want of boats or bridges, to ſurrender at diſcretion. Charles fled in a mean calaſh, attended by a little troop inviolably attached to his perſon, ſome on foot, and ſome on horſeback. They were obliged to croſs a ſandy deſert, where neither herb nor tree was to be ſeen, and where the burning heat and want of water were more intolerable than the extremities of cold they had formerly ſuffered. The whole had almoſt periſhed for want of water, when a ſpring was fortunately diſcovered; after which they reached Oczakow, a town in the Turkiſh dominions, the baſhaw of which ſupplied the king with every neceſſary. It was ſome time, however, before boats could be got ready for tranſporting the whole of the king's attendants; by which accident 500 Swedes and Coſſacks fell into the hands of the enemy. This loſs affected him more than all his other misfortunes. He ſhed tears at ſeeing acroſs the river Bog the greater part of his few remaining friends carried into captivity, without having it in his power to aſſiſt them. The baſhaw waited upon him to apologize for the delay, and was ſeverely reprimanded by Charles, as if he had been his own ſubject.

201 The Swedes entirely defeated.

202 The camp taken, and the Swediſ army almoſt all killed or taken.

203 Charles arrives ſafe i Turkey.

The king remained but a few days at Oczakow, when the ſeraſquier of Bender ſent an aga to compliment him on his arrival in the Turkiſh dominions, and to invite him to that city.

204 Is kindly received, and his hopes of conquering Ruſſia begin to revive.

city. Here he was treated with the utmoſt hoſpitality: the Turks practiſed to its utmoſt extent their generous maxim of regarding as ſacred the perſons of unfortunate princes who had taken ſhelter in their dominions: and perhaps regarded him, notwithſtanding his misfortunes, as an ally that might be uſeful to themſelves againſt the Ruſſians. Every one, indeed, regarded him in his diſtreſs. The French king offered him a ſafe paſſage from the Levant to Marſeilles, from whence he might eaſily return to his own dominions. But Charles was too obſtinate to receive advice. Puffed up with the notion of imitating Alexander the Great, he diſdained to return except at the head of a numerous army; and he yet expected, by means of the Turks, to dethrone his adverſary the Czar. Negotiations for this purpoſe, indeed, were carried on in the Turkiſh divan; and it was propoſed to eſcort Charles with a numerous army to the frontiers of Poland: but the revolution which took place there quickly put an end to all ſuch projects.

205 Auguſtus recovers the kingdom of Poland.

Auguſtus thought himſelf no longer bound to obſerve the treaty which he had made, than Charles was at hand to force him to it. After the battle of Pultowa, therefore, he entered Poland, and took every meaſure, in concert with the Czar, for the recovery of his kingdom. Staniſlaus was not able to ſtand before ſuch enemies, but was obliged to leave his dominions and fly to Bender, in the diſguiſe of a Swediſh officer, in order to ſhare the fortune of Charles.—

206 The Danes invade Sweden;

It was not in Poland alone that the Swediſh affairs began to ſuffer in conſequence of the defeat at Pultowa. The Danes quickly invaded the province of Schonen with an army of 13,000 foot and 2500 horſe. Only 13,000 Swediſh forces remained to defend all the territories poſſeſſed by Charles in Germany; and of theſe only a ſmall part were allotted for the defence of Schonen. The regency of Sweden, however, exerted themſelves to the utmoſt to repel this ungenerous invaſion; and having collected an army of 12,000 militia and 8000 regulars, diſpatched them under general Steenboek into Schonen. Some Saxon troops were incorporated in this army; and among theſe a prodigious deſertion took place, which the general found it impoſſible to prevent; and thus the Danes gained ſeveral advantages, and at laſt took Chriſtianſtadt. Their inſolence on this ſucceſs was ſo great, that the Swedes demanded to be inſtantly led againſt them.

207 But are utterly defeated.

Here the good fortune of Sweden ſeemed once more to revive. The Danes were driven from a very ſtrong ſituation, with the loſs of 8000 killed and taken priſoners, beſides a vaſt number wounded. The king received the intelligence of this victory with the greateſt exultation; and could not help exclaiming, "My brave Swedes, ſhould it pleaſe God that I once more join you, we ſhall conquer them all!"

In the mean time, Charles, by means of his agents the count Poniatowſki and the Sieur Neugebar, uſed his utmoſt efforts to procure a rupture between the Porte and Ruſſia.

208 The Turks declare war againſt the Ruſſians.

For a long time the money beſtowed by Peter on the vizirs and janiſaries prevailed; but at laſt, in 1711, the grand ſignior, influenced by his mother, who was ſtrongly in the intereſt of Charles, and had been wont to call him *her lion*, determined to avenge his quarrel with Peter. He therefore gave orders to the vizir to fall upon the Ruſſians with an army of 200,000 men. The vizir promiſed obedience; but at the ſame time profeſſed his ignorance in the art of war, and diſlike to the preſent expedition. The khan of Crim Tartary, who had been gained over by the reputation and preſents of the king of Sweden, had orders to take the field with 40,000 of his men, and had the liberty of aſſembling his army at Bender, that Charles might ſee that the war was undertaken upon his account. The Czar, on theſe news, left the ſiege of Riga, where he had continued for ſome months; and with 24,000 men entered Moldavia, where he was joined by Cantemir a vaſſal of the Porte.

209 The Czar brought into a deſperate ſituation, but is relieved by a treaty.

The vizir marched againſt him with a prodigious army, and, through the negligence of the Czar, cooped him up in ſuch a manner that he could neither advance nor retreat. In this deſperate ſituation, he perceived that he was now in as bad a ſituation as Charles at Pultowa; and gave orders for breaking through the enemy with fixed bayonets. The deſponding ſpiritleſs ſoldiers, however, were little diſpoſed to execute theſe orders; when Catharine, wife to the czar, without his knowledge, ſet on foot a treaty with the vizir; and having ſoon obtained his conſent, had the peace ſigned in ſix hours; by which means, in all probability the whole Ruſſian army was ſaved.

The new treaty was moſt violently oppoſed by count Poniatowſki and the khan of Tartary. The former had made the king acquainted with the ſituation of both armies; on which he inſtantly ſet out from Bender, filled with the hopes of fighting the Ruſſians, and taking ample vengeance. Having ridden 50 leagues poſt, he arrived at the camp juſt as the czar was drawing off his half-famiſhed troops.

210 Rage of Charles on this occaſion.

He alighted at Poniatowſki's tent; and being informed of particulars, inſtantly flew in a rage to the vizir, whom he loaded with reproaches, and accuſed of treachery. Recollecting himſelf, however, he propoſed a method by which the fault might be remedied; but finding his propoſal rejected, he poſted back to Bender, after having by the groſſeſt inſults ſhowed his contempt of the vizir.

The violent behaviour of Charles did not promote his intereſt. The vizir perceived that his ſtay in Turkey might prove fatal to himſelf; and therefore determined to get him out of the country as ſoon as poſſible, either by fair means or foul.

211 The Grand Signior deſires him to depart.

Succeeding vizirs adopted the ſame plan; and at laſt the grand ſignior himſelf wrote a letter to the king, in which he deſired him to depart by next winter, promiſing to ſupply him with a ſufficient guard, with money, and every thing elſe neceſſary for his journey. Charles gave an evaſive anſwer, and endeavoured to procraſtinate his journey, as well to gratify his own ſtubborn temper, as becauſe he diſcovered a correſpondence between Auguſtus and the khan of Tartary, the object of which, he had reaſon to believe, was to betray him to the Saxons. When he was therefore again preſſed to fix the day of his departure, he replied, that he could not think of going before his debts were paid. Being aſked how much was neceſſary for this purpoſe, he replied, 1000 purſes (A).

212 Mean and unjuſt behaviour of Charles.

Twelve hundred purſes were inſtantly ſent to the ſeraſquier at Bender, with orders to deliver them to the king of Sweden, but not before he ſhould have begun his journey. By fair promiſes, however, Charles perſuaded him to part with the money; after which, inſtead of ſetting out, he ſquandered away his treaſure in preſents and gratifications, and then demanded 1000 purſes more before he would ſet out. The ſeraſquier was aſtoniſhed at this behaviour. He ſhed tears; and, turning to the king, told him, that his head would be the forfeit of having obliged him with the money. The grand ſignior, on being acquainted with this ſhameful behaviour of Charles, flew into a rage, and called an extraordinary divan, where he himſelf ſpoke, a thing very unuſual for the Turkiſh monarchs. It was unanimouſly agreed that ſuch a trouble-

ſome

(A) Each purſe contained 30 ſequins.

213 The Turks reſolve to force him to depart.

214 His deſperate reſolution to reſiſt.

215 Is abandoned by all his followers except 40.

216 Fights like a madman, but is taken priſoner with all his followers.

ſome gueſt ought to be removed by force ſhould other means fail. Orders were therefore poſitively ſent to Charles to depart; and, in caſe of refuſal, to attack him in his quarters. Nothing could equal his obſtinacy on this occaſion: in ſpite of the menaces of his enemies, in ſpite of the intreaties of his friends, he perſiſted in his reſolution; and at laſt determined to reſiſt, with 300 Swedes, being all the attendants he had, an army of 20,000 janiſaries well armed and furniſhed with cannon. At length he was attacked in good earneſt; though it muſt be owned, that even in this extremity, the Turks ſhowed their regard to him, and were tender of his life, which the king did not return at all in a ſimilar manner. Moſt of the Swedes ſurrendered at once, perhaps as thinking it the only method of ſaving the king's life. This miſconduct, however, had a quite contrary effect. Charles became the more obſtinate, the more deſperate his affairs ſeemed to be. With 40 menial ſervants only, and the generals Hord and Dardorff, he determined to defend himſelf to the laſt extremity. Seeing his ſoldiers lay down their arms, he told the generals, "We muſt now defend the houſe. Come, (adds he with a ſmile), let us fight *pro aris et focis*." The houſe had been already forced by the Tartars, all but a hall which was near the door, and where his domeſtics had aſſembled themſelves. Charles forced his way through the janiſaries, attended by the generals Hord and Dardoff, joined his people, and then barricaded the door. The moment he entered, the enemy, who were in the houſe, threw down their booty, and endeavoured to eſcape at the windows. Charles purſued them from room to room with much bloodſhed, and cleared the houſe in a few minutes. He then fired furiouſly from the windows, killed 200 of the Turks in a quarter of an hour, ſo that the baſhaw who commanded them asw at length forced to ſet the houſe on fire. This was done by arrows with lighted matches ſhot into the roof; but Charles inſtead of quitting it, gave orders for extinguiſhing the fire in which he himſelf aſſiſted with great diligence. All efforts, however, were vain: the roof fell in; and Charles, with his few faithful companions, was ready to be buried in the ruins. In this extremity one called out that there was a neceſſity for ſurrendering. "What a ſtrange fellow! (cries the king), who would rather be a priſoner with the Turks than mix his aſhes with thoſe of his ſovereign." Another had the preſence of mind to cry out, that the chancery was but 50 paces off, had a ſtone roof, and was proof againſt fire. Pleaſed with the thoughts of again coming to blows, the king exclaimed, "A true Swede! Let us take all the powder and ball we can carry." He then put himſelf at the head of his troops, and ſallied out with ſuch fury that the Turks retreated 50 paces; but falling down in the hurry, they ruſhed in upon him, and carried him by the legs and arms to the baſhaw's tent.

217 Staniſlaus arreſted in Turkey.

218 Extreme inſenſibility of Charles.

This extraordinary adventure, which ſavours not a little of inſanity, happened on the 12th of February 1713. He was now kept priſoner, with all his retinue: and in this ſituation he was viſited by the unfortunate Staniſlaus. The latter, as we have already obſerved, came in the diſguiſe of a Swediſh officer, and had indeed ſerved in the Swediſh army in Pomerania, for which reaſon he was arreſted in the Turkiſh dominions; but being known at Bender, notice was ſent to the baſhaw who was conducting the king of Sweden to Adrianople. The baſhaw communicated the news to Baron Fabricius, a favourite of Charles, who immediately imparted it to the king. "Dear Fabricius, (ſays this inflexible monarch), run and tell him never to make peace with Auguſtus; we ſhall ſoon have a change in our affairs."

219 Begins to think of returning to his dominions.

220 Obliged by his unſeaſonable pride, to keep his bed for 10 months.

221 Sends an ambaſſador to the Porte, who is not very favourably received.

Such were the conſiderations that ſtill occurred to the mind of Charles; however, at laſt he ſeemed inclined to ſubmit to his fate, and began ſeriouſly to think of returning to his kingdom, now reduced to the moſt deplorable ſituation. His habitation was now fixed at Demotica, a ſmall town about ſix leagues from Adrianople. Here he was allowed proviſions for his own table and thoſe of his retinue; but only 25 crowns a-day in money, inſtead of 500 which he had received at Bender. During his reſidence here he received a deputation from Heſſe-Caſſel, ſoliciting his conſent to the marriage of the landgrave with Eleonora princeſs royal of Sweden; to which he readily agreed: a deputation was alſo ſent him by the regency of Sweden, requeſting that he would prepare for returning to his own dominions, which were ready to ſink under a ruinous war in his abſence. What determined him, however, more than any thing to haſten his return, was the following accident. The new grand vizir Ibrahim Molla, having for private reaſons determined to come to a rupture with the czar, invited Charles to a conference, in the ſtyle and with the familiarity of an equal. Charles was ſo much chagrined at this indignity, that he ſent his chancellor Mullern to meet the vizir, with a pretence that he was ſick. To avoid giving offence to this miniſter, Charles was obliged to keep his bed during his reſidence at Demotica, which was for 10 months after. At laſt, this vizir being ſtrangled, and the Swediſh intereſt at the Porte thereby entirely ruined, he determined to quit Turkey at all events. His departure was to be negotiated by his favourite Grothuſen, whom he veſted with the character of ambaſſador extraordinary; ſending him to Adrianople with a train of 14 perſons richly dreſſed. To equip this retinue the king was reduced to the moſt mortifying ſhifts, and to the neceſſity of borrowing money from uſurers at 50 *per cent*. The great object was, to obtain from the vizir money and a paſſport. Grothuſen was received with all the reſpect due to his rank; but the vizir ſtarted difficulties. With regard to the paſſport, he ſaid, it could be of no uſe until the conſent of the court of Vienna was firſt obtained; and as to money, he ſaid, "his maſter knew how to *give* when he thought proper, but it was beneath his dignity to *lend*; that the king ſhould have every neceſſary provided for his journey, and poſſibly the Porte might make ſome pecuniary preſent but he would not have it expected." The imperial miniſter, however, removed every difficulty with regard to the paſſport, by granting it in the moſt full and ample manner, in the name of the emperor, the princes and ſtates of Germany. He ſent alſo a preſent to the king, conſiſting of a tent of ſcarlet richly embroidered with gold; a ſabre, the handle of which was ſtudded with jewels; and eight fine horſes richly capariſoned. Money, the article moſt wanted, was entirely forgotten; however, the day was fixed for Charles's departure, and the vizir appointed 60 carriages loaded with all kinds of proviſions, and ſeveral companies of janiſaries and other troops to attend him to the frontiers of Tranſylvania.

222 Sets out for Sweden.

223 Diſmiſſes his retinue, and proceeds with only one attendant.

On the 14th of October 1714, Charles quitted his bed at Demotica, and ſet out for Sweden. All the princes through whoſe territories he was to paſs, had given orders for his entertainment in the moſt magnificent manner; but the king, perceiving that theſe compliments only rendered his impriſonment and other misfortunes more conſpicuous, ſuddenly diſmiſſed his Turkiſh attendants, and aſſembling his own people, bid them take no care about him, but make the beſt of their way to Stralſund. After this he ſet out poſt, in the habit of a German officer, attended only by Colonel During. Keeping the by-roads through Hungary, Moravia, Auſtria, Bavaria, Wirtemberg, the Palatinate, Weſtphalia, and Mecklenburg, he arrived on the 21ſt of November at midnight before the gates of Stralſund. Being unknown, he was admitted with difficulty; but being ſoon recognized by

224
Arrives at Stralſund, and is received with the utmoſt joy.

by the governor, the greateſt tokens of joy were ſhown all over the town. In the midſt of the tumult Charles went to bed. He had been booted for 16 days, and now his legs were ſwelled to ſuch a degree that it was neceſſary to cut his boots off. Having ſlept for ſome hours, he aroſe, reviewed his troops, and gave orders for renewing the war with redoubled vigour.

225
Diſtreſſed ſituation of Sweden.

226
Steenboek defeats the Danes, but is afterwards taken priſoner with his whole army.

Sweden was now in the greateſt diſtreſs. We have already mentioned, that on the news of the defeat at Pultowa, the Danes had invaded Schonen, but were defeated by General Steenboek. This victory, however, did not put an end to the war. On the contrary, the kings of Denmark and Poland, with the czar of Muſcovy, entered into ſtricter bonds of amity than ever. They dreaded the return of Charles to his own dominions, and apprehended that numberleſs victories would ſoon efface the remembrance of Pultowa. They determined, therefore, to make the beſt uſe of their time; and perhaps Charles never took a more imprudent reſolution than obſtinately to remain ſo long in the Turkiſh dominions. The kings of Denmark and Poland invaded Pomerania; but after laying ſiege in vain to Stralſund, Wiſmar, and other places, they were obliged to retire with diſgrace into winter-quarters. In 1712, the king of Denmark invaded and reduced Bremen and Verden; but the ſame year met with a terrible defeat from Steenboek, with the loſs of a vaſt number killed and wounded, and almoſt all their artillery taken. The following year, however, this general being purſued, and ſurrounded by the united forces of the Ruſſians, Danes, and Saxons, was obliged to throw himſelf into the neutral town of Tommingen; where he was beſieged, and obliged to ſurrender at diſcretion, with his whole army. The conſequence of this diſaſter was an invaſion of Finland by the czar: which province he totally reduced, after defeating the Swedes in ſeveral engagements. Indeed, the Swediſh forces were now ſo much reduced, that they were unable to cope with almoſt any enemy. The return of Charles, however, ſeemed to give new life to the whole nation. Though the number of inhabitants was viſibly diminiſhed, the levies he had ordered were completed in a few weeks: but the hands left to cultivate the earth conſiſted of the infirm, aged, and decrepid; ſo that a famine was threatened in conſequence of the military rage which had ſeized all the youth of the kingdom.

227
The king is unable to retrieve the Swediſh affairs.

228
Is encompaſſed on all ſides by enemies.

229
His deſperate valour.

The preſence of Charles did not now produce thoſe conſequences which the allies had feared. The kingdom was too much reduced to be able to furniſh the neceſſary ſupplies of men and money; and though the king's courage and military ſkill were not in the leaſt diminiſhed, the efforts he made, inſtead of reſtoring Sweden to its ſplendour, ſerved entirely to ruin it. In 1715, Pruſſia declared againſt him, on account of his demanding back the town of Stetin, which that monarch had ſeized. To complete his embarraſſment, the elector of Hanover, George I. of Britain, alſo became his enemy. The forces of Denmark, Pruſſia, Saxony, and Hanover, joined to inveſt Wiſmar, while a body of 36,000 men formed the ſiege of Stralſund; at the ſame time that the czar, with a fleet of 20 large ſhips of war, and 150 tranſports, carrying 30,000 men, threw every part of the Swediſh coaſt into the greateſt conſternation. The heroiſm of Charles could not prevail againſt ſo many enemies; yet he was ſtill ſo dreadful, that the prince of Anhalt, with 12,000 brave troops, did not think himſelf a match for this furious enemy when at the head of only 2000, till he had entrenched his army behind a ditch, defended by chevaux de frize. It appeared, indeed, that his precaution was not unneceſſary; for in the night Charles with his men clambered up the ditch, and attacked the enemy in his uſual manner. Numbers, however, at laſt prevailed; and Charles was obliged to retire, after having ſeen his favourite Grothuſen, General Dardorff, and During, the companions of his exile, killed by his ſide, he himſelf being wounded in the breaſt.

230
Stralſund beſieged.

231
And taken, in ſpite of the utmoſt efforts of the king.

This raſh attempt was made in order to ſave Rugen, from whence the town of Stralſund was ſupplied with proviſions. The place was well fortified, and garriſoned with 9000 men, with Charles himſelf at their head; but nothing could reſiſt the efforts of the enemy. The houſes were laid in aſhes by the bombs; the walls miſerably ſhattered, and large breaches made in them by the cannon; ſo that by the 17th of December it was propoſed to give the aſſault. The attack on the horn-work was deſperate: the enemy was twice repulſed; but at laſt, by dint of numbers, effected a lodgment. The next day Charles headed a ſally, in which he dealt terrible deſtruction among the beſiegers, but was at length overpowered and obliged to retreat into the town. At laſt his officers, apprehending that he muſt either fall into the hands of the enemy, or be buried in the ruins of the place, intreated him to retire. A retreat, however was now almoſt as dangerous as to remain in the town, on account of the fleets of the enemy with which the ſea was covered; and it is thought that this very circumſtance induced the king to conſent to it. Setting out, therefore, in a ſmall boat with ſails and oars, he paſſed all the enemy's ſhips and batteries, and arrived ſafe at Yſtedt in Schonen.

232
Charles invades Norway to no purpoſe.

234
A treaty with the Czar of Muſcovy projected.

To revenge himſelf for theſe loſſes, Charles invaded Norway with an army of 25,000 men. The Danes were every where defeated and purſued with that vigour for which the king of Sweden was ſo remarkable; but ſtrong reinforcements arriving from Denmark, and proviſions failing, he was at laſt obliged to retire, and evacuate the country. Soon after this the Swedes loſt Wiſmar; but when every thing ſeemed to go to wreck, Baron Goertz the chief miniſter and favourite of Charles found means to ſet on foot a treaty with the czar of Muſcovy, by which the moſt formidable of all Charles's enemies was taken off. The miniſter found means to work upon the inflexible and ſtubborn temper of Charles, by repreſenting to him that the ceſſion of certain provinces to Peter would induce him to aſſiſt him in his projects of again dethroning Auguſtus, and of replacing James on the throne of Britain; which laſt ſcheme he had projected out of revenge for the elector of Hanover having ſeized on the duchies of Bremen and Verden. In conſequence of the conferences between the czar and Goertz, the former engaged to ſend into Poland an army of 80,000 men, in order to dethrone that prince whom he had ſo long defended. He engaged alſo to furniſh ſhips for tranſporting 30,000 Swedes to Germany and 10,000 into Denmark. This treaty, however, was not fully ratified; and the king's death, which happened in 1718, put a final ſtop to all the great proſpects of Sweden.

234
Charles invades Norway again, and lays ſiege to Frederickſhall.

235
His extreme raſhneſs in conſequence of which he is killed.

The king had reſolved on the conqueſt of Norway before he dethroned Auguſtus; and as no difficulties ever deterred him, he marched his army into that cold and barren country in the month of October, when the ground was covered with froſt and ſnow. With 18,000 men he formed the ſiege of Frederickſhall, though the ſeverity of the froſt rendered it almoſt impoſſible to break ground. Charles, however, reſolved to form trenches; and his ſoldiers cheerfully obeyed, digging into the ground with the ſame labour as if they had been piercing a rock. On the 11th of December the king viſited the trenches in the midſt of a terrible fire from the enemy, imagining that his men might be animated by his preſence. He took his poſt in the moſt dangerous ſtation he could chooſe, ſtanding upon a gabion and leaning with his arm over the parapet, while the enemy were firing chain ſhot at the very ſpot where he ſtood. He was intreated

treated to change his ſtation; but he remained obſtinate, as if he had been proof againſt cannon bullets. At laſt he was ſeen to fall on the parapet with a deep groan. A ſmall cannon-ball had ſtruck him on the temple, beat in the left eye, and forced the right eye quite out of its ſocket; his right hand in the mean time graſped the hilt of his ſword, as if he had meant to revenge the blow (c).

236 Account of the Swediſh affairs from the death of Cha. XII. to the year 1771.

Charles XII. was ſucceeded by his ſiſter the princeſs Ulrica Eleonora, wiſe to the hereditary prince of Heſſe. On this occaſion the ſtates took care to make a previous ſtipulation for the recovery of their liberties, and obliged the princeſs to ſign a paper to this purpoſe before entering on the government. Their firſt care was to make a peace with Great Britain, which the late king intended to have invaded. The Swedes then, to prevent their farther loſſes by the progreſs of the Ruſſian, the Daniſh, the Saxon, and other arms, made many great ſacrifices to obtain peace from thoſe powers. The French, however, about the year 1738, formed a dangerous party in the kingdom, under the name of the *Hots;* which not only broke the internal quiet of the kingdom, but led it into a ruinous war with Ruſſia, by which the province of Finland was loſt. Their Swediſh majeſties having no children, it was neceſſary to ſettle the ſucceſſion; eſpecially as the duke of Holſtein was deſcended from the queen's eldeſt ſiſter, and was, at the ſame time, the preſumptive heir to the empire of Ruſſia. Four competitors appeared; the duke of Holſtein Gottorp, prince Frederic of Heſſe Caſſel nephew to the king, the prince of Denmark, and the duke of Deux Ponts. The duke of Holſtein would have carried the election, had he not embraced the Greek religion, that he might mount the throne of Ruſſia. The czarina interpoſed, and offered to reſtore all the conqueſts ſhe had made from Sweden, excepting a ſmall diſtrict in Finland, if the Swedes would receive the duke of Holſtein's uncle, Adolphus Frederic biſhop of Lubec, as their hereditary prince and ſucceſſor to their crown. This was agreed to; and a peace was concluded at Abo, under the mediation of his Britannic majeſty. This peace was ſo firmly adhered to by the czarina, that his Daniſh majeſty thought proper to drop all reſentment for the indignity done his ſon. The prince-ſucceſſor married the princeſs Ulrica, third ſiſter to the king of Pruſſia; and in 1751 entered into the poſſeſſion of his new dignity, which proved to him a crown of thorns. Through a ſtrange medley of affairs and views of intereſt, the French had acquired vaſt influence in all the deliberations of the Swediſh ſenate, who of late have been little better than penſioners to that crown. The intrigues of the ſenators forced Adolphus to take part in the late war againſt Pruſſia: but as that war was diſagreeable not only to the people, but alſo to the king of Sweden, the nation never made ſo mean an appearance; and upon Ruſſia's making peace with the king of Pruſſia, the Swedes likewiſe made their peace, upon the terms of leaving things as they ſtood at the beginning of the war. Adolphus died diſpirited in 1771, after a turbulent reign of twenty years; and was ſucceeded by his ſon Guſtavus.

237 Guſtavus aſcends the throne.

The moſt remarkable tranſaction of this reign is the revolution which took place in the government in the year 1772, by which the king, from being the moſt limited became one of the moſt deſpotic monarchs in Europe. Ever ſince the death of Charles XII. the whole power of the kingdom had been lodged in the ſtates; and this power they had on all occaſions moſt grievouſly abuſed. Guſtavus therefore determined either to ſeize on that power of which they made ſuch a bad uſe, or periſh in the attempt.

238 Account of the revolution in 1772, by which he became deſpotic.

The revolution was effected in the following manner. On the morning of the 19th of Auguſt 1772, a conſiderable number of officers, as well as other perſons known to be attached to the royal cauſe, had been ſummoned to attend his majeſty. Before ten he was on horſeback, and viſited the regiment of artillery. As he paſſed through the ſtreets he was more than uſually courteous to all he met, bowing familiarly to the loweſt of the people. On the king's return to his palace, the detachment which was to mount guard that day being drawn up together with that which was to be relieved, his majeſty retired with the officers into the guard-room. He then addreſſed them with all that eloquence of which he is ſaid to have been a perfect maſter; and after inſinuating to them that his life was in danger, he expoſed to them in the ſtrongeſt colours the wretched ſtate of the kingdom, the ſhackles in which it was held by means of foreign gold, and the diſſentions and troubles ariſing from the ſame cauſe which had diſtracted the diet during the courſe of fourteen months. He aſſured them that his only deſign was to put an end to theſe diſorders; to baniſh corruption, reſtore true liberty, and revive the ancient luſtre of the Swediſh name, which had been long tarniſhed by a venality as notorious as it was diſgraceful. Then aſſuring them in the ſtrongeſt terms that he diſclaimed for ever all abſolute power, or what the Swedes call *ſovereignty*, he concluded with theſe words: "I am obliged to defend my own liberty and that of the kingdom, againſt the ariſtocracy which reigns. Will you be faithful to me, as your forefathers were to Guſtavus Vaſa and Guſtavus Adolphus? I will then riſk my life for your welfare and that of my country."

The officers, moſt of them young men, of whoſe attachment the king had been long ſecure, who did not thoroughly perhaps ſee into the nature of the requeſt his majeſty made them, and were allowed no time to reflect upon it, immediately conſented to every thing, and took an oath of fidelity to him.

239 Reſolution of a Swediſh officer.

Three only refuſed. One of theſe, Frederic Cederſtrom, captain of a company of the guards, alleged he had already and very lately taken an oath to be faithful to the ſtates, and conſequently could not take that which his majeſty then exacted

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(c) Such is the account given by Voltaire of the untimely death of this northern hero. Many perſons, however, who had the beſt opportunities of procuring authentic information at the time, have declared that they believed he was aſſaſſinated by a Frenchman who was among his attendants. The famous earl of Peterborough, who, in his rapid marches and fearleſs intrepidity, bore no ſmall reſemblance to Charles XII. aſſured biſhop Berkely, that he had no doubt of the Swediſh monarch's having been aſſaſſinated; and Mr Wraxall, in the account of his Travels through Sweden, gives ſuch arguments for the truth of that opinion as leave very little doubt in our minds. It muſt be confeſſed, however, that Mr Coxe reaſons plauſibly in ſupport of the other opinion; and perhaps at this diſtance of time nothing can be ſaid with certainty on this queſtion, but what has been ſaid by Johnſon:

His fall was deſtined to a barren ſtrand,
A petty fortreſs, and a *dubious hand.*
He left the name, at which the world grew pale,
To paint a moral, or adorn a tale.

Vanity of Human Wiſhes.

Sweden.

exacted of him. The king, looking at him ſternly, anſwered, "Think of what you are doing." "I do, replied Cederſtrom; and what I think to day, I ſhall think to-morrow: and were I capable of breaking the oath by which I am already bound to the ſtates, I ſhould be likewiſe capable of breaking that your majeſty now requeſts me to take."

The king then ordered Cederſtrom to deliver up his ſword, and put him in arreſt.

His majeſty, however, apprehenſive of the impreſſion which the proper and reſolute conduct of Cederſtrom might make upon the minds of the other officers, ſhortly afterwards ſoftened his tone of voice; and again addreſſing himſelf to Cederſtrom, told him, that as a proof of the opinion he entertained of him, and the confidence he placed in him, he would return him his ſword without inſiſting upon his taking the oath, and would only deſire his attendance that day. Cederſtrom continued firm; he anſwered, that his majeſty could place no confidence in him that day, and that he begged to be excuſed from the ſervice.

While the king was ſhut up with the officers, Senator Ralling, to whom the command of the troops in the town had been given two days before, came to the door of the guard-room, and was told that he could not be admitted. The ſenator inſiſted upon being preſent at the diſtribution of the orders, and ſent to the king to deſire it; but was anſwered, he muſt go to the ſenate, where his majeſty would ſpeak to him.

The officers then received their orders from the king; the firſt of which was, that the two regiments of guards and of artillery ſhould be immediately aſſembled, and that a detachment of 36 grenadiers ſhould be poſted at the door of the council-chamber to prevent any of the ſenators from coming out.

But before the orders could be carried into execution, it was neceſſary that the king ſhould addreſs himſelf to the ſoldiers; men wholly unacquainted with his deſigns, and accuſtomed to pay obedience only to the orders of the ſenate, whom they had been taught to hold in the higheſt reverence.

240 The king gains over the ſoldiers.

As his majeſty, followed by the officers, was advancing from the guard room to the parade for this purpoſe, ſome of them more cautious, or perhaps more timid than the reſt, became, on a ſhort reflection, apprehenſive of the conſequences of the meaſure in which they were engaged: they began to expreſs their fears to the king, that unleſs ſome perſons of greater weight and influence than themſelves were to take a part in the ſame cauſe, he could hardly hope to ſucceed in his enterpriſe. The king ſtopped a while, and appeared to heſitate. A ſerjeant of the guards overheard their diſcourſe, and cried aloud,—"It ſhall ſucceed—Long live Guſtavus!" His majeſty immediately ſaid, "Then I will venture;"—and ſtepping forward to the ſoldiers, he addreſſed them in terms nearly ſimilar to thoſe he had made uſe of to the officers, and with the ſame ſucceſs. They anſwered him with loud acclamations: one voice only ſaid, No; but it was not attended to.

In the mean time ſome of the king's emiſſaries had ſpread a report about the town that the king was arreſted. This drew the populace to the palace in great numbers, where they arrived as his majeſty had concluded his harangue to the guards. They teſtified by reiterated ſhouts their joy at ſeeing him ſafe; a joy which promiſed the happieſt concluſion to the buſineſs of the day.

The ſenators were now immediately ſecured. They had from the window of the council-chamber beheld what was going forward on the parade before the palace; and, at a loſs to know the meaning of the ſhouts they heard, were coming down to inquire into the cauſe of them, when 30 grenadiers, with their bayonets fixed, informed them it was his majeſty's pleaſure they ſhould continue where they were. They began to talk in a high tone, but were anſwered only by having the door ſhut and locked upon them.

Sweden.

241 Secures the ſenators, and becomes maſter of the whole power in the kingdom.

The moment the ſecret committee heard that the ſenate was arreſted, they ſeparated of themſelves, each individual providing for his own ſafety. The king then mounting his horſe, followed by his officers with their ſwords drawn, a large body of ſoldiers, and numbers of the populace, went to the other quarters of the town where the ſoldiers he had ordered to be aſſembled were poſted. He found them all equally willing to ſupport his cauſe, and to take an oath of fidelity to him. As he paſſed through the ſtreets, he declared to the people, that he only meant to defend them, and ſave his country; and that if they would not confide in him, he would lay down his ſceptre, and ſurrender up his kingdom. So much was the king beloved, that the people (ſome of whom even fell down upon their knees) with tears in their eyes implored his majeſty not to abandon them.

242 Summons an aſſembly of the ſtates;

The king proceeded in his courſe, and in leſs than an hour made himſelf maſter of all the military force in Stockholm. In the mean time the heralds, by proclamation in the ſeveral quarters of the city, ſummoned an aſſembly of the States for the enſuing morning, and declared all members traitors to their country who ſhould not appear. Thither his majeſty repaired in all the pomp of royalty, ſurrounded by his guards, and holding in his hand the ſilver ſceptre of Guſtavus Adolphus. In a very forcible ſpeech, he lamented the unhappy ſtate to which the country was reduced by the conduct of a party ready to ſacrifice every thing to its ambition, and reproached the ſtates with adapting their actions to the views of foreign courts, from which they received the wages of perfidy. "If any one dare contradict this, let him riſe and ſpeak."—Conviction, or fear, kept the aſſembly ſilent, and the ſecretary read the new form of government, which the king ſubmitted to the approbation of the ſtates. It conſiſted of fifty-ſeven articles; of which the following five were the chief.

243 Which accepts a new form of government.

1. The king has the entire power of convoking and diſſolving the aſſembly of the ſtates as often as he thinks proper. 2. His majeſty alone has the command of the army, fleet, and finances, and the diſpoſal of all offices civil and military. 3. In caſe of an invaſion, or of any preſſing neceſſity, the king may impoſe taxes, without waiting for the aſſembly of the ſtates. 4. The diet can deliberate upon no other ſubjects than thoſe propoſed by the king. 5. The king ſhall not carry on an offenſive war without the conſent of the ſtates. When all the articles were gone through, the king demanded if the ſtates approved of them, and was anſwered by a general acclamation. He then diſmiſſed all the ſenators from their employments, adding, that in a few days he would appoint others; and concluded this extraordinary ſcene by drawing out of his pocket a ſmall book of pſalms, from which, after taking off the crown, he gave out Te Deum. All the members very devoutly added their voices to his, and the hall reſounded with thankſgivings, which it is to be feared never roſe to heaven, if ſincerity was neceſſary to their paſſport.

244 The king makes a good uſe of his power.

The power thus obtained the king employed for the good of his ſubjects. He took care that the law ſhould be adminiſtered with impartiality to the richeſt noble and the pooreſt peaſant, making a ſevere example of ſuch judges as were proved to have made juſtice venal. He gave particular attention and encouragement to commerce, was a liberal and enlightened patron of learning and ſcience, and laboured ſtrenuouſly to introduce into his kingdom the moſt valuable improvements in agriculture that had been made in foreign countries.

245 Reforms the army and navy.

But while thus active in promoting the arts of peace, he was not inattentive to thoſe of war. The fleet, which he found decayed and feeble, he in a few years reſtored to a reſpectable footing, and, beſides changing the regulations of the navy, he raiſed a new corps of ſailors, and formed them to the ſervice by continual exerciſe. The army, which, a well as the navy, had been neglected during the ariſtocracy, was next to be reformed. The king began by giving cloaks, tents, and new arms to all the regiments. Afterwards, under the direction of Field Marſhal Count de Heſſenſtein, a new exerciſe was introduced, and ſeveral camps were formed, in which the ſoldiery were manœuvred by the king himſelf. The ſale of military offices, which had been permitted for many years, was entirely ſuppreſſed; and the king provided not only for the re-eſtabliſhment of diſcipline and good order in the army, but for the future welfare of the individuals which compoſed it. Theſe warlike preparations were neceſſary to a plan which he had formed for entirely aboliſhing the power of the ariſtocracy, and freeing Sweden from the factions which had long been formed in it by the court of St Peterſburg. The change which he had introduced into the conſtitution was very inimical to the intrigues of that court; and the Ruſſian ambaſſador exerted himſelf openly to bring about a rupture between the king and the diſcontented nobles. Guſtavus ordered him to quit the kingdom in eight days, and immediately prepared for war with Ruſſia. To this apparently raſh enterpriſe he was incited by the Ottoman Porte, at that time unable to oppoſe the armies of the two empires; and his own ambition, together with the internal ſtate of his kingdom, powerfully concurred to make him lend every aſſiſtance to his ancient ally.

246 His conduct in the war with Ruſſia.

It is needleſs for us to enter into a detail of the particulars of that war, which, as well as the aſtoniſhing activity and military ſkill diſplayed by the Swediſh monarch, are freſh in the memory of all our readers. Suffice it to ſay, that neither Guſtavus Adolphus nor Charles XII. gave greater proofs of undaunted courage and military conduct in their long and bloody wars than were given by Guſtavus the III. from the end of the year 1787 to 1790, when peace was reſtored between the courts of St Peterſburg and Stockholm. Had his army remained faithful, it ſeems in a high degree probable that he would have penetrated to the metropolis of the Ruſſian empire in the firſt campaign; and when he was deſerted by that army, and his councils diſtracted by new hoſtilities commenced againſt him by the Danes, the vigour and reſources of his mind never forſook him. When the court of Copenhagen was compelled, by the means of England and Pruſſia, to withdraw its troops from the territories of Sweden, the king attacked Ruſſia with ſuch vigour both by ſea and land, diſplayed ſuch addreſs in retrieving his affairs when apparently reduced to the laſt extremity, and renewed his attacks with ſuch pertinacious courage, that the empreſs lowered the haughtineſs of her tone, and was glad to treat with Guſtavus as an equal and independent ſovereign.

247 Not an arbitrary deſpot, tho' in ſome actions artful and inſidious.

The king of Sweden was now at liberty to cheriſh again the arts of peace, and to humble the haughty ſpirit of the nobles. For his attempting to deprive thoſe men of that power which they had for many years employed againſt their country, he has been held up to the world as a deſpot who trampled on the liberties of his ſubjects; and, in one word, as a perjured tyrant, who overthrew the conſtitution which he had ſworn to maintain. That he was not troubled with a ſcrupulous conſcience, when ſo artfully conducting the revolution of 1772, muſt be acknowledged; nor can it be denied, that in his treaties with other powers he ſometimes endeavoured to overreach them: but if the neceſſities of ſtate could in any caſe be an apology for falſehood, they would ſufficiently apologize for the duplicity of Guſtavus. He was engaged in the arduous enterpriſe of freeing his ſubjects from an ariſtocratic tyranny ſupported by a foreign power the moſt formidable in the north; he had been forced into a war with that power, and, as there is reaſon to believe, promiſed aſſiſtance which he never received, and it cannot excite wonder nor great indignation, that, as ſoon as he could make an honourable peace, he embraced the opportunity without paying much regard to the intereſts of an alliance, which tamely looked on while he was ſtruggling with difficulties apparently unſurmountable.

248 The revolution beneficial.

That the revolution which he effected in his own country was calculated to promote the general good of the people, is unqueſtionable; and to gain ſuch an object he might ſurely reſtore the crown to its ancient ſplendor, without bringing upon his government the odious epithet of *deſpotiſm*.

249 Produces a conſpiracy againſt the king's life.

The nobles, however, continued diſcontented, and a conſpiracy was planned againſt Guſtavus under his own roof. He had entered into the alliance that was formed againſt the revolutionary government of France; and to raiſe an army which he was to lead in perſon to co-operate with the emperor and the king of Pruſſia, he was obliged to negotiate large loans, and to impoſe upon his ſubjects heavy taxes. The nobles took advantage of that circumſtance to prejudice the minds of many of the people againſt the ſovereign who had laboured ſo long for their real good. On the 16th of March 1792 he received an anonymous letter, warning him of his immediate danger from a plot that was laid to take away his life, requeſting him to remain at home, and avoid balls for a year; and aſſuring him that, if he ſhould go to the maſquerade for which he was preparing, he would be aſſaſſinated that very night. The king read the note with contempt, and at a late hour entered the ball room. After ſome time he ſat down in a box with the compte D'Eſſen, and obſerved that he was not deceived in his contempt for the letter, ſince had there been any deſign againſt his life, no time could be more favourable than that moment.

250 The king dangerouſly wounded.

He then mingled, without apprehenſion, among the crowd; and juſt as he was preparing to retire in company with the Pruſſian ambaſſador, he was ſurrounded by ſeveral perſons in maſks, one of whom fired a piſtol at the back of the king, and lodged the contents in his body. A ſcene of dreadful confuſion immediately enſued. The conſpirators, amidſt the general tumult and alarm, had time to retire to other parts of the room: but one of them had previouſly dropped his piſtols and a dagger cloſe by the wounded king. A general order was given to all the company to unmaſk, and the doors were immediately cloſed; but no perſon appeared with any particular diſtinguiſhing marks of guilt. The king was immediately conveyed to his apartment; and the ſurgeon, after extracting a ball and ſome ſlugs, gave favourable hopes of his majeſty's recovery.

Suſpicions immediately fell upon ſuch of the nobles as had been notorious for their oppoſition to the meaſures of the court. The anonymous letter was traced up to colonel Liljehorn, major in the king's guards, and he was immediately apprehended. But the moſt ſucceſsful clue that ſeemed to offer was in conſequence of the weapons which had fallen from the aſſaſſin. An order was iſſued, directing all the armourers, gunſmiths, and cutlers in Stockholm, to give every information in their power to the officers of juſtice concerning the weapons. A gunſmith who had repaired the piſtols readily recognized them to be the ſame which, he had repeated ſome time ſince for a nobleman of the name of Ankarſtrom, a captain in the army; and the cutler who had made the dagger referred at once to the ſame perſon.

251 The king dies. The king languiſhed from the 17th to the 29th of March. At firſt the reports of his medical attendants were favourable; but on the 28th a mortification was found to have taken place, which terminated his exiſtence in a few hours. On opening his body, a ſquare piece of lead and two ruſty nails were found unextracted within the ribs.

252 His behaviour before his death. During his illneſs, and particularly after he was made acquainted with the certainty of his approaching diſſolution, Gaſtavus continued to diſplay that unſhaken courage which he had manifeſted on every occaſion during his life. A few hours before his deceaſe he made ſome alterations in the arrangement of public affairs. He had before, by his will, appointed a council of regency; but convinced, by recent experience, how little he could depend on the attachment of his nobles and being alſo aware of the neceſſity of a ſtrong government in difficult times, he appointed his brother, the duke of Sudermania, ſole regent, till his ſon, who was then about fourteen, ſhould have attained the age of eighteen years. His laſt words were a declaration of pardon to the conſpirators againſt his life. The actual murderer alone was excepted; and he was excepted only at the ſtrong inſtance of the regent, and thoſe who ſurrounded his majeſty in his dying moments. Immediately on the death of the king, the young prince was proclaimed by the title of Guſtavus IV.

253 Puniſhment of the conſpirators. Ankarſtrom was no ſooner apprehended, than he confeſſed with an air of triumph, that he was the perſon "who had endeavoured to liberate his country from a monſter and a tyrant." Suſpicions at the ſame time fell on the counts Horn and Ribbing, baron Pechlin, baron Ehrenſvard, baron Hartmanſdorf, Von Engerſtrom the royal ſecretary, and others; and theſe ſuſpicions were confirmed by the confeſſion of Ankarſtrom. After a very fair and ample trial, this man was condemned to be publicly and ſeverely whipped on three ſucceſſive days, his right hand and his head to be cut off, and his body impaled; which ſentence he ſuffered not till the 17th of May, long after the death of the king.—His property was given to his children, who, however, were compelled to change their name.

The counts Horn and Ribbing were condemned to loſe their right hands, and to be decapitated. Col. Liljehorn and lieutenant Ehrenſvard were alſo to be beheaded.—All theſe conſpirators were degraded from the rank of nobles, and their property declared to be confiſcated. Major Hartmanſdorf was to forfeit his rank in the army and to be impriſoned for one year. Engerſtrom was to ſuffer perpetual impriſonment, and baron Pechlin and ſecretary Lilleſtrahle to be impriſoned during pleaſure. Four others, accuſed of being concerned in the conſpiracy, were pardoned, and ſome were acquitted.

254 Diviſion of Sweden. The kingdom of the Sweden, in its preſent ſtate, is divided into the following provinces: 1. Sweden Proper. 2. Gothland. 3. Finland. 4. Swediſh Lapland. And, 5. The Swediſh iſlands. Great abatements muſt be made for the lakes and unimproved parts of Sweden, which are ſo extenſive that the habitable part is confined to narrow bounds.

255 Climate, ſoil, &c. The face of Sweden is pretty ſimilar to thoſe of its neighbouring countries; only it has the advantage of navigable rivers.

The ſame may be ſaid with regard to its climate, ſoil, &c. Summer burſts from winter; and vegetation is more ſpeedy than in ſouthern climates. Stoves and warm furs mitigate the cold of winter, which is ſo intenſe, that the noſes and extremities of the inhabitants are ſometimes mortified. The Swedes, ſince the days of Charles XII. have been at incredible pains to correct the native barrenneſs of their country, by erecting colleges of agriculture, and in ſome places with great ſucceſs. The ſoil is much the ſame with that of Denmark and ſome parts of Norway, generally very bad, but in ſome valleys ſurpriſingly fertile. The Swedes, till of late years, had not induſtry ſufficient to remedy the one, nor improve the other. The peaſants now follow the agriculture of France and England; and ſome late accounts ſay, that they rear almoſt as much grain as maintains the natives. Gothland produces wheat, rye, barley, oats, peaſe, and beans; and in caſe of deficiency, the people are ſupplied from Livonia and the Baltic provinces. In ſummer, the fields are verdant, and covered with flowers; and produce ſtrawberries, raſpberries, currants, and other ſmall fruits. The common people know, as yet, little of the cultivation of apricots, peaches, nectarines, pine-apples, and the like high-flavoured fruits; but melons are brought to great perfection in dry ſeaſons.

Sweden produces cryſtals, amethyſts, topazes, prophyry, lapis lazuli, agate, cornelian, marble, and other foſſils. The chief wealth of the country, however, ariſes from her mines of ſilver, copper, lead and iron. The laſt-mentioned metal employs no fewer then 450 forges, hammering-mills, and ſmelting-houſes. A kind of a gold mine has likewiſe been diſcovered in Sweden; but ſo inconſiderable, that from the year 1741 to 1747, it produced only 2398 gold ducats, each valued at 9s. 4d. ſterling. The firſt gallery of one ſilver mine is 100 fathoms below the ſurface of the earth; the roof is ſupported by prodigious oaken beams, and from thence the miners deſcend about 40 fathoms to the loweſt vein. This mine is ſaid to produce 20,000 crowns a year. The product of the copper mines is uncertain; but the whole is loaded with vaſt taxes and reductions of the government, which has no other reſources for the exigences of ſtate. Thoſe ſubterraneous manſions are aſtoniſhingly ſpacious, and at the ſame time commodious for their inhabitants, ſo that they ſeem to form a hidden world. The water-falls in Sweden afford excellent conveniency for turning mills for forges; and for ſome years the exports of iron from Sweden brought in 300,000l. ſterling. Dr Buſching thinks that they conſtituted two-thirds of the national revenue. It muſt, however, be obſerved, that the extortions of the Swediſh government, and the importation of American bar-iron into Europe, and ſome other cauſes, have greatly diminiſhed this manufacture in Sweden; ſo that the Swedes very ſoon muſt apply themſelves to other branches of trade and improvements, eſpecially in agriculture.

256 Animals. The animals differ little from thoſe of Norway and Denmark, only the Swediſh horſe are known to be more ſerviceable in war than the German. The fiſhes found in the rivers and lakes of Sweden are the ſame which thoſe in other northern countries, and taken in ſuch quantities, that their pikes (particularly) are ſalted and pickled for exportation. The train-oil of the ſeals, taken in the gulph of Finland, is a conſiderable article of exportation.

257 Character of the Swedes. There is a great diverſity of characters among the people of Sweden; and what is peculiarly remarkable among them, they have been known to have different characters in different ages. At preſent, their peaſants ſeem to be a heavy plodding race of men, ſtrong and hardy; but without any other ambition than that of ſubſiſting themſelves and their families as well as they can: they are honeſt, ſimple, and hoſpitable; and the mercantile claſſes are much of the ſame caſt; but great application and perſeverance is diſcovered among them all. One could form no idea that the modern Swedes are the deſcendants of thoſe who, under Guſtavus Adolphus and Charles XII. carried terror in their

names through the moſt diſtant countries, and ſhook the foundations of the greateſt empires. The principal nobility and gentry of Sweden are naturally brave, polite, and hoſpitable; they have high and warm notions of honour, and are jealous of their national intereſts. The dreſs of the common people is almoſt the ſame with that of Denmark: the better ſort are infatuated with French modes and faſhion. The common diverſions of the Swedes are, ſkating, running races in ſledges, and ſailing in yachts upon the ice. They are not fond of marrying their daughters when young, as they have little to ſpare in their own life-time. The women go to plough, threſh out the corn, row upon the water, ſerve the brick layers, carry burdens, and do all the common drudgeries in huſbandry.

258 Religion. Chriſtianity was introduced here in the 9th century. Their religion is Lutheran, which was propagated among them by Guſtavus Vaſa, about the year 1523, as we have already related. The Swedes are ſurpriſingly uniform and unremitting in religious matters; and have ſuch an averſion to Popery, that caſtration is the fate of every Roman Catholic prieſt diſcovered in their country. The archbiſhop of Upſal has a revenue of about 400 l. a year; and has under him thirteen ſuffragans, beſides ſuperintendants, with moderate ſtipends. No clergyman has the leaſt direction in the affairs of ſtate; but their morals, and the ſanctity of their lives, endear them ſo much to the people, that the government would repent making them its enemies. Their churches are neat, and often ornamented. A body of eccleſiaſtical laws and canons direct their religious economy. A converſion to Popery, or a long continuance under excommunication, which cannot paſs without the king's permiſſion, is puniſhed by impriſonment and exile.

259 Language. The Swediſh language is a dialect of the Teutonic, and reſembles that of Denmark. The Swediſh nobility and gentry are, in general, more converſant in polite literature than thoſe of many other more flouriſhing ſtates. They have of late exhibited ſome noble ſpecimens of their munificence for the improvement of literature and ſcience, particularly natural hiſtory.

260 Manufactures, &c. The Swediſh commonalty ſubſiſts by agriculture, mining, grazing, hunting, and fiſhing. Their materials for traffic are the bulky and uſeful commodities of maſts, beams, and other ſorts of timber for ſhipping; tar, pitch, bark of trees, potaſh, wooden utenſils, hides, flax, hemp, peltry, furs, copper, lead, iron, cordage, and fiſh.

Even the manufacturing of iron was introduced into Sweden ſo late as the 16th century; for till that time they ſold their own crude ore to the Hanſe-towns, and bought it back again manufactured into utenſils. About the middle of the 17th century, by the aſſiſtance of the Dutch and Flemings, they ſet up ſome manufactures of glaſs, ſtarch, tin, woollen, ſilk, ſoap, leather-dreſſing, and ſaw-mills. Bookſelling was at that time a trade unknown in Sweden. They have ſince had ſugar baking, tobacco-plantations, and manufactures of ſail-cloth, cotton, fuſtian, and other ſtuffs; alſo of linen, alum, brimſtone, paper-mills, and gunpowder-mills. Vaſt quantities of copper, braſs, ſteel, and iron, are now wrought in Sweden, dug from mines, ſome of them more than 1100 feet deep. The iron mine of Dannemora, which is much the moſt profitable of any of thoſe with which every part of Sweden abounds, is ſaid to yield 60lb. of metal in a 100lb. of ore, and the others about 30lb. The iron extracted from this is known in Europe under the name of *Oregrund*; which name is derived from a ſea-port on the Baltic. A large portion of it is employed by different nations for making the beſt ſteel. The mine was diſcovered in 1470. The unwrought ore was firſt ſold to the merchants of Lubeck. It was not until the reign of Guſtavus Vaſa that the Swedes worked it themſelves. It is aſſerted, that the mine of Dannemora yields about 40,000 ſtones of bar-iron *per* year, which is ſuppoſed to be one tenth part of the quantity which all the iron-mines of Sweden produce. Of this product, amounting to 400,000 ſtones, 300,000 are annually exported; the remainder is manufactured at home. It is calculated that no leſs than 25,600 men are employed in mining, and the branches immediately connected with it, *viz.* 4000 for breaking the rocks, either by exploſion or manual labour; 10,000 to hew timber and burn it into charcoal; 2000 are employed in ſmelting; 1800 in tranſporting the metal from the furnaces to the forges; 600 in tranſporting ſand, fuel, &c. 4000 for tranſporting the charcoal, and 2400 at the forges. They have alſo foundaries for cannon, forgeries for fire-arms and anchors, armories, wire and flatting-mills, mills alſo for fulling, and for boring and ſtamping: and of late they have built many ſhips for ſale.

There are likewiſe in Sweden ſome ſilver mines, of which that of *Salba*, or *Salhberg*, is the richeſt as well as the moſt ancient. It exiſted ſo early as 1188, and, during the whole of the 14th century, it yielded 24,000 marks of ſilver *per annum*. In the 15th century the quantity was diminiſhed to 20,000. In the reign of Charles X. it gave only 2000, and it furniſhes at preſent ſtill leſs, the ore yielding only one ounce of pure metal *per* quintal. The chief gallery where the pureſt ſilver was obtained having fallen in, is not yet cleared, notwithſtanding their inceſſant labour. They are alſo digging pits in a perpendicular direction, in order to arrive at the principal vein, which extends itſelf from the north to the ſouth eaſt. Formerly lead employed in ſeparating the metal was imported from England; but the mine furniſhes at preſent a ſufficient quantity for the purpoſe.

Certain towns in Sweden, being 24 in number, are called *Staple-towns*, where the merchants are allowed to import and export commodities in their own ſhips. Thoſe towns which have no foreign commerce, though lying near the ſea, are called *land-towns*. A third kind are termed *mine-towns*, as belonging to mine-diſtricts. The Swedes, about the year 1752, had greatly increaſed their exports, and diminiſhed their imports, moſt part of which arrive or are ſent off in Swediſh ſhips; the Swedes having now a kind of navigation act like that of the Engliſh. Thoſe promiſing appearances were, however, blaſted by the madneſs and jealouſies of the Swediſh government; and the people ſo oppreſſed with taxes, that ſome important revolution was daily expected in that kingdom.

261 Revenues. The revenue of Sweden, ſince the unfortunate wars of Charles XII. has been greatly reduced. Her gold and ſilver ſpecies, in the reign of Ad. Frederic, aroſe chiefly from the king's German dominions. Formerly, the crown-lands, poll-money, tithes, mines, and other articles, are ſaid to have produced a million ſterling. The payments that are made in copper, which is here the chief medium of commerce, is extremely inconvenient; ſome of thoſe pieces being as large as tiles; and a cart or wheelbarrow is often required to carry home a moderate ſum. The Swedes, however, have gold ducats, and eight-mark pieces of ſilver, valued each at 5s. 2d. (ſterling) and the ſubſidies paid them by France help to increaſe their currency.

262 Military ſtrength. No country in the world has produced greater heroes or braver troops than the Swedes; and yet they cannot be ſaid to maintain a ſtanding army, as their forces conſiſt of a regulated militia. The cavalry is clothed, armed, and maintained, by a rate raiſed upon the nobility and gentry, according to their eſtates; and the infantry by the peaſants. Each province is obliged to find its proportion of ſoldiers,

according to the number of farms it contains; every farm of 60l. or 70l. *per annum* is charged with a foot-ſoldier, furniſhing him with diet, lodging, and ordinary clothes, and about 20s. a-year in money; or elſe a little wooden houſe is built him by the farmer, who allows him hay and paſturage for a cow, and ploughs and ſows land enough to ſupply him with bread. When embodied, they are ſubject to military law, but otherwiſe to the civil law of the country. It may therefore literally be ſaid, that every Swediſh ſoldier has a property in the country he defends. This national army is thought to amount to above 50,000 men. Sweden formerly could have fitted out 40 ſhips of the line.

SWEDENBORG (Emanuel), was born at Stockholm on the 29th of January 1689. His father was biſhop of Weſt-Gothia; member of a ſociety for the propagation of the Goſpel, formed on the plan of that of England; and preſident of the Swediſh church in Pennſylvania and London. To this laſt office he was appointed by Charles XII. who ſeems to have had a great regard for the biſhop, and to have continued that regard to his ſon.

Of the courſe of young Swedenborg's education we have procured no account; but from the character of the father, it may be ſuppoſed to have been pious; and by his appearing with reputation as an author, when but 20 years of age, it is proved to have been ſucceſsful. His firſt work was publiſhed in 1709; and the year following he ſent into the world a collection of pieces on different ſubjects, in Latin verſe, under the title of *Ludus Heliconius, ſive Carmina Miſcellanea quæ variis in locis cecinit.* The ſame year he began his travels, firſt into England, and afterwards into Holland, France, and Germany; and returning to Stockholm in 1714, he was two years afterwards appointed to the office of aſſeſſor in the Metallic College by Charles XII. who honoured him with frequent converſations, and beſtowed upon him a large ſhare of his favour. At this period of his life Swedenborg devoted his attention principally to phyſic and mathematical ſtudies; and in 1718 he accompanied the king to the ſiege Frederickſhall, where he gave an eminent proof that he had not ſtudied in vain. Charles could not ſend his heavy artillery to Frederickſhall from the badneſs of the roads, which were then rendered much worſe than uſual by being deeply covered with ſnow. In this extremity Swedenborg brought the ſciences to the aid of valour. By the help of proper inſtruments he cut through the mountains, and raiſed the valleys which ſeparated Sweden from Norway, and then ſent to his maſter two galleys, five large boats, and a ſloop, loaded with battering pieces, to be employed in the ſiege. The length of this canal was about two miles and a half. The execution of this great work, however, did not occupy all his time. In 1716 he had begun to publiſh eſſays and obſervations on the mathematical and phyſical ſciences, under the title of *Dædalus Hyperboreus*; and he found leiſure during the ſiege to complete his intended collection, and alſo in the ſame year to publiſh an introduction to algebra, under the whimſical title of *The Art of the Rules.*

At the ſiege of Frederickſhall he loſt his patron Charles; but found another in Ulrica Eleonora, the ſiſter and ſucceſſor of that hero, by whom in 1719 he was ennobled, and took of courſe his ſeat among the ſenators of the equeſtrian order in the triennial aſſemblies of the ſtates. His promotion did not leſſen his ardour for the ſciences; for he publiſhed in the ſame year *A Method to fix the Value of Money, and to determine the Swediſh Meaſures in ſuch a Way as to ſuppreſs all the Fractions and facilitate the Calculations.* About the ſame time he gave the public a treatiſe on *the Poſition and Courſe of the Planets*; with another on *the Heights of the Tides, and Flux and Reflux of the Sea*; which, from information gathered in different parts of Sweden, appeared to have been greater formerly than when he wrote.

As Swedenborg continued, under the new ſovereign, to hold the office of aſſeſſor to the Metallic College, he thought it neceſſary, for the diſcharge of his duty, to make a ſecond journey into foreign countries, that he might himſelf examine their mines, particularly thoſe of Saxony and Harts. During theſe travels, which were undertaken for the improvement of the manufactures of his native country, he printed at Amſterdam, 1. *Prodromus principiorum Naturalium, ſive novorum tentaminum, Chemiam et Phyſicam experimentalem geometrice explicandi.* 2. *Nova obſervata & inventa circa Ferrum & Ignem, præcipue naturam Ignis Elementarum, una cum nova Camini inventione.* 3. *Methodus nova inveniendi Longitudines locorum terræ marique ope Lunæ.* 4. *Modus conſtruendi receptacula navalia, vulgo en Suedois, Dockybynadder.* 5. *Nova conſtructio aggeris aquatici.* 6. *Modus explorandi virtutes Navigiorum.* And at Leipſic and Hamburg, 7. *Miſcellanea obſervata circa res naturales, præſertim Mineralia, Ignem, & Montium ſtrata.*

European Magazine, 1787, July.

This journey was made, and theſe tracts publiſhed, in the compaſs of a year and a half; and perhaps there has not been another man, Linnæus excepted, who has done ſo much in ſo ſhort a time. After his return in 1722, Swedenborg divided his time ſo equally between the duties of his office and his private ſtudies, that in 1733 he finiſhed his grand work, entitled *Opera Philoſophica & Mineralia*, and had it printed under his own direction in 1734, part at Dreſden and part at Leipſic; in which year he alſo went to inſpect the mines of Auſtria and Hungary. This work is divided into three volumes folio; the title of the firſt is *Principia rerum Naturalium ſive novorum tentaminum, Phænomena Mundi elementaris philoſophice explicandi.* The ſecond, *Regnum ſubterraneum ſive Minerale de Ferro*; and the third, *Regnum ſubterraneum ſive Minerale de Cupro, & Orichalco*; all of them written with great ſtrength of judgment, and ornamented with plates, to facilitate the comprehenſion of the text.

In the year 1729 he was enrolled among the members of the Society of Sciences at Upſal, and was, probably about the ſame time, made a Fellow of the Royal Academy of Sciences at Stockholm; nor were ſtrangers leſs willing than his own countrymen to acknowledge the greatneſs of his merit. Wolfius, with many other learned foreigners, were eager to court his correſpondence. The Academy of St Peterſburg ſent him, on the 17th of December 1734, a diploma of aſſociation as a correſpondent member; and ſoon afterwards the editors of the *Acta Eruditorum* at Leipſic found in his works a valuable ſupplement to their own collection.

By many perſons the approbation of learned academies would have been highly valued; but by Baron Swedenborg it was conſidered as of very little importance. "Whatever of worldly honour and advantage may appear to be in the things before mentioned, I hold them (ſays he) but as matters of low eſtimation, when compared to the honour of that holy office to which the Lord himſelf hath called me, who was graciouſly pleaſed to maniſeſt himſelf to me, his unworthy ſervant, in a perſonal appearance, in the year 1743; to open in me a ſight of the ſpiritual world, and to enable me to converſe with ſpirits and angels; and this privilege has continued with me to this day. From that time I began to print and publiſh various unknown *Arcana*, which have been either ſeen by me or revealed to me, concerning heaven and hell, the ſtate of men after death, the true wor-

Short Account of the Honorable E. Swedenborg.

ſhip of God, the ſpiritual ſenſe of the Scriptures, and many other important truths tending to ſalvation and true wiſdom."

We ſhall not affront the underſtandings of our readers by making upon this account of the Baron's *call* ſuch reflections as every perſon of a ſound mind will make for himſelf; but it is rather remarkable, that a man who had devoted the better part of his life to the ſtudy of ſuch ſciences as generally fortify the mind againſt the deluſions of fanaticiſm, and who had even excelled in theſe ſciences, ſhould have fallen into ſuch a reverie as this. After this extraordinary call, the Baron dedicated himſelf wholly to the great work which, he ſuppoſed, was aſſigned him, ſtudying diligently the word of God, and from time to time publiſhing to his fellow-creatures ſuch important information as was made known to him concerning another world. Among his various diſcoveries concerning the ſpiritual world, one is, that it exiſts not in ſpace. "Of this (ſays he) I was convinced, becauſe I could there ſee Africans and Indians very near me, although they are ſo many miles diſtant here on earth; nay, that I could be made preſent with the inhabitants of other planets in our ſyſtem, and alſo with the inhabitants of planets that are in other worlds, and revolve about other ſuns. By virtue of ſuch preſence (*i. e.* without real ſpace), not of place, I have converſed with apoſtles, departed popes, emperors, and kings; with the late reformers of the church, Luther, Calvin, and Melancthon, and with others from diſtant countries."

Swedenborg's Univerſal Theology, vol. i. p. 87.

Notwithſtanding the want of ſpace in the ſpiritual world, he tells us, "that after death a man is ſo little changed that he even does not know but he is living in the preſent world; that he eats and drinks, and even enjoys conjugal delight as in this world; that the reſemblance between the two worlds is ſo great, that in the ſpiritual world there are cities, with palaces and houſes, and alſo writings and books, employments and merchandizes; that there is gold, ſilver, and precious ſtones there. In a word (he ſays), there is in the ſpiritual world all and every thing that there is in the natural world, but that in heaven ſuch things are in an infinitely more perfect ſtate."

Ibid. N° 734.

Such was his zeal in the propagation of theſe whimſical and ſometimes ſenſual doctrines, that he frequently left his native country to viſit diſtant cities, particularly London and Amſterdam, where all his theological works were printed at a great expence, and with little proſpect or probability of a reimburſement. "Wherever he reſided when on his travels, he was (ſays one of his admirers) a mere ſolitary, and almoſt inacceſſible, though in his own country of a free and open behaviour. He affected no honour, but declined it; purſued no worldly intereſt, but ſpent his time in travelling and printing, in order to communicate inſtruction and benefit to mankind. He had nothing of the preciſe in his manner, nothing of melancholy in his temper, and nothing in the leaſt bordering on enthuſiaſm in his converſation or writings." This is too much. We believe he was an inoffenſive viſionary; of his converſation we cannot judge; but the ſpecimens that we have given of his writings are frantic enthuſiaſm. He died at London, March 29th, in the year 1772; and after lying in ſtate, his remains were depoſited in a vault at the Swediſh church, near Radcliff-Highway.

Short Account, &c. p. 11. and Harley's Preface to the Treatiſe on Influx.

Though Baron Swedenborg's followers appear not to have been numerous during his life, they have increaſed ſince his death; and a ſect ſubſiſts at preſent in England which derives its origin from him, and is called *The New Jeruſalem Church*. The diſcriminating tenets of this ſect ſeem to be the following: "Holding the doctrine of one God, they maintain that this one God is no other than Jeſus Chriſt, and that he always exiſted in a human form; that for the ſake of redeeming the world, he took upon himſelf a proper human or material body, but not a human ſoul; that this redemption conſiſts in bringing the hells or evil ſpirits into ſubjection, and the heavens into order and regulation, and thereby preparing the way for a new ſpiritual church; that without ſuch redemption no man could be ſaved, nor could the angels retain their ſtate of integrity; that their redemption was effected by means of trials, temptations, or conflicts with evil ſpirits; and that the laſt of them, by which Chriſt glorified his humanity, perfecting the union of his divine with his human nature, was the paſſion of the croſs. Though they maintain that there is but one God, and one divine perſon, they hold that in this perſon there is a real Trinity; conſiſting of the divinity, the humanity, and the operation of them both in the Lord Jeſus; a Trinity which did not exiſt from all eternity, but commenced at the incarnation. They believe that the Scriptures are to be interpreted not only in a literal but in a ſpiritual ſenſe, not known to the world till it was revealed to B. Swedenborg; and that this ſpiritual ſenſe extends to every part of Scripture, except the Acts of the Apoſtles. They believe that there are angels attending upon men, reſiding, as B. Swedenborg ſays, in their affections; that temptation conſiſts in a ſtruggle between good and bad angels within men; and that by this means God aſſiſts men in theſe temptations, ſince of themſelves they could do nothing. Indeed B. Swedenborg maintains, that there is an univerſal influx from God into the ſouls of men, inſpiring them eſpecially with the belief of the divine unity. This efflux of divine light on the ſpiritual world he compares to the efflux of the light from the ſun in the natural world.

Prieſtley's Letters to the New Jeruſalem Church, p. 4. &c.

"There are (ſays B. Swedenborg) two worlds, the natural and the ſpiritual, entirely diſtinct, though perfectly correſponding to each other; that at death a man enters into the ſpiritual world, when his ſoul is clothed with a body, which he terms *ſubſtantial*, in oppoſition to the preſent *material* body, which, he ſays, is never to riſe out of the grave."

SWEEP, in the ſea-language, is that part of the mould of a ſhip where ſhe begins to compaſs in the rung-heads: alſo when the hauſer is dragged along the bottom of the ſea to recover any thing that is ſunk, they called this action *ſweeping for it*.

SWEET, in the wine trade, denotes any vegetable juice, whether obtained by means of ſugar, raiſins, or other foreign or domeſtic fruit, which is added to wines with a deſign to improve them.

SWEIN-MOT. See *Forest Courts*.

SWERTIA, MARSH GENTIAN, in botany: A genus of plants belonging to the claſs of *pentandria*, and to the order of *digynia*; and in the natural ſyſtem ranging under the 20th order, *rotaceæ*. The corolla is wheel-ſhaped. There are nectariferous pores at the baſes of the ſegments of the corolla. The capſule is unilocular and bivalve. There are ſix ſpecies; the perennis, difformis, rotata, carinthiaca, corniculata, dichotoma. The perennis is a native of England. It is diſtinguiſhed by radical oval leaves. It flowers in Auguſt.

SWIETENIA, MAHOGANY, in botany: A genus of plants belonging to the claſs of *decandria*, and to the order of *monogynia*; and in the natural ſyſtem arranged under the 54th order, *Miſcellaneæ*. The calyx is quinquefid. There are five petals; the nectarium is cylindrical, ſupporting the antheræ with its mouth. The capſule is five-celled, woody, and opening at the mouth. The ſeeds are imbricated and winged. There is only one ſpecies, the mahagoni, which is a native of the warmeſt parts of America, and grows alſo in the iſland of Cuba, Jamaica, Hiſpaniola, and the Bahama iſlands. It abounded formerly in the low lands of Jamaica, but it is now found only on high hills and places difficult of acceſs.

London Medical Journal.

It thrives in moſt ſoils, but varies in texture and grain according to the nature of the ſoil. On rocks it is of a ſmaller ſize, but very hard and weighty, of a cloſe grain, and beautifully ſhaded; while the produce of the low and richer lands is obſerved to be more light and porous, of a paler colour and open grain; and that of mixed ſoils to hold a medium between both. The tree grows very tall and ſtraight, and is uſually four feet in diameter; the flowers are of a reddiſh or ſaffron colour, and the fruit of an oval form, and about the ſize of a turkey's egg.

Brown's Natural Hiſtory of Jamaica.

The wood is generally hard, takes a fine poliſh, and is found to anſwer better than any other ſort in all kinds of cabinet ware. It is now univerſally eſteemed, and ſells at a good price; but it is pity that it is not cultivated in the more convenient waſte lands of Jamaica. It is a very ſtrong timber, and anſwers very well in beams, joiſts, plank, boards, and ſhingles; and has been frequently put to thoſe uſes in Jamaica in former times. It is ſaid to be uſed ſometimes in ſhip-building; a purpoſe for which it is remarkably adapted, if not too coſtly, being very durable, capable of reſiſting gun-ſhots, and burying the ſhots without ſplintering.

The ſeed-veſſels are of a curious form, conſiſting of a large cone ſplitting into five parts, and diſcloſing its winged ſeeds, diſpoſed in the regular manner of thoſe of an apocynum. The ſeeds being winged, are diſperſed on the ſurface of the ground, where ſome falling into the chinks of the rocks, ſtrike root; then creep out on the ſurface of it, and ſeek another chink, into which they creep and ſwell to ſuch a ſize and ſtrength, that at length the rock ſplits, and is forced to admit of the root's deeper penetration; and with this little nutriment the tree increaſes to a ſtupendous ſize in a few years.

Philoſophical Tranſactions, n° 484.

The firſt uſe to which mahogany was applied in England, was to make a box for holding candles. Dr Gibbons, an eminent phyſician in the latter end of the laſt and beginning of the preſent century, had a brother, a Weſt India captain, who took over ſome planks of this wood as ballaſt. As the Doctor was then building him a houſe in King-ſtreet, Covent-Garden, his brother thought they might be of ſervice to him. But the carpenters, finding the wood too hard for their tools, they were laid aſide for a time as uſeleſs. Soon after, Mrs Gibbons wanting a candle-box, the Doctor called on his cabinet maker (Wollaſton in Long-Acre) to make him one of ſome wood that lay in his garden. Wollaſton alſo complained that it was too hard. The Doctor ſaid he muſt get ſtronger tools. The candle-box was made and approved; inſomuch, that the Doctor then inſiſted on having a bureau made of the ſame wood, which was accordingly done; and the fine colour, poliſh, &c. were ſo pleaſing, that he invited all his friends to come and ſee it. Among them was the ducheſs of Buckingham. Her Grace begged ſome of the ſame wood of Dr Gibbons, and employed Wollaſton to make her a bureau alſo; on which the fame of mahogany and Mr Wollaſton was much raiſed, and things of this ſort became general. This account was given by Henry Mill, Eſq; a gentleman of undoubted veracity.

SWIFT (Dr Jonathan), ſo univerſally admired as a wit and claſſical writer of the Engliſh language, was born in Dublin on November 30th 1667. His father was an attorney, and of a good family; but dying poor, the expence of his ſon's education was defrayed by his friends. At the age of ſix young Swift was ſent to the ſchool of Kilkenny, whence he was removed in his 15th year to Trinity College, Dublin.

In his academical ſtudies (ſays Dr Johnſon) he was either not diligent or not happy. The truth appears to be, that he deſpiſed them as intricate and uſeleſs. He told Mr Sheridan, his laſt biographer, that he had made many efforts, upon his entering the college, to read ſome of the old treatiſes on logic writ by Smegleſius, Keckermannus, Burgerſdicius, &c. and that he never had patience to go thro' three pages of any of them, he was ſo diſguſted at the ſtupidity of the work. When he was urged by his tutor to make himſelf maſter of this branch, then in high eſtimation, and held eſſentially neceſſary to the taking of a degree, Swift aſked him, What it was he was to learn from thoſe books? His tutor told him, The art of reaſoning. Swift ſaid, That he found no want of any ſuch art; that he could reaſon very well without it; and that, as far as he could obſerve, they who had made the greateſt proficiency in logic had, inſtead of the art of reaſoning, acquired the art of wrangling; and inſtead of clearing up obſcurities, had learned how to perplex matters that were clear enough before. For his own part, he was contented with that portion of reaſon which God had given him; and he would leave it to time and experience to ſtrengthen and direct it properly; nor would he run the riſk of having it warped or falſely biaſſed by any ſyſtem of rules laid down by ſuch ſtupid writers, of the bad effects of which he had but too many examples before his eyes in thoſe reckoned the moſt acute logicians. Accordingly, he made a firm reſolution, that he never would read any of thoſe books; which he ſo pertinaciouſly adhered to, that though his degree was refuſed him the firſt time of ſitting for it, on account of his not anſwering in that branch, he went into the hall a ſecond time as ill prepared as before; and would alſo have been ſtopped a ſecond time, on the ſame account if the intereſt of his friends, who well knew the inflexibility of his temper, had not ſtepped in, and obtained it for him; though in a manner little to his credit, as it was inſerted in the College Regiſtry, that he obtained it *ſpeciali gratia*, "by ſpecial favour;" where it remains upon record.

"He remained in the college near three years after this, not through choice, but neceſſity, little known or regarded. By ſcholars he was reckoned a blockhead; and as the lowneſs of his circumſtances would not permit him to keep company with perſons of an equal rank with himſelf, upon an equal footing, he ſcorned to take up with thoſe of a lower claſs, or to be obliged to thoſe of a higher. He lived therefore much alone, and his time was employed in purſuing his courſe of reading in hiſtory and poety, then very unfaſhionable ſtudies for an academic; or in gloomy meditations on his unhappy circumſtances. Yet, under this heavy preſſure, the force of his genius broke out, in the firſt rude draught of the Tale of a Tub, written by him at the age of 19, though communicated to nobody but his chamber fellow Mr Waryng; who, after the publication of the book, made no ſcruple to declare, that he had read the firſt ſketch of it in Swift's hand-writing when he was of that age."

In 1688, being, by the death of Godwin Swift his uncle, who had chiefly ſupported him, left without ſubſiſtence, he went to conſult his mother, who then lived at Leiceſter, about the future courſe of his life; and, by her direction, ſolicited the advice and patronage of Sir William Temple, whoſe father had lived in great friendſhip with Godwin Swift. Temple received him with great kindneſs, and was ſo much pleaſed with his converſation, that he detained him two years in his houſe, and recommended him to king William, who offered to make him a captain of horſe. This, not ſuiting his diſpoſition, and Temple not having it quickly in his power to provide for him otherwiſe, Swift left his patron (1694) in diſcontent; having previouſly taken his maſter's degree at Oxford, by means of a teſtimonial from Dublin, in which the words of diſgrace were omitted. He was reſolved to enter into the church, where his firſt preferment was only L. 100 a-year, being the prebend of *Kilroot* in *Conner*; which ſome time afterwards, upon Sir William Temple's earneſtly inviting him back to his houſe at Moorpark, he reſigned in favour of a clergyman far advanced in years and burdened with a numerous family. For this man he ſolicited the prebend, to which he himſelf inducted him.

In 1699 Swift loſt his patron Sir William Temple, who left him a legacy in money, with the property of his manuſcripts; and, on his death-bed, obtained for him a promiſe from the king of the firſt prebend that ſhould become vacant at Weſtminſter or Canterbury. That this promiſe might not be forgotten, Swift dedicated to the king the poſthumous works with which he was entruſted, and for a while attended the court; but ſoon found his ſolicitations hopeleſs. He was then invited by the earl of Berkely to accompany him into Ireland, where, after ſuffering ſome cruel diſappointments, he obtained the livings of Laracor and Rathbeggin in the dioceſe of Meath; and ſoon afterwards invited over the unfortunate Stella, a young woman of the name of Johnſon, whoſe life he contrived to embitter, and whoſe days, though he certainly loved her, we may confidently affirm that he ſhortened by his caprice.

This lady is generally believed to have been the daughter of Sir William Temple's ſteward; but her niece, a Mrs Hearn, aſſured Mr Berkeley, the editor of a volume of letters intitled *Literary Relics*, that her father was a merchant, and the youngeſt brother of a good family in Nottinghamſhire; that her mother was the intimate friend of lady Gifford, Sir William's ſiſter; and that ſhe herſelf was educated in the family with his niece, the late Mrs Temple of Moorpark by Farnham*. This ſtory would be intitled to the fulleſt credit, had not Mrs Hearn affirmed, in the ſame letter, that, before the death of Sir William Temple, Mrs Johnſon's little fortune had been greatly injured by the South-ſea bubbles, which are known to have injured no perſon till the year 1720: (See COMPANY, II. 1.) When one part of a narrative is ſo palpably falſe, the remainder will always be received with heſitation. But whether Miſs Johnſon was the daughter of Temple's ſteward or of the friend of lady Gifford, it is certain that Sir William left her L. 1000; and that, accompanied by Mrs Dingley, whoſe whole fortune amounted to an annuity of L. 27 for life, ſhe went, in conſequence of Swift's invitation, to Laracor. With theſe two ladies he paſſed his hours of relaxation, and to them he opened his boſom; but they never reſided in the ſame houſe, nor did he ſee either without a witneſs.

In 1701 Swift publiſhed *A Diſcourſe of the Conteſts and Diſſenſions in Athens and Rome*. It was his firſt work, and indeed the only which he ever expreſsly acknowledged. According to his conſtant practice he had concealed his name; but after its appearance, paying a viſit to ſome Iriſh biſhop, he was aſked by him if he had read that pamphlet, and what its reputation was in London. Upon his replying that he believed it was very well liked in London; "Very well liked!" ſaid the biſhop with ſome emotion. "Yes, Sir, it is one of the fineſt tracts that ever was written, and biſhop Burnet is one of the beſt writers in the world." Swift, who always hated Burnet with ſomething more than political rancour, immediately queſtioned his right to the work, when he was told by the biſhop that he was "a young man;" and ſtill perſiſting to doubt of the juſtice of Burnet's claim, on account of the diſſimilarity of the ſtyle of the pamphlet from that of his other works, he was told that he was "a very poſitive young man," as no perſon in England but biſhop Burnet was capable of writing it. Upon which Swift replied, with ſome indignation, I am to aſſure your lordſhip, however, that biſhop Burnet did *not* write the pamphlet, for I wrote it myſelf. And thus was he forced in the heat of argument to avow what otherwiſe he would have for ever concealed.

Early in the enſuing ſpring king William died; and Swift, on his next viſit to London, found queen Anne upon the throne. It was generally thought, upon this event, that the Tory party would have had the aſcendant; but, contrary to all expectation, the Whigs had managed matters ſo well as to get entirely into the queen's confidence, and to have the whole adminiſtration of affairs in their hands. Swift's friends were now in power; and the Whigs in general, knowing him to be the author of the Diſcourſe on the Conteſts, &c. which was written in defence of king William and his miniſters againſt the violent proceedings of the houſe of commons, conſidered themſelves as much obliged to him, and looked upon him as faſt to their party. But Swift thought with the Whigs only in the ſtate; for with reſpect to the church his principles were always thoſe of a Tory. He therefore declined any intimate connection with the leaders of the party, who at that time profeſſed what was called *low church principles*. But what above all ſhocked him, ſays Mr Sheridan, was their inviting Deiſts, Freethinkers, Atheiſts, Jews, and Infidels, to be of their party, under pretence of moderation, and allowing a general liberty of conſcience. As Swift was in his heart a man of true religion, he could not have borne, even in his private character, to have mixed with ſuch a motely crew. But when we conſider his principles in his political capacity, that he looked upon the church of England, as by law eſtabliſhed, to be the main pillar of the newly erected conſtitution, he could not, conſiſtently with the character of a good citizen, join with thoſe who conſidered it more as an ornament than a ſupport to the edifice; and could therefore look on with compoſure while it was undermining, or could even open the gate to a blind multitude, to try, like Sampſon, their ſtrength againſt it, and conſider it only as ſport. With ſuch a party, neither his religious nor political principles would ſuffer him to join; and with regard to the Tories, as is uſual in the violence of factions, they had run into oppoſite extremes, equally dangerous to the ſtate. He was therefore during the earlier part of the queen's reign of no party, but employed himſelf in diſcharging the duties of his function, and in publiſhing from time to time ſuch tracts as he thought might be uſeful. In the year 1704 he publiſhed the *Tale of a Tub*, which, conſidered merely as a work of genius, is unqueſtionably the greateſt which he ever produced; but the levity with which religion was thought to be there treated, raiſed up enemies to him among all parties, and eventually precluded him from a biſhopric. From that period till the year 1708, he ſeems to have employed himſelf in ſolitary ſtudy; but he then gave ſucceſſively to the public *The Sentiments of a Church of England man*, the ridicule of aſtrology under the name of *Bickerſtaff*, the *Argument againſt aboliſhing Chriſtianity*, and the defence of the *Sacramental Teſt*.

Soon after began the buſy and impartant part of Swift's life. He was employed (1710) by the primate of Ireland to ſolicit the queen for a remiſſion of the firſt fruits and twentieth parts to the Iriſh clergy. This introduced him to Mr Harley, afterwards earl of Oxford, who, though a Whig himſelf, was at the head of the Tory miniſtry, and in great need of an auxiliary ſo able as Swift, by whoſe pen he and the other miniſters might be ſupported in pamphlets, poems, and periodical papers. In the year 1710 was commenced the *Examiner;* of which Swift wrote 33 papers, beginning his firſt part of it on the 10th of November 1711. The next year he publiſhed *the Conduct of the Allies* ten days before the parliament aſſembled ; and ſoon afterwards, *Reflections on the barrier Treaty.* The purpoſe of theſe pamphlets was to perſuade the nation to a peace, by ſhowing that "mines had been exhauſted and millions deſtroyed" to ſecure the Dutch and aggrandize the emperor, without any advantage whatever to Great Britain. Though theſe two publications, together with his *Remarks on the Biſhop of Sarum's Introduction to the third Volume of his Hiſtory of the Reformation,* certainly turned the tide of popular opinion, and effectually promoted the deſigns of the miniſtry, the beſt preferment which his friends could venture to give him was the deanery of St Patrick's which he accepted in 1713. In the midſt of his power and his politics he kept a journal of his viſits, his walks, his interviews with miniſters, and quarrels with his ſervant, and tranſmitted it to Mrs Johnſon and Mrs Dingley, to whom he knew that whatever befel him was intereſting ; but in 1714 an end was put to his power by the death of the queen, which broke down at once the whole ſyſtem of Tory politics, and nothing remained for him but to withdraw from perſecution to his deanery.

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* See Inquiry into the Life of Dean Swift, prefixed to Literary Relics, printed in 1789, for Elliot and Kay.

In the triumph of the Whigs, Swift met with every mortification that a ſpirit like his could poſſibly be expoſed to. The people of Ireland were irritated againſt him beyond meaſure ; and every indignity was offered him as he walked the ſtreets of Dublin. Nor was he only inſulted by the rabble, but perſons of diſtinguiſhed rank and character forgot the decorum of common civility to give him a perſonal affront. While his pride was hurt by ſuch indignities, his more tender feelings were alſo often wounded by baſe ingratitude. In ſuch a ſituation he found it in vain to ſtruggle againſt the tide that oppoſed him. He ſilently yielded to it, and retired from the world to diſcharge his duties as a clergyman, and attended, to the care of his deanery. That no part of his time might lie heavy on his hands, he employed his lieſure hours on ſome hiſtorical attempts relating to the change of the miniſters and the conduct of the miniſtry ; and completed the hiſtory of the four laſt years of the queen, which had been begun in her lifetime, but which he never publiſhed. Of the work which bears that title, and is ſaid to be his, Dr Johnſon doubts the genuineneſs ; and it certainly is not ſuch as we ſhould have expected from a man of Swift's ſagacity and opportunities of information.

In the year 1716 he was privately married to Mrs Johnſon by Dr Aſhe biſhop of Clogher ; but the marriage made no change in their ſituation, and it would be difficult to prove (ſays Lord Orrery) that they were ever afterwards together but in the preſence of a third perſon. The dean of St Patrick's lived in a private manner, known and regarded only by his friends, till about the year 1720 that he publiſhed his firſt political pamphlet relative to Ireland, intitled *A propoſal for the Univerſal Uſe of Iriſh Manufactures ;* which ſo rouſed the indignation of the miniſtry that they commenced a proſecution againſt the printer, which drew the attention of the public to the pamphlet, and at once made its author popular.

Whilſt he was enjoying the laurels which this work had wreathed for him, his felicity, as well as that of his wife, was interrupted by the death of Mrs Van Homrigh, and the publication of his poem called *Cadenus and Veneſſa,* which brought upon him much merited obloquy. With Mrs Van Homrigh he become acquainted in London during his attendence at court ; and finding her poſſeſſed of genius and fond of literature, he took delight in directing her ſtudies, till he got inſenſibly poſſeſſion of her heart. From being proud of his praiſe, ſhe grew fond of his perſon ; and deſpiſing vulgar reſtraints, ſhe made him ſenſible that ſhe was ready to receive him as a huſband. She had wit, youth, beauty, and a competent fortune to recommend her ; and for a while Swift ſeems to have been undetermined whether or not he ſhould comply with her wiſh. She had followed him to Ireland, where ſhe lived in a houſe about twelve miles diſtant from Dublin ; and he continued to viſit her occaſionally, and to direct her ſtudies as he had done in London ; but with theſe attentions ſhe was not ſatisfied, and at laſt ſent him a letter written with great ardour and tenderneſs, inſiſting that he ſhould immediately accept or refuſe her as a wife. His anſwer, which probably contained the ſecret of his marriage, be carried himſelf ; and having indignantly thrown it on the lady's table inſtantly quitted the houſe, we believe without ſpeaking to her, and returned to Dublin to reflect on the conſequences of his own conduct. Theſe were dreadful. Mrs Van Homrigh ſurvived her diſappointment but a few weeks ; during which time ſhe cancelled a will that ſhe had made in his favour, and ordered the poem to be publiſhed in which Cadenus had proclaimed her excellence and confeſſed his love.

His patriotiſm again burſt forth in 1724 to obſtruct the currency of Wood's halfpence ; and his zeal was crowned with ſucceſs. Wood had obtained a patent to coin 180,000 l. in halfpence and farthings for the kingdom of Ireland ; and was about to turn his braſs into gold, when Swift finding that the metal was debaſed to an enormous degree, wrote letters under the name of *M. B. Drapier* to ſhow the folly of giving gold and ſilver for coin not worth a third part of its nominal value. A proſecution was carried on againſt the printer ; and lord Carteret, then lord-lieutenant, iſſued proclamation, offering L. 300 for diſcovering the author of the fourth letter. The day after it was publiſhed there was a full levee at the caſtle. The lord-lieutenant was going round the circle, when Swift abruptly entered the chamber, and puſhing his way through the crowd, never ſtopped till he got within the circle ; where, with marks of the higheſt indignation in his countenance, he addreſſed the lord-lieutenant with the voice of a Stentor, that re-echoed though the room, "So, my lord-lieutenant, this is a glorious exploit that you performed yeſterday, in iſſuing a proclamation againſt a poor ſhop-keeper, whoſe only crime is an honeſt endeavour to ſave his country from ruin. You have given a noble ſpecimen of what this devoted nation is to hope for from your government. I ſuppoſe you expect a ſtatue of copper will be erected to you for this ſervice done to Wood." He then went on for a long time, inveighing in the bittereſt terms againſt the patent, and diſplaying in the ſtrongeſt colours all the fatal conſequences of introducing that execrable coin. The whole aſſembly were ſtruck mute with wonder at this unprecedented ſcene. For ſome time a profound ſilence enſued. When lord Carteret, who had liſtened with great compoſure to the whole ſpeech, made this fine reply, in a line of Virgil's :

> *Res duræ, & regni novitas me talia cogunt*
> *Moliri.*

For this time Swift was known by the name of *the Dean* and was known by the populace as the champion, patron, and inſtructor of Ireland.

In 1727 he returned to England ; where, in conjunction with Pope, he collected three volumes of miſcellanies ; and the ſame year he ſent into the world his *Gulliver's Travels,* a production which was read by the high and the low, and filled every reader with a mingled emotion of merriment and amazement. Whilſt he was enjoying the reptutation of this work, he was ſuddenly called to a home of ſorrow. Poor Stella was ſinking into the grave ; and after a languiſhing decay of about two months, died in her 44th year, on January 28. 1728. How much he wiſhed her life is ſhown by his papers; nor can it be doubted that he dreaded the death of her whom he loved moſt, aggravated by the conſciouſneſs that himſelf had haſtened it. With her vaniſhed all his domeſtic enjoyments, and of courſe he turned his thoughts more to public affairs; in the contemplation of which he could ſee nothing but what ſerved to increaſe the malady. The advances of old age, with all its attendant infirmities; the death of almoſt all his old friends; the frequent returns of his moſt diſpiriting maladies, deafneſs and giddineſs; and, above all, the dreadful apprehenſions that he ſhould outlive his underſtanding, made life ſuch a burden to him, that he had no hope left but a ſpeedy diſſolution, which was the object of his daily prayer to the Almighty.

The ſeverity of his temper increaſing, he drove his acquaintance from his table, and wondered why he was deſerted. In 1732, he complains, in a letter to Mr Gay, that "he had a large houſe, and ſhould hardly find one viſitor if he was not able to hire him with a bottle of wine:" and, in another to Mr Pope, "that he was in danger of dying poor and friendleſs, even his female friends having forſaken him; which," as he ſays, "vexed him moſt." Theſe complaints were afterwards repeated in a ſtrain of yet greater ſenſibility: "All my friends have forſaken me.

"*Vertiginoſus, inops, ſurdus, male gratus amicis.*
"Deaf, giddy, helpleſs, left alone,
"To all my friends a burden grown."

The fits of giddineſs and deafneſs to which he had been ſubjected from his boyiſh years, and for which he thought walking or riding the beſt remedy, became more frequent and violent as he grew old; and the preſentiment which he had long entertained of that wretchedneſs which would inevitably overtake him towards the cloſe of life, clouded his mind with melancholy and tinged every object around him. How miſerable he was rendered by that gloomy proſpect, we may learn from the following remarkable ancedote mentioned by Mr Faulkner in his letter to lord Cheſterfield. "One time, in a journey from Drogheda to Navan, the dean rode before the company, made a ſudden ſtop, diſmounted his horſe, fell on his knees, lifted up his hands, and prayed in the moſt devout manner. When his friends came up, he deſired and inſiſted on their alighting; which they did, and aſked him the meaning. "Gentlemen," ſaid he, "pray join your hearts in fervent prayers with mine, that I may never be like this oak-tree, which is decayed and withered at top, while the other parts are ſound." In 1736, while he was writing a ſatire called the *Legion Club* againſt the Iriſh parliament, he was ſeized with ſo dreadful a fit of his malady, that he left the poem unfiniſhed; and never after attempted a compoſition that required a courſe of thinking. From this time his memory gradually declined, his paſſions perverted his underſtanding, and, in 1741, he became utterly incapable of converſation; and it was found neceſſary to appoint legal guardians to his perſon and his fortune. He now loſt all ſenſe of diſtinction. His meat was brought to him cut into mouthfuls; but he would never touch it while the ſervant ſtaid; and at laſt after it ſtood perhaps an hour, would eat it walking; for he continued his old habit, and was on his feet ten hours a-day. During next year a ſhort interval of reaſon enſuing, gave hopes of his recovery; but in a few days he ſunk into lethargic ſtupidity, motionleſs heedleſs, and ſpeechleſs, after a year of total ſilence, however, when his houſe-keeper told him that the uſual illuminations were preparing to celebrate his birth, he anſwered "It is all folly; they had better let it alone." He at laſt ſunk into a perfect ſilence, which continued till the 29th of October 1745, when he expired without a ſtruggle, in his 78th year. The behaviour of the citizens on this occaſion gave the ſtrongeſt proof of the deep impreſſion he had made on their minds. Though he had been ſo many years to all intents and purpoſes dead to the world, and his departure from that ſtate ſeemed a thing rather to be wiſhed than deplored, yet no ſooner was his death announced, than they gathered from all quarters, and forced their way in crowds into the houſe, to pay the laſt tribute of grief to their departed benefactor. Nothing but lamentations was heard all around the quarter where he lived, as if he had been cut off in the vigour of his years. Happy were they who firſt got into the chamber where he lay, to procure, by bribes to the ſervants, locks of his hair, to be handed down as ſacred relics to their poſterity; and ſo eager were numbers to obtain at any price this precious memorial, that in leſs than an hour his venerable head was entirely ſtripped of all its ſilver ornaments, ſo that not a hair remained. By his will, which was dated in May 1740, juſt before he ceaſed to be a reaſonable being, he left about L. 1200 in ſpecific legacies; and the reſt of his fortune, which amounted to about L. 11,000, to erect and endow an hoſpital for lunatics and idiots. He was buried in the moſt private manner, according to directions in his will, in the great aiſle of St Patrick's cathedral, and, by way of monument, a ſlab of black marble was placed againſt the wall, on which was engraved the following Latin epitaph, written by himſelf:

Hic depoſitum eſt corpus
Jonathan Swift, S. T. P.
Hujus Eccleſiæ Cathedralis
Decani:
Ubi ſæva indignatio
Ulterius cor lacerare nequit.
Abi, viator,
Et imitare, ſi poteris,
Strenuum pro virili libertatis vindicem.
Obiit anno (1745)
Menſis (Octobris) die (29.)
Ætatis anno 78.

Swift undoubtedly was a man of native genius. His fancy was inexhauſtible; his conceptions were lively and comprehenſive; and he had the peculiar felicity of conveying them in language equally correct, free and perſpicuous. His penetration was as quick as intuition; he was indeed the critic of nature; and no man ever wrote ſo much, and borrowed ſo little.

As his genius was of the firſt claſs, ſo were ſome of his virtues. The following anecdote will illuſtrate his filial piety. His mother died in 1710, as appears by a memorandum in one of the account-books which Dr Swift always made up yearly, and on each page entered minutely all his receipts and expences in every month, beginning his year from November 1. He obſerved the ſame method all his lifetime till his laſt illneſs. At the foot of that page which includes his expences of the month of May 1710, at the glebe houſe of Laracor in the county of Meath, where he was then reſident, are theſe remarkable words, which ſhow at the ſame time his filial piety, and the religious uſe which he thought it his duty to make of that melancholy event. "*Mem.* On Wedneſday, between ſeven and eight in the evening, May 10. 1710, I received a letter in my chamber at Laracor (Mr Percival and Jo. Beaumont being by) from Mrs F—, dated May 9. with one incloſed, ſent by Mrs Worral at Leiceſter to Mrs F—, giving an account that my dear mother, Mrs Abigail Swift, died that morning, Monday April 24. 1710, about ten o'clock, after a long ſickneſs: being ill all winter, and lame; and extremely ill about a month or ſix weeks before her death. I have now loſt my barrier between me and death. God grant I may live to be as well prepared for it as I confidently believe her to have been! If the way to heaven be through piety, truth, juſtice, and charity, ſhe is there. J. S." He always treated his mother, during her life, with the utmoſt duty and affection; and ſhe ſometimes came to Ireland to viſit him after his ſettlement at Laracor.

The liberality of the dean hath been a topic of juſt encomium with all his admirers; nor could his enemies deny him this praiſe. In his domeſtic affairs, he always acted with ſtrict economy. He kept the moſt regular accounts; and he ſeems to have done this chiefly with a view to increaſe his power of being uſeful. "His income, which was little more than L. 700 *per annum*, he endeavoured to divide into three parts, for the following purpoſes. Firſt, to live upon one-third of it. Secondly, to give another third in penſions and charities, according to the manner in which perſons who received them had lived: and the other third he laid by, to build an hoſpital for the reception of idiots and lunatics." "What is remarkable in this generous man, is this (ſays Mr F.) that when he lent money upon bond or mortgage, he would not take the legal intereſt, but one *per cent.* below it."

His charity appears to have been a ſettled principle of duty more than an inſtinctive effort of good nature: but as it was thus founded and ſupported, it had extraordinary merit, and ſeldom failed to exert itſelf in a manner that contributed moſt to render it beneficial. He did not laviſh his money on the idle and the worthleſs. He nicely diſcriminated characters, and was ſeldom the dupe of impoſition. Hence his generoſity always turned to an uſeful account: while it relieved diſtreſs, it encouraged induſtry, and rewarded virtue. We dwell with great pleaſure on this truly excellent and diſtinguiſhing part of the dean's character: and for the ſake of his charity we can overlook his oddities, and almoſt forgive his faults. He was a very peculiar man in every reſpect. Some have ſaid, "What a man he would have been, had he been without theſe whims and infirmities which ſhaded both his genius and his character!" But perhaps the peculiarities complained of were inſeparable from his genius. The vigour and fertility of the root could not fail now and then of throwing out ſuperfluous ſuckers. What produced theſe, produced alſo the more beautiful branches, and gave the fruit all its richneſs.

It muſt be acknowledged, that the dean's fancy hurried him into great abſurdities and inconſiſtencies, for which nothing but his extraordinary talents and noble virtues, diſcovered in other inſtances, could have atoned. The rancour he diſcovered on all occaſions towards the diſſenters is totally unjuſtifiable. No ſect could have merited it in the degree in which he always ſhowed it to them; for, in ſome inſtances, it bordered on downright perſecution. He doubtleſs had his reaſons for expoſing their principles to ridicule, and might perhaps have ſufficient grounds for ſome of his accuſations againſt their principal leaders in Ireland; but nothing could juſtify his virulence againſt the whole body. In a ſhort poem on one claſs of diſſenters he beſtowed a ſtricture upon Betteſworth, a lawyer eminent for his inſolence to the clergy, which, from a very conſiderable reputation, brought him into immediate and univerſal contempt. Betteſworth, enraged at his diſgrace and loſs, went to the dean, and demanded whether he was the author of that poem? "Mr Betteſworth (anſwered he), I was in my youth acquainted with great lawyers, who, knowing my diſpoſition to ſatire, adviſed me, if any *ſcoundrel* or *blockhead* whom I had lampooned ſhould aſk, 'Are you the author of this paper?' to tell him that I was not the author; and therefore, I tell *you*, Mr Betteſworth, that I am not the author of theſe lines."

Swift has been accuſed of irreligion and miſanthropy, on account of his Tale of a Tub, and his Yahoos in Gulliver's Travels; but both charges ſeem to be ill-founded, or at leaſt not ſupported by that evidence. The *Tale of a Tub* holds up to ridicule ſuperſtitious and fanatical abſurdities; but it never attacks the eſſentials of religion: and in the ſtory of the *Yahoos*, diſguſting we confeſs, there appears to us as little evidence that the author hated his own ſpecies, as in the poems of *Strephon and Chloe*, and the *Ladies' Dreſſing Room*, that he approved of groſſneſs and filth in the female ſex. We do not indeed, with his fondeſt admirers, perceive the moral tendency of the Voyage to the Houyhnhnms, or conſider it as a ſatire admirably calculated to reform mankind; but neither do we think that it can poſſibly corrupt them, or lead them to think meanly of their rational nature. According to Sheridan, "the deſign of this apologue is to place before the eyes of man a picture of the two different parts of his frame, detached from each other, in order that he may the better eſtimate the true value of each, and ſee the neceſſity there is that the one ſhould have an abſolute command over the other. In your merely animal capacity, ſays he to man, without reaſon to guide you, and actuated only by a blind inſtinct, I will ſhow you that you would be degraded below the beaſts of the field. That very form, that very body, you are now ſo proud of, as giving you ſuch a ſuperiority over all other animals, I will ſhow you, owe all their beauty, and all their greateſt powers, to their being actuated by a rational ſoul. Let that be withdrawn, let the body be inhabited by the mind of a brute, let it be prone as theirs are, and ſuffered like theirs to take its natural courſe, without any aſſiſtance from art, you would in that caſe be the moſt deformed, as to your external appearance, the moſt deteſtable of all creatures. And with regard to your internal frame, filled with all the evil diſpoſitions and malignant paſſions of mankind, you would be the moſt miſerable of beings, living in a continued ſtate of internal vexation, and of hatred and warfare with each other.

"On the other hand, I will ſhow another picture of an animal endowed with a rational ſoul, and acting uniformly up to the dictates of right reaſon. Here you may ſee collected all the virtues, all the great qualities, which dignify man's nature, and conſtitute the happineſs of his life. What is the natural inference to be drawn from theſe two different repreſentations? Is it not evidently a leſſon to mankind, warning them not to ſuffer the animal part to be predominant in them, leſt they reſemble the vile Yahoo, and fall into vice and miſery; but to emulate the noble and generous Houyhnhnm, by cultivating the rational faculty to the utmoſt; which will lead them to a life of virtue and happineſs."

Such *may* have been the author's intention; but it is not ſufficiently obvious to produce the proper effect, and is indeed hardly conſiſtent with that incapability under which he repreſents the Yahoos of ever acquiring, by any culture, the virtues of the noble Houyhnhnms.

With reſpect to his religion, it is a fact unqueſtionable, that while the power of ſpeech remained, he continued conſtant in the performance of his private devotions; and in proportion as his memory failed, they were gradually ſhortened, till at laſt he could only repeat the Lord's prayer, which he continued to do till the power of utterance for ever ceaſed. Such a habit as this could not have been formed but by a man deeply impreſſed with a conviction of the truth and importance of revelation.

The moſt inexcuſable part of Swift's conduct is his treatment of Stella and Vaneſſa, for which no proper apology can be made, and which the vain attempts of his friends have only tended to aggravate. One attributes his ſingular

gular conduct to a peculiarity in his conſtitution; but if he knew that he was incapable of fulfilling the duties of the married ſtate, how came he to tie one of the ladies to himſelf by the marriage ceremony, and in the moſt explicit terms to declare his paſſion to the other? And what are we to think of the ſenſibility of a man who, ſtrongly attached as he ſeems to have been to both, could without ſpeaking, fling a paper on the table of the one, which "proved (as our author expreſſes it) her death-warrant," and could throw the other, his beloved Stella, in her laſt illneſs, into unſpeakable agonies, and "never ſee her more, for only adjuring him, by their friendſhip, to let her have the ſatisfaction of dying at leaſt, though ſhe had not lived his acknowledged wife?" Another apologiſt inſinuates, upon ſomething like evidence, that Stella bore a ſon to Swift, and yet labours to excuſe him for not declaring her his wife, becauſe ſhe had agreed at the marriage that it ſhould remain a ſecret from all the world unleſs the diſcovery ſhould be called for by *urgent neceſſity*; but what could be meant by the term *urgent neceſſity* unleſs it alluded to the birth of children, he confeſſes that it would be hard to ſay. The truth we believe to be what has been ſaid by Johnſon, that the man whom Stella had the misfortune to love was fond of ſingularity, and deſirous to make a mode of happineſs for himſelf, different from the general courſe of things and the order of Providence; he wiſhed for all the pleaſures of perfect friendſhip, without the uneaſineſs of conjugal reſtraint. But with this ſtate poor Stella was not ſatisfied: ſhe never was treated as a wife, and to the world ſhe had the appearance of a miſtreſs. She lived ſullenly on, hoping that in time he would own and receive her. This, we believe, he offered at laſt to do, but not till the change of his manners and the deprivation of his mind made her tell him, that "it was too late."

The natural acrimony of Swift's temper had been increaſed by repeated diſappointments. This gave a ſplenetic tincture to his writings, and amidſt the duties of private and domeſtic life it too frequently appeared to ſhade the luſtre of his more eminent virtues.—The dean hath been accuſed of avarice, but with the ſame truth as he hath been accuſed of infidelity. In detached views, no man was more liable to be miſtaken. Even his genius and good ſenſe might be queſtioned, if we were only to read ſome paſſages of his writings. To judge fairly and pronounce juſtly of him as a man and as an author, we ſhould examine the uniform tenor of his diſpoſition and conduct, and the general nature and deſign of his productions. In the latter he will appear great, and in the former good; notwithſtanding the puns and puerilities of the one, and the abſurdities and inconſiſtencies of the other.

SWIFT, in ornithology. See HIRUNDO.

SWIMMING, the art of ſuſpending one's ſelf on water, and at the ſame time making a progreſſive motion thro' it.

1 Swimming not natural to man.

As ſwimming is not natural to man, it is evident that at ſome period it muſt have been unknown among the human race. Nevertheleſs there are no accounts of its origin to be found in the hiſtory of any nation; nor are there any nations ſo barbarous but that the art of ſwimming is known among them, and that in greater perfection than among civilized people. It is probable, therefore, that the art, though not abſolutely natural, will always be acquired by people in a ſavage ſtate from imitating the brute animals, moſt of whom ſwim naturally. Indeed ſo much does this appear to be the caſe, that very expert ſwimmers have recommended it to thoſe who wiſhed to learn the art, to keep ſome frogs in a tub of water conſtantly beſide them, and to imitate the motions by which they move thro' that element.

2 Depends on a ſimple principle.

The theory of ſwimming depends upon one very ſimple principle; namely, that if a force is applied to any body, it will always move towards that ſide where there is the leaſt reſiſtance. Thus, if a perſon ſtanding in a boat puſhes with a pole againſt the ſide or any other part of the veſſel in which he ſtands, no motion will enſue; for as much as he preſſes in one direction with the pole, juſt ſo much does the action of his feet, on which the preſſure of the pole muſt ultimately reſt, puſh the veſſel the other way: but if, inſtead of the ſide of the veſſel, he puſhes the pole againſt the ſhore, then only one force acts upon it, namely, that of the feet; which being reſiſted only by the fluid water, the boat begins to move from the ſhore. Now the very ſame thing takes place in ſwimming, whether the animal be man, quadruped, bird or fiſh. If we conſider the matter ſimply, we may ſuppoſe an animal in ſuch a ſituation that it could not poſſibly ſwim; thus, if we cut off the fins and tail of a fiſh, it will indeed float in conſequence of being ſpecifically lighter than the water, but cannot make any progreſſive motion, or at leaſt but very little, in conſequence of wriggling its body; but if we allow it to keep any of its fins, by ſtriking them againſt the water in any direction, the body moves the contrary way, juſt as a boat moves the contrary way to that in which the oars ſtrike the water. It is true that as the boat is but partly immerged in the water, the reſiſtance is comparatively leſs than when a frog or even any other quadruped ſwims; but a boat could certainly be rowed with oars tho' it was totally immerged in water, only with leſs velocity than when it is not. When a man ſwims, he in like manner ſtrikes the water with his hands, arms, and feet; in conſequence of which the body moves in a direction contrary to the ſtroke. Upon this principle, and on this only, a man may either aſcend, deſcend, or move obliquely, in any poſſible direction in the water. One would think, indeed, that as the ſtrength of a man's arms and legs is but ſmall, he could make but very little way by any ſtroke he could give the water, conſidering the fluidity of that element. Nevertheleſs it is incredible what expert ſwimmers will perform in this way; of which Mr Forſter gives a moſt remarkable inſtance in the inhabitants of Otaheite; whoſe agility, he tells us, was ſuch, that when a nail was thrown overboard, they would jump after it into the ſea, and never fail to catch it before it came to the bottom.

As to the practice of ſwimming, there are but few directions which can be given. The great obſtacle is the natural dread which people have of being drowned; and this it is impoſſible to overcome by any thing but accuſtoming ourſelves to go into the water. With regard to the real danger of being drowned, it is but little; and on innumerable occaſions ariſes entirely from the terror abovementioned, as will appear from the following obſervations by Doctor Franklin.

3 Obſervation by Dr Franklin.

"1ſt, That though the legs, arms, and head, of a human body, being ſolid parts, are ſpecifically ſomewhat heavier than freſh water, yet the trunk, particularly the upper part, from its hollowneſs, is ſo much lighter than water, as that the whole of the body, taken together, is too light to ſink wholly under water, but ſome part will remain above until the lungs become filled with water; which happens from drawing water into them inſtead of air, when a perſon in the fright attempts breathing while the mouth and noſtrils are under water.

"2dly, That the legs and arms are ſpecifically lighter than ſalt water, and will be ſupported by it; ſo that a human body would not ſink in ſalt water though the lungs were filled as above, but from the greater ſpecific gravity of the head.

"3dly, That therefore a perſon throwing himſelf on his back in ſalt water, and extending his arms, may eaſily lie ſo as to keep his mouth and noſtrils free for breathing; and by a ſmall motion of his hands may prevent turning, if he ſhould perceive any tendency to it.

"4thly, That in freſh water, if a man throws himſelf on his back near the ſurface, he cannot long continue in that ſituation, but by a proper action of his hands on the water. If he uſes no ſuch action, the legs and lower part of the body will gradually ſink till he comes into an unright poſition; in which he will continue ſuſpended, the hollow of the breaſt keeping the head uppermoſt.

"5thly, But if in this erect poſition the head is kept upright above the ſhoulders, as when we ſtand on the ground, the immerſion will, by the weight of that part of the head that is out of the water, reach above the mouth and noſtrils, perhaps a little above the eyes, ſo that a man cannot long remain ſuſpended in water with his head in that poſition.

"6thly, The body continued ſuſpended as before, and upright, if the head be leaned quite back, ſo that the face looks upwards, all the back part of the head being then under water, and its weight conſequently in a great meaſure ſupported by it, the face will remain above water quite free for breathing, will riſe an inch higher every inſpiration, and ſink as much every expiration, but never ſo low as that the water may come over the mouth.

"7thly, If therefore a perſon unacquainted with ſwimming, and falling accidentally into the water, could have preſence of mind ſufficient to avoid ſtruggling and plunging, and to let the body take this natural poſition, he might continue long ſafe from drowning, till perhaps help would come; for as to the clothes, their additional weight while immerſed is very inconſiderable, the water ſupporting it; though when he comes out of the water, he would find them very heavy indeed."

4 His method of learning to ſwim,

The method of learning to ſwim is as follows: The perſon muſt walk into water ſo deep that it will reach to the breaſt. He is then to lie down gently on the belly, keeping the head and neck perfectly upright, the breaſt advancing forward, the thorax inflated, and the back bent; then withdrawing the legs from the bottom, and ſtretching them out, ſtrike the arms forwards in uniſon with the legs. Swimming on the back is ſomewhat ſimilar to that on the belly; but with this difference, that although the legs are employed to move the body forwards, the arms are generally unemployed, and the progreſſive motion is derived from the movement of the legs. In diving, a perſon muſt cloſe his hands together, and, preſſing his chin upon his breaſt, make an exertion to bend with force forwards. While in that poſition, he muſt continue to move with rapidity under the ſurface; and whenever he chooſes to return to his former ſituation, he has nothing to do but bend back his head, and he will immediately return to the ſurface.

It is very common for novices in the art of ſwimming to make uſe of corks or bladders to aſſiſt in keeping the body above water. Some have utterly condemned the uſe of theſe; however, Dr Franklin allows that they may be of ſervice for ſupporting the body while one is learning what is called the *ſtroke*, or that manner of drawing in and ſtriking out the hands and feet that is neceſſary to produce progreſſive motion. "But (ſays he) you will be no ſwimmer till you can place confidence in the power of the water to ſupport you: I would therefore adviſe the acquiring that confidence in the firſt place, eſpecially as I have known ſeveral who, by a little of the practice neceſſary for that purpoſe, have inſenſibly acquired the ſtroke, taught as it were by nature.

5 And of acquiring confidence.

"The practice I mean is this: Chooſing a place where the water deepens gradually, walk coolly into it till it is up to your breaſt: then turn round your face to the ſhore, and throw an egg into the water, between you and the ſhore; it will ſink to the bottom, and be eaſily ſeen there, if the water is clear. It muſt lie in the water ſo deep as that you cannot reach it to take it up but by diving for it. To encourage yourſelf in order to do this, reflect that your progreſs will be from deeper to ſhallower water; and that at any time you may, by bringing your legs under you, and ſtanding on the bottom, raiſe your head far above the water: then plunge under it with your eyes open, throwing yourſelf towards the egg, and endeavouring, by the action of your hands and feet againſt the water, to get forward till within reach of it. In this attempt you will find that the water buoys you up againſt your inclination; that it is not ſo eaſy a thing to ſink as you imagined; that you cannot but by active force get down to the egg. Thus you feel the power of the water to ſupport you, and learn to confide in that power; while your endeavours to overcome it, and to reach the egg, teach you the manner of acting on the water with your feet and hands; which action is afterwards uſed in ſwimming to ſupport your head higher above water, or to go forward through it."

6 Swimming a pleaſant and uſeful exerciſe.

As ſwimming is a healthy exerciſe and a pleaſant amuſement, and as a dexterity in it may frequently put it in a man's power to ſave his own life and the lives of his fellow-creatures, perhaps of his deareſt friends, it can neither be uſeleſs nor unintereſting to conſider a few of the evolutions which a ſwimmer muſt be maſter of, that he may move in any direction without difficulty, without danger, and without being unneceſſarily fatigued.

7 How to turn to the right or left.

There are ſeveral different ways of turning one's ſelf in ſwimming. You may do it in this way: Turn the palm of the right hand outwards, extend the arm in the ſame manner, and make a contrary movement with the left hand and left arm; then, by a gradual motion, incline your head and whole body to the left ſide, and the evolution will be finiſhed. There is another way which is eaſier ſtill: Bend your head and body toward that ſide to which you are going to turn. If you wiſh to turn to the left, incline the thumb and the right hand toward the bottom, bend the fingers of the right hand, ſtretch it out, and uſe it for driving away the water ſidewiſe, or, which is the ſame thing, for puſhing yourſelf the contrary way. At the ſame time, with your left hand, the fingers being cloſe, puſh the water behind you, and all at once turn your body and your face to the left, and the manœuvre will be accompliſhed. If you wiſh to turn to the right, you muſt do with your right hand what you did with your left, and with your left what you did with your right. You muſt be careful when turning yourſelf never to ſtretch out your legs, and be ſure that the water be ſo deep that you be in no danger of hurting yourſelf.

8 How to turn from the belly to the back.

When you are ſwimming on your belly, and wiſh to turn on your back, draw your feet in quickly, and throw them before you; ſtretch out your hands behind you, and keep your body firm and ſteady. When you wiſh to turn from ſwimming on your back, fold your feet at once under your body as if you were throwing them to the bottom, and at the ſame inſtant dart your body forwards, that you may fall upon your belly.

9 The eyes ought to be turned towards heaven.

In ſwimming, the eyes ought to be turned towards heaven. This is a moſt important rule, and to the neglect of it many of the accidents which befal ſwimmers are owing. For when they bend their eyes downwards, they inſenſibly bend their head too, and thus the mouth being too deep in the water, may admit a quantity of it in breathing; beſides, the more the body is ſtretched, it covers a greater part of the ſurface of the water, and conſequently its ſpecific gravity is leſs. Any perſon who will make the experiment will find it impoſſible to dive while he keeps his head erect and his eyes fixed on the heavens (A).

10 How to ſwim on the back, The eaſieſt poſture in ſwimming is lying on the back. When you wiſh to ſwim in this poſture, lay yourſelf ſoftly on your back, and raiſe your breaſt to the ſurface of the water, keeping your body extended in the ſame line. Put your hands eaſily over the upper part of your thighs, and throw out your legs and draw then in alternately, keeping them within two feet of the ſurface. In this way you may advance in any direction you pleaſe. You may perhaps not like having ſo much of your head under water; there is, however, no way of ſwimming ſo eaſy, ſo ſafe, and ſo little fatiguing. If you wiſh to ſwim with great rapidity, you may uſe your arms as well as your feet; and you will find this the eaſieſt way of breaking the force of the waves.

11 And advance forwards. In ſwimming on the back, one may advance forward as well as backward. For this purpoſe the body muſt be kept ſtraight and extended; the breaſt inflated, ſo that the hollow of the back may aſſume a ſemicircular form. The hands muſt recline over the upper parts of the thighs. It is alſo neceſſary to raiſe the legs one after another, and draw them in ſtrongly towards the hams, and then leave them ſuſpended in the water. This way of ſwimming is not only pleaſant, but may ſerve to reſt you when fatigued.

12 How to ſwim on one ſide. When you are tired with ſwimming on your back and belly, you may ſwim on one ſide. When you wiſh to do this, ſink a little your left ſide and raiſe your right; you will immediately find yourſelf on your left ſide. Move then your left hand without either raiſing or ſinking it; you have only to ſtretch it and draw it back, as in a ſtraight line, on the ſurface of the water. Independent of the pleaſure which this kind of motion will give you, you will have the ſatisfaction of ſeeing both ſides of the river.

13 How to ſwim on the belly without the aſſiſtance of the hands. It is poſſible to ſwim on the belly without the aſſiſtance of the hands. For this purpoſe you muſt keep your breaſt erect, your neck ſtraight, and fix your hands behind your head, or upon your back, while you move forward by employing your feet. This way is not without its advantages. It is an excellent reſource when the arms are ſeized with a cramp, or with any indiſpoſition which makes it painful to exert them. This in ſome caſes may be preferable to ſwimming on the back; for while in that attitude, one cannot ſee before them without turning every inſtant. If one of your legs be ſeized with a cramp, take hold of it with the hand oppoſite to it, and uſe the other hand and leg to advance or ſupport yourſelf.

14 How to ſwim with the hands joined. A very ancient and graceful mode of ſwimming, is that of ſwimming with the hands joined. When you wiſh to put this in practice, join your hands, keeping the thumbs and fingers towards heaven, ſo that they may appear above the water; then draw them back and puſh them forwards alternately from your breaſt. This method of ſwimming may be uſeful in ſeveral circumſtances, but above all if you are entangled with graſs or weeds. Your hands will then open a paſſage for you.

15 With the hands elevated. As a perſon may ſometimes have occaſion to carry ſomething in his hand in ſwimming, which he is anxious to preſerve from the water, he may ſwim eaſily with one hand and hold a parcel in the other, as Cæſar ſwam with his Commentaries at Alexandria; or one may ſwim with both hands elevated. To perform this well, the ſwimmer muſt raiſe his breaſt, and keep it as much inflated as he can, at the ſame time that he ſupports the arms above the water. It muſt not be concealed, that this method of ſwimming is attended with ſome danger to one who is not dexterous at the art; for if one ſhould imprudently draw in his breaſt, when his arms are raiſed, he would immediately ſink to the bottom.

16 How to riſe to the ſurface after diving. Every one knows that when a man plunges into the water, and when he has reached the bottom, he has nothing to do but to give a ſmall ſtroke with his foot againſt the ground, in order to riſe; but an experienced ſwimmer, if he miſſes the ground, has recourſe to another expedient, which is very pretty, and which has not been conſidered with ſufficient attention. We ſuppoſe him at a conſiderable depth, when he perceives that he cannot reach the bottom. In ſuch a caſe, he firſts puts his hands before his face, at the height of his forehead, with the palms turned outwardly; then holding the fore part of his arm vertically, he makes them move backwards and forwards from right to left; that is to ſay, theſe two parts of his arms, having the elbow as a kind of pivot, deſcribe very quickly, both the hands being open, and the fingers joined, two ſmall portions of a circle before the forehead, as if he would make the water retire, which he in fact does; and from theſe ſtrokes given to the water, there reſults an oblique force, one part of which carries the ſwimmer upwards.

There are many artificial methods of ſupporting one's ſelf in water, but we have not room to deſcribe them.—Thoſe who wiſh to ſee a full account of them may conſult the *Encyclopédie Methodique*.

Swimming of Fiſh. A great proportion of the inhabitants of the waters have an air-bladder, by which they poiſe themſelves. Their movements chiefly depend upon their tail. See COMPARATIVE ANATOMY, n° 147, 155; and ICHTHYOLOGY, n° 3.

SWINDLER, a word which has been lately adopted into the Engliſh language, derived from the German word *ſchwindel*, "to cheat." Swindling has now become ſo common in ſeveral of the great towns of this country, that it is unfortunately too well known to require any deſcription.

SWINE, in zoology. See SUS.

Swine-Stone. See *Swine-STONE*.

SWINGING, a kind of exerciſe ſtrongly recommended to perſons in conſumption by ſome phyſicians, and diſapproved of by others. See MEDICINE, p. 224.

SWING-TREE of a waggon, is the bar faſtened acroſs the fore-guide, to which the traces of the horſes are faſtened.

Swing-Wheel, in a royal pendulum, that wheel which drives the pendulum. In a watch or balance clock it is called the crown-wheel.

SWINGLE, in the fire-works in England, the wooden ſpoke which is fixed to the barrel that draws the wire, and which,

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(A) An intereſting queſtion occurs here, which deſerves to be conſidered. Since the body, when ſpread upon the ſurface, can be ſupported with ſo little exertion, and frequently without any at all, as in ſwimming on the back, how comes it to paſs that a perſon when drowned ſinks and frequently riſes again ſome time afterwards? The reaſon is this: In the act of drowning, the lungs are filled with water, and conſequently the body, being ſpecifically heavier, ſinks. It is well known that the human body contains a great quantity of air: this air is at firſt compreſſed by the water; and while this is the caſe the body remains at the bottom: but as ſoon as the air by its elaſticity endeavours to diſengage itſelf from the compreſſion, the body is ſwelled and expanded, becomes ſpecifically lighter than the water, and conſequently riſes to the top.

which, by its being forced back by the cogs of the wheel, is the occaſion of the force with which the barrel is pulled.

SWITZ, or **SCHWEITS**, the capital of one of the cantons of Switzerland, to which it gives name, ſeated on the eaſt ſide of the lake Lucern, in N. Lat. 46. 55. E. Long. 8. 30.

SWITZERLAND, or **SWISSERLAND**, is bounded on the north by Swabia; on the eaſt by Tirol; on the ſouth by Savoy and the Milaneſe; and on the weſt by France, being about 260 miles long and 100 broad. It is divided into 13 cantons, viz. *Berne, Zurich, Schaffhauſen, Baſil, Lucerne, Underwalden, Uri, Switz, Friburg, Zug, Soleure, Glaris*, and *Appenzel*. See theſe articles.

The Swiſs were anciently called *Helvetii*; and being ſubdued by the Romans, they continued in ſubjection to that power till the empire declined, when they became a part of the kingdom of Burgundy. After that they fell under the dominion of the Franks, then of the Germans; but being oppreſſed by the latter, they threw off the yoke, and erected ſeveral ſtates and republics, which, at the treaty of Weſtphalia in 1648, were recognized as free and independent. The cantons of Switz, Uri, and Underwalden, having, as early as the year 1308, entered into a confederacy in the canton of Switz, and having alſo obtained their firſt victory, in 1315, over Leopold archduke of Auſtria in the ſame canton, its name was given to the whole confederacy, which it ſtill retains. The other cantons ſucceſſively acceded to this aſſociation, but ſome of them not until upwards of 100 years after. With reſpect to the government and conſtitution of theſe cantons, ſome of them are ariſtocracies and ſome democracies. In the former, both the legiſlative and executive power is lodged in the burghers or citizens of the capital of each canton; and of theſe there are ſeven, viz. Zurich, Berne, Baſil, Friburg, Soleure, and Schaffhauſen; an account of the moſt important of which may be ſeen under their reſpective names. In the others, the legiſlative power is lodged in the whole body of the people; and every male above 16, whether maſter or ſervant, has a vote in making laws and in the choice of magiſtrates. For what concerns the whole Helvetic body, there are diets ordinary and extraordinary: the former are held annually, and the others upon particular emergencies; and both are ſummoned by the city of Zurich, which appoints the time and place of their meetings. Beſides the general diets ſince the Reformation, there have been particular diets of the two religions, at which all public affairs of conſequence that regard the two parties are treated ſeparately; for though a ſenſe of their common intereſt obliges them to ſtudy to maintain the league and union, yet it is certain, that the mutual confidence between the cantons is in ſome meaſure loſt through the zeal of each party for their particular opinions, eſpecially of the Roman Catholics. The annual general diets are held always at Frauenfeld or Baden, principally to regulate the affairs of the common bailiages. Lucern takes the lead of the Roman Catholic cantons, being the moſt powerful of that denomination; but Zurich, tho' leſs powerful than that of Berne, takes the precedence of all the other cantons, both Proteſtant and Popiſh. Theſe cantons do not make one commonwealth, but are ſo many independent ſtates, united together by ſtrict alliances for their mutual defence. The extraordinary diets or congreſſes are held at Aldorf. Each canton uſually deputes two envoys both to the ordinary and extraordinary, to which alſo the abbot and the town of St Gall, and the town of Biel, ſend repreſentatives as allies. To the 13 cantons belong in common 21 bailiages, two towns, and two lordſhips. The allies, or incorporated places as they are called, are the abbot and town of St Gall, the three Griſon leagues, the republic of the Valais, the towns of Muhlhauſen and Biel, the principality of Neuenberg or Neufchatel, Geneva, and the biſhop of Baſil. Of theſe the abbot and town of St Gall, and the town of Biel, are regarded as members of the Helvetic body, but the reſt only as allies.

As to the air, ſoil, and produce of Switzerland, that part of the canton of Berne to the eaſt of the lake of Geneva, together with the cantons of Uri, Switz, Underwalden, Glaris, Appenzel, and part of the canton of Lucern, conſiſt of ſtupendous mountains, whoſe tops are ſaid to be from 9000 to 12,000 feet above the level of the ſea, conſiſting of craggy inacceſſible rocks, of which ſome are quite bare, while others are always covered with ice and ſnow. Among the mountains are many excellent medicinal and other ſprings, cold and warm baths, water-falls, craggy precipices, deep narrow valleys, and caverns. They yield alſo a great variety of herbs, thickets, and buſhes, in the upper parts; and in the lower, rich paſtures and woods. The higheſt are thoſe in the canton of Uri. Many of the valleys are covered with lakes, or watered by brooks and rivers. In ſome of them are towns, villages, woods, vineyards, and corn-lands. Both on the mountains and in the valleys the air is extremely cold in winter; but in ſummer it is very pleaſant, cool, and refreſhing on the former, but exceſſively hot in the latter. Sometimes it is winter on the north ſide of a mountain when it is ſummer on the other; nay, flowers may be gathered ſometimes with one hand, and ſnow with the other. Prodigious maſſes of ice and ſnow often fall from them in winter, and do a great deal of damage (ſee GLACIER); and moſt of the ſtreams and rivers take their riſe from the thawing of the ice and ſnow on their ſides and tops. From the riſing or deſcending of the clouds, with which they are commonly enveloped, the inhabitants can, for the moſt part, pretty exactly foretel the changes of the weather; ſo that they ſerve them inſtead of weather-glaſſes. The other and lower parts of Switzerland are very pleaſant and fertile, being diverſified with vineyards, corn-fields, meadows, and paſture-grounds. The mountains in theſe are but mole-hills in compariſon of the others: there is neither ſnow nor ice on them in ſummer; and they frequently afford not only good paſturage, but arable ground. Many petrifactions are found both among theſe and the others, with a variety of foſſils. The ſands of the rivers yield gold-duſt, particularly thoſe of the Rhine, the Emmet, and the Aar, the Reuſs, the Arve, and the Inn. The metals of this country being generally found to be brittle, the only mines that are worked are a few iron ones. In the lower parts of Switzerland they ſow rye, oats, barley, ſpelt, flax, and hemp. Wines of various ſorts are alſo produced in ſome of them, with a variety of fruits. Of wood for fuel and other uſes there is generally plenty; in ſome places, however, they are obliged to burn ſheeps dung, and in others a kind of heath and ſmall ſhrubs. In the valleys they cultivate ſaffron with ſucceſs. The Switzers derive their principal ſubſiſtence from their flocks and herds of cattle, which in ſummer graze upon the mountains. Their cheeſe is much eſteemed, eſpecially that of Berne and Griers in the canton of Friburg. Great numbers of horſes are alſo bred here, and bought up for the French cavalry. Beſides the abovementioned rivers, the Rhone and the Teſin have their ſources in this country. The lakes are very numerous; but the chief are thoſe of Geneva, Neufchatel, Biel, Zurich, Thun, Brien, Conſtance, and Lucern. Both rivers and lakes abound with fiſh, and afford a cheap water-carriage. Switzerland is not ſo populous as many other countries in Europe; and the Popiſh cantons leſs ſo than the Proteſtant. The total number of the inhabitants is computed at two millions.

The language generally ſpoken here is the German, in which alſo all public affairs are tranſacted; but in thoſe parts of the country that border on Italy or France, a corrupt French or Italian prevails. The two predominant religions are Calviniſm and Popery. Of the former are the cantons of Zurich and Berne, the town of St Gall, Geneva, Muhlhauſen, and Biel, the principality of Neufchatel, the greater part of Baſil, Schaffhauſen, the country of the Griſons, the Thurgau, Toggenburg, Glaris, and the Rhine valley; the frontiers of Appenzel, with a ſmall part of Solothurn, and ſome places in the countries of Baden and Sargans. The reſt of the Swiſs cantons, allies and dependents, are Popiſh. For the education of youth there is an univerſity at Baſil, and academies at Zurich, Berne, Lauſanne, and Geneva, beſides gymnaſiums and ſcholæ illuſtres, both in the Popiſh and Proteſtant cantons. There are alſo ſocieties among them for the improvement of the German language and the ſciences.

The principal manufactures are ſnuff and tobacco, linen of ſeveral ſorts, lace, thread, ſilk, and worſted ſtockings, neckcloths, cotton ſtuffs, gloves, handkerchiefs, ſilks of ſeveral ſorts, gold and ſilver brocades, a variety of woollen manufactures, hats, paper, leather of all ſorts, earthen wares, porcelain, toys, watches, clocks, and other hardwares, &c. The trade of Switzerland is greatly promoted by many navigable lakes and rivers. In ſome of the above manufactures, and in cheeſe, butter, ſheep, horſes, black cattle, hides, and ſkins, the exports are conſiderable; and as the imports are chiefly grain and ſalt, with ſome American and Aſiatic goods, there is probably a large balance in their favour. In ſome parts of Switzerland dreſs is reſtrained by ſumptuary laws.

The public revenues are in general very inconſiderable, ariſing chiefly from the uſual regalia, appropriated everywhere to the ſovereign, the demeſnes, and public granaries, voluntary contributions, the ſale of ſalt, and a land-tax; in the Proteſtant cantons, from the church-lands alſo that were ſeized at the Reformation. Except in Zurich, Berne, Baſil, and Schaffhauſen, where the people are more induſtrious, have a greater trade, and are richer than in the others, they defray the ordinary charges, and that is all.

The cantons never keep any ſtanding troops, except for a few garriſons; but their militia is reckoned to be the beſt regulated of any in Europe. Every male from 16 to 60 is enrolled, and about one third of them regimented. They muſt all provide themſelves with arms, cloathing, and accoutrements, and appear on the ſtated days for exerciſe; and the ſeveral cantons and diſtricts muſt be furniſhed with a ſufficient train of artillery, and all the other implements of war. The Switzers of the ſeveral cantons are allowed to engage in the ſervice of ſuch foreign princes and ſtates as are in alliance with thoſe cantons, or with whom they have made a previous agreement. Such ſtates, paying an annual ſubſidy to the reſpective cantons, are allowed to make levies. Every man enliſts voluntarily, and for what number of years he pleaſes; at the expiration of which he is at liberty to return home. A great many thus always returning from foreign ſervice, Switzerland is never unprovided with able and experienced officers and ſoldiers. With reſpect to their character, they are a brave, honeſt, hoſpitable, hardy people; very true to their engagements, friendly, and humane. In ſhort, there is not a people in Europe whoſe national character is better. In their perſons they are generally tall, robuſt, and well-made; but their complexions are none of the beſt, and thoſe that live in the neighbourhood of the mountains are ſubject to wens. The women are ſaid to be generally handſome and well-ſhaped, ſenſible and modeſt, yet frank, eaſy, and agreeable in converſation. Few of the peaſants are miſerably poor; many of them are rich, eſpecially in the Proteſtant cantons, and that of Berne in particular.

SWIVELS, a kind of ring made to turn round in a ſtaple, or other ring. Theſe are uſed when a ſhip lies at her moorings; alſo in tedders for cattle, that they may turn round without unwarping the tedder.

Swivel-Cannon, is a ſmall piece of artillery belonging to a ſhip of war, which carries a ſhot of half a pound, and is fixed in a ſocket on the top of the ſhip's ſide, ſtern, or bow, and alſo in her tops. The trunnions of this piece are contained in a ſort of iron crotch, of which the lower end terminates in a cylindrical pivot reſting in the ſocket, ſo as to ſupport the weight of the cannon. The ſocket is bored in a ſtrong piece of oak, reinforced with iron hoops, in order to enable it to ſuſtain the recoil. By means of this frame, which is called the *ſwivel*, and an iron handle on its caſcable, the gun may be directed by the hand to any object. It is therefore very neceſſary in the tops, particularly when loaded with muſket-balls, to fire down on the upper decks of the adverſary in action.

SWOONING. See Medicine, n° 274.

SWORD, an offenſive weapon worn at the ſide, and ſerving either to cut or ſtab. Its parts are, the handle, guard, and blade; to which may be added the bow, ſcabbard, pummel, &c.

Sword of State, which is borne before the king, lords, and governors of counties, cities, or boroughs, &c. For or before the king, it ought to be carried upright; the hilt as low as the bearer's waiſt, the blade up between his eyes. For or before a duke, the blade muſt decline from the head, and be carried between the neck and the right ſhoulder. For or before an earl, the blade is to be carried between the point of the ſhoulder and the elbow: and for or before a baron, the blade is to be borne in the bend of the arm. This ceremonial form no leſs denotes the dignity of a governor than the coronet ſet on his coat of arms.

Sword-Fiſh. See Xiphias.

SWORN brothers (*fratres jurati*), perſons who, by mutual oath, covenanted to ſhare each others fortune. Formerly, in any notable expedition to invade and conquer an enemy's country, it was the cuſtom for the more eminent ſoldiers to engage themſelves by reciprocal oaths to ſhare the rewards of their ſervice. This practice gave occaſion to the proverb of *ſworn brothers* or *brethren in iniquity*, becauſe of their dividing plunder and ſpoil.

SYCAMORE-tree, in botany. See Acer.

SYCOPHANT, an appellation given by the ancient Athenians to thoſe who informed of the exportation of figs contrary to law; and hence it is ſtill uſed in general for all informers, paraſites, flatterers, cheats, &c.

SYDENHAM (Dr Thomas), an excellent Engliſh phyſician, was the ſon of Willian Sydenham of Winford Eagle in Dorſetſhire, and was born there about the year 1624. He ſtudied at Magdalen-hall, Oxford; but left that univerſity when Oxford was garriſoned for king Charles I. and went to London: where, becoming acquainted with Dr Thomas Cox, an eminent phyſician, that gentleman perſuaded him to apply himſelf to the ſtudy of phyſic; accordingly, after the garriſon was delivered up to the parliament, he retired again to Magdalen-hall, entered on the ſtudy of medicine, and in 1648 was created bachelor of phyſic. Soon after, he was made a fellow of All-Souls college, and continued there ſeveral years: when, leaving the univerſity, he ſettled at Weſtminſter, became doctor of his faculty at Cambridge; grew famous for his practice; and was the chief phyſician in London from the year 1660 to 1670; at which period he began to be diſabled by the gout. He died in 1689. His works are highly eſteemed both at home and abroad. He was famous for his cool regimen in the ſmall-pox; for giving the bark after the paroxyſm in agues; and

for

Syderopœcilus
Sylla.

for his uſe of laudanum. He regulated his practice more by his own obſervations and inquiries, than by the method either of his predeceſſors or contemporaries.

SYDEROPŒCILUS, in natural hiſtory, the name of a ſtone mentioned by the ancients. It was found in Arabia, and ſeems to have obtained this name from its being ſpotted with a ferruginous colour. The deſcriptions of the ancients are, however, in this, as in many other inſtances, too ſhort to ſuffer us to gueſs what ſtone they meant.—This might poſſibly be a granite with ſpots of this peculiar colour.

SYENE, an ancient city of Egypt, ſituated, according to Mr Bruce, in north latitude 24° 0′ 45″. Pliny and Strabo both ſay that it lay directly under the tropic of Cancer. Whether Mr Bruce's authority be ſufficient to overturn the evidence of Pliny and Strabo, we ſhall leave to others to determine.

Syene is remarkable for being the place where the firſt attempt was made to meaſure the circumference of the earth. This was done by Eratoſthenes, whom Ptolemy Euergetes had invited from Athens to Alexandria. In this attempt two poſitions were aſſumed, viz. that Alexandria and Syene were exactly 5000 ſtadia diſtant from each other, and that they were preciſely under the ſame meridian; but both theſe are denied by Mr Bruce, who has made many obſervations on the ſubject, which our limits will not allow us to take notice of at preſent. He tells us, that there is at Aſum an obeliſk erected by Ptolemy Euergetes, the patron of Eratoſthenes, without hieroglyphics, directly facing the ſouth, with its top firſt cut into a narrow neck, then ſpread out like a fan into a ſemicircular form, with pavements curiouſly levelled to receive the ſhade, and make the ſeparation of the true ſhadow from the penumbra as diſtinct as poſſible. This is ſuppoſed by Mr Bruce to have been conſtructed with a deſign to vary the experiment of Eratoſthenes with a larger radius; and the inquiry concerning the dimenſions of the earth, in our author's opinion, was the occaſion of many obeliſks being erected in this kingdom; a demonſtration of which is, that the figure of the top is varied; being ſometimes very ſharp, and ſometimes a portion of a circle, in order to get rid of the great impediment ariſing from the penumbra, which makes it difficult to determine the length of the ſhadow with preciſion. It is now called *Aſſouan*.

SYLLA (Lucius Cornelius), was deſcended from the illuſtrious family of the Scipios. His behaviour in his younger years by no means correſponded with the excellent education which he had received. But debauchery, inſtead of bringing along with it infamy and ruin, its uſual attendants, ſerved only to increaſe the wealth of this fortunate Roman; for Nocopolis, a rich courtezan, whoſe affections he had gained, left him heir to her great eſtate.—He learned the art of war under Marius, whom he attended to Numidia in quality of queſtor. Though hitherto unaccuſtomed to arms, he became in a ſhort time the moſt ſkilful ſoldier in the army, while by his polite and obliging behaviour he gained the love and eſteem of every body. His courage and dexterity contributed a great deal towards the ſucceſs of the war; it was his eloquence in particular that perſuaded Bocchus to deliver up Jugurtha. He ſerved afterwards in the ſocial war, where his actions entirely eclipſed thoſe of every other commander. As a reward for this conduct he was raiſed to the prætorſhip. It is pretended by ſome that Sylla purchaſed this dignity; and that when he threatened one day to make uſe of the powers of *his* office againſt Strabo the father of Pompey, that Roman replied with a ſmile, "You are in the right to ſay ſo; your office is certainly *yours*, ſince you purchaſed it." Be this as it may, after the concluſion of the ſocial war he was made conſul, and ſoon after declared general of the army which was to be ſent againſt Mithridates king of Pontus. Marius, at that time the moſt renowned of the Roman generals, expected that the management of this war would have been committed to him, and was therefore much exaſperated at the diſappointment. The people were perſuaded by his intrigues to reverſe the former decree, and ſubſtitute him in place of Sylla. Upon this he ſent down officers to take the command of the army; but Sylla by this time had gained over the ſoldiers; who inſtead of obeying the decree of the people, ſlew Marius's officers, and intreated Sylla to lead them inſtantly to Rome. Accordingly he entered the city ſword in hand ſlew Sulpicius the conſul, obliged Marius to flee, new-modelled the laws, and afterwards marched into the Eaſt, and immediately laid ſiege to Athens; for that city, together with the reſt of Greece, had fallen into the power of Mithridates. He wrote to the Amphyctions, who were aſſembled at Delphi, to ſend him all the gold which was depoſited in the temple of Apollo, becauſe he ſtood in need of money; promiſing, at the ſame time, to reſtore it again at the end of the war. When he received this treaſure, he obſerved, with an air of raillery, that he now no longer deſpaired of victory, ſince the gods themſelves furniſhed him with money to pay his troops. Famine ſoon obliged the Athenians to think of a ſurrender. Their ambaſſadors waited on Sylla, and began to harangue about Theſeus and Codrus, and Marathon and Salamis,—when he interrupted them, and exclaimed, "Go, repeat theſe fine orations in your ſchools; I have come hither, not to learn your hiſtory, but to chaſtiſe rebels." Athens was at laſt taken by aſſault, and Sylla was upon the point of deſtroying it, when he recollected its ancient glory, and ſpared (as he ſaid) the living for the ſake of the dead. After burning the Piræus, he gained two deciſive victories over the generals of Mithridates. In the ſecond battle, which was fought at Orchomenus, he was almoſt defeated; his troops began to flee, when, leaping from his horſe, he ſnatched up a ſtandard, and advanced againſt the enemy, crying out. "I will die here gloriouſly; and, ſoldiers, when you are aſked where you abandoned your general, anſwer, at Orchomenus." This reproach recalled the courage of the Romans; they followed him to the charge, and gained a complete victory. Mithridates, humbled by theſe diſaſters, ſent ambaſſadors to ſue for peace.

Mean time Cinna had declared againſt Sylla in Italy; and Marius returning from baniſhment, had taken the moſt ſevere vengeance on all his enemies. Sylla was declared a traitor; his laws were reverſed, his friends murdered, and the government new-modelled. The news of theſe tranſactions induced Sylla to conclude a treaty with Mithridates, and march directly to Rome. His approach terrified the Romans. Marius and Cinna were both dead; but the conſuls made vigorous preparations to oppoſe him. A civil war was begun; but Sylla in the end ſubdued all his enemies, and entirely ruined the Marian faction. He entered Rome at the head of his victorious army, and publicly aſſumed the ſurname of *Happy*. Happy, indeed, had he ceaſed to live when he ceaſed to conquer. The remainder of his life contains nothing elſe but a catalogue of the moſt abominable cruelties. He declared that every one who expected pardon for their late offences, muſt gain it by deſtroying the enemies of the ſtate. The ſword of the aſſaſſin was thus unſheathed, and murder encouraged as the path to power and diſtinction. The nobleſt of the Romans were everywhere maſſacred; ſlaves were rewarded for cutting off their maſters; children were ſeen dragging their parents to execution; and brothers claiming a recompenſe for the murder of brothers. Sylla ordered 8000 wretches, who had thrown themſelves upon his clemency, to be butchered in the Campus Martius. In the mean time he entered the ſenate-houſe, and began to talk with great coolneſs about his exploits. The ſenate, alarmed at the horrid outcries of the ſufferers, at firſt thought that the city was given up to be plundered; but Sylla informed them, with an unembarraſſed air, that it was only ſome criminals puniſhed by his orders, and that they needed not be apprehenſive about their own fate.

To carry on theſe cruelties with the appearance of juſtice, he commanded the people to elect him dictator. He kept this office for more than two years; and then, to the amazement of all, laid it down, and offered to ſtand his trial before the people. Soon afterwards he retired into the country, and plunged headlong into every kind of debauchery. Nor did he relinquiſh his cruelty together with his power: His wife falling ill in the midſt of a ſumptuous feaſt, he divorced her immediately; and ordered her to be carried away, leſt her death ſhould interrupt the feſtivity of his houſe.

He died of the morbus pedicularis, in the 60th year of his age. His body, according to his orders, was burnt. A little before his death he wrote his epitaph; the tenor of which was that no man had ever exceeded him in doing good to his friends or injury to his enemies.

His perſon was elegant, his air noble, his manners eaſy and apparently ſincere. He was fond of pleaſure, but fonder of glory; indulging without ſcruple in ſenſual delights, but never ſuffering them to interrupt his ſerious buſineſs: He was eloquent, liberal, crafty, inſinuating; a profound maſter of diſſimulation; he ſpoke of himſelf with modeſty, while he laviſhed praiſes on every other perſon: He ſtooped even to an acquaintance with the meaneſt ſoldier, and conſtantly adapted himſelf to the humours, purſuits and opinions, of thoſe with whom he converſed. Such was his character during the earlier part of his life; but when ſucceſs had raiſed him above the neceſſity of diſſimulation, he diſplayed a hideous train of vices, which his ambition had formerly taught him to conceal.—It was Sylla who recovered the works of Ariſtotle at the taking of Athens.

SYLLABLE, in grammar, one or more letters pronounced by a ſingle impulſe of the voice, forming a complete ſound, and conſtituting a word or a part of a word. No ſingle letter can form a ſyllable except a vowel. The longeſt ſyllable in the Engliſh language is the word *ſtrength*.

The moſt natural way of dividing words into ſyllables is, to ſeparate all the ſimple ſounds of which any word conſiſts, ſo as not to divide thoſe letters which are joined cloſe together according to the moſt accurate pronunciation.

SYLLABUB, a kind of compound drink, moſt uſual in the ſummer ſeaſon; ordinarily made of white wine and ſugar, into which is ſquirted new milk with a ſyringe or wooden cow. Sometimes it is made of canary in lieu of white wine; in which caſe the ſugar is ſpared, and a little lemon and nutmeg are added in lieu of it. To prepare it the beſt way, the wine and other ingredients, except the milk, are to be mixed over night, and the milk or cream added in the morning. The proportion is, a pint of wine to three of milk. For

SYLLABUB, *whipt*, to half a pint of white wine or Rheniſh is put a pint of cream, with the whites of three eggs. This they ſeaſon with ſugar, and beat with birchen rods, or work with a ſyringe. The froth is taken off as it riſes, and put into a pot; where, after ſtanding to ſettle two or three hours, it is fit to eat.

SYLLABUS, in matters of literature, denotes a table of contents, or an index of the chief heads of a book or diſcourſe.

SYLLOGISM, in logic, an argument or term of reaſoning, conſiſting of three propoſitions; the two firſt of which are called *premiſes*; the laſt, the *concluſion*. See LOGIC, Part III.

SYLVIA, in natural hiſtory, a new genus of birds, belonging to the order of paſſeres, formed by Dr Latham by limiting the motacilla to the wagtail, and arranging the other ſpecies, formerly claſſed under that genus, under the ſylvia.

The motacilla he thus deſcribes: The beak is ſubulated, ſlender, and ſomewhat indented at the point. The tongue ſeems torn at the end, and the tail is long. He thus characterizes the ſylvia: The beak is ſubulated, ſtraight, and ſmall; the mandibles are nearly equal. The noſtrils are obovate, and a little depreſſed. The exterior toe is joined at the under part of the baſe of the middle one. The tongue is cloven, and the tail is ſmall. He makes 13 ſpecies of the motacilla, and 174 ſpecies of the ſylvia. See MOTACILLA.

SYMBOL, a ſign or repreſentation of ſomething moral, by the figures or properties of natural things. Hence ſymbols are of various kinds; as hieroglyphics, types, enigmas, parables, fables, &c.

SYMMACHUS, a citizen and ſenator of ancient Rome, and conſul in the year 391, has left us ten books of epiſtles; from which, as well as from other things, we collect, that he was a warm oppoſer of the Chriſtian religion. He was baniſhed from Rome by Valentinian on ſome account or other, but afterwards recalled and received into favour by Theodoſius. Ammianus Marcellinus ſpeaks of him as a man of great learning and modeſty. Scioppius, Pareus, and other learned men, have written notes upon the epiſtles of Symmachus: we know of no later edition of them than that of Frankfort, 1642, 8vo. Ambroſe biſhop of Milan wrote againſt Symmachus, and ſo did the Chriſtian poet, Prudentius.

SYMMETRY, the juſt proportion of the ſeveral parts of any thing, ſo as to compoſe a beautiful whole.

SYMMETRY, in painting. See PAINTING, Part I. Sect. III.

SYMONDSBOROUGH, a remarkable large barrow of Flints, near Wellington in Devonſhire, in the northern extremity of Hemyock. The common people have a notion that a king called *Symon* was buried here. The tradition of the country plainly ſhows that it was the burial-place of ſome perſon or perſons of eminence.

SYMPATHETIC, ſomething that acts or is acted upon by ſympathy. Thus we ſay, ſympathetic diſeaſes, inks, &c.

SYMPATHETIC Inks. See *Sympathetic INK.*

SYMPATHY, an agreement of affections and inclinations, or a conformity of natural qualities, humours, temperaments, which make two perſons delighted and pleaſed with each other.

SYMPATHY, alſo denotes the quality of being affected by the affection of another; and may ſubſiſt either between different perſons or bodies, or between different parts of the ſame body. It is either ſimilar or diſſimilar; ſimilar, when the affection or action in the ſympathiſer is ſimilar to the affection or action in the ſympathant; and diſſimilar, when thoſe are different.—Sympathy, too, is often an imitative faculty, ſometimes involuntary, frequently without conſciouſneſs: thus we yawn when we ſee others yawn, and are made to laugh by the laughing of another.

Sympathy, according to Dr Jackſon *, relates to the operations of the affections of the mind, to the operations of the imagination, and to the affections of the external ſenſes.

1. The paſſions and affections of the mind produce in the body different ſenſations and impreſſions, and, as ſympathies

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* Treatiſe on Sympathy.

of conſciouſneſs, determine in general the ſpirits to thoſe parts which labour moſt, or are moſt apt to be affected. Thus fear and anger determine to the heart; luſt to the eyes, &c.; joy, pity, wonder, and the like, to the head. See Passion, page 14.

The affections of the mind of one perſon will often work upon the ſpirits of many. Thus whole companies are ſometimes diſpoſed to be ſad and melancholy, or merry and jovial, when any one is preſent much inclined to either of thoſe ſtates of mind; and it has been obſerved, that old people, who have loved the company of the young, and have been converſant continually with them, have generally lived long. But young people muſt not conclude from this, that the company and converſation of the grave and old will operate upon their living and ſenſitive principle, thro' the affections of their mind, and diſpoſe them to be ſhort-lived. On the contrary, by thus improving their underſtanding, they will be more enabled to fortify their conſtitution and reſiſt the ravages of youthful indulgence.

It may alſo be further obſerved, that thoſe tender ſympathetic affections which lay hold of the mind, at the repreſentation of theatrical performances, originate from the ſame principle, while they are to be conſidered as the ſureſt teſt of juſt execution in the actor, and of the expreſſive language of the author. Indeed all ſtage-effect depends on ſympathy.

It has been ſaid, that the paſſions of the mind are occaſionally infectious, particularly ſome of them. Thus *fear* and *ſhame* are ſometimes very ſuddenly ſo. We frequently may have occaſion to ſee, that the ſtarting of one will make another ready to ſtart. Again, when one man is out of countenance in company, others will often bluſh in his behalf. However, the ſerious paſſions may ſurely be ſo under the control of reaſon as to reſiſt infection, whatever may be the caſe of temporary, muſcular, or nervous attraction.

2. Our author is inclined to think, that a connection between the affections and ſenſations of the female mind and uterus, is very materially concerned in the proceſs of generation, and probably can alone give efficacy to thoſe actions and impreſſions ſubſervient to conception, through the ſympathizing affections of the mind. But this is a ſubject of which we know ſo little, that the ſpeculations of even the moſt diſtinguiſhed philoſophers reſpecting it have been nothing but the wild ravings of imagination.

With reſpect to the depravity and force of the imagination in the production of ſympathies, they always operate moſt upon "weak minds and ſpirits, and therefore moſt on women, ſuperſtitious and fearful perſons, ſick people, children, and young creatures." "Their effects, however, ſometimes fail to appear, becauſe they are encountered and overcome by the mind and ſpirit before they work any manifeſt effects."

Such effects are obviated upon the ſame principle which eſtabliſhes the prevention of bodily diſeaſe: "for in infection and contagion from body to body (as, for example, during the plague), the miaſma may be received; but from the ſtrength and good diſpoſition of the body, it is expelled and wrought out before it has had ſufficient time to form the diſeaſe."

It has been ſaid, and many are of the opinion, that the force of imagination doth often forward the end propoſed. Thus, for inſtance, it has been put as a queſtion, "Whether a man, when he conſtantly and ſtrongly believes that ſuch a thing ſhall be (as that ſuch a one will love him, and the like), helps any thing to the effecting the thing deſired?" Certainly not in the manner which has been advanced, namely, "by a ſecret operation on the ſpirit of another." If he ſucceeds, it is either becauſe he perſevered, or becauſe his perſeverance and earneſtneſs (and not any occult operation) makes him at length be attended to.

There is not a doubt but the force of imagination often gives energy to our actions. It may, however, unleſs we are much on our guard, eaſily delude us aſide from reaſon. It has been the tree which has yielded the fruits of ſuperſtition in former times, and which has often fed the human mind with the moſt extravagant notions of ſympathy. Sympathies of this kind, ſuch as the power of charms, and the like, are now pretty generally exploded.

3. The five ſenſes, *hearing*, *taſting*, *ſmelling*, *feeling*, and *ſeeing*, are conſcious of a ſympathetic impreſſion from odious objects. "1. A diſagreeable ſound will ſet the teeth on edge, and make all the body ſhiver. 2. The ſwallowing of a nauſeous medicine will be attended with a ſhaking of the head and neck. 3. Diſagreeable ſmells produce nearly the ſame effect, which are leſs perceived, becauſe there is a remedy at hand by ſtopping the noſe. 4. If you come ſuddenly out of the ſun into the ſhade, the ſenſe of feeling is diſturbed by a chillneſs or ſhivering of the whole body. 5. And even ſudden darkneſs produces a propenſity to ſhivering.

There is a very apparent reaſon why a ſympathy ſhould take place between the eyes. Hence their motions are ſynchronous. It may be ſaid, that cuſtom and habit diſpoſe the eyes to move one and the ſame way; "for when one eye moveth towards the noſe, the other eye moveth from the noſe."

Though the eyes are by nature prone to move in concert, cuſtom will, however, deſtroy this natural concert, and produce the contrary effect. Thus ſome people can ſquint when they will. Our author therefore gives this caution to mothers and nurſes: "Let them not ſuffer infants to ſit with a candle placed behind them: for both their eyes will be diſpoſed to move outwards, as affecting to ſee the light of the candle, which may bring on the habit of ſquinting."

It appears as a quality in the ſenſes of hearing and ſeeing, "that the inſtrument of each ſeparate ſenſe has a ſympathy and ſimilitude to that which giveth the reflection." Thus it has been obſerved, "that the eye will ſympathize with a cryſtal glaſs of water, and the ear with caves and ſuch hollow places as are ſuited to report echo."

Sympathies have been compared to uniſons of ſound in muſic. Uniſons of ſound produce agreeable ſympathetic feelings; the reverſe produce diſagreeable feelings. "All concords and diſcords of muſic are (no doubt) ſympathies and antipathies of ſound." Moreover, "they are ſaid to work as well by report of ſound as by motion."

The moſt agreeable as well as odious objects operate in a ſecondary way, in producing thoſe ſympathetic impreſſions and actions which they commonly give riſe to. An increaſed ſecretion of ſaliva often takes place at the ſight of a favourite diſh: and the running of water from a bottle, or otherwiſe, will ſometimes affect individuals of a particular temperament, with an involuntary propenſity to void urine.

Many have attempted to account for the remarkable ſympathy which takes place between parts of the body ſeemingly unconnected with each other; but as theſe attempts are merely conjectures, without any ſolid principles to reſt on, we paſs them over as the dreams of ingenious men. It would be fortunate for ſcience, if men would confine themſelves to thoſe ſubjects which can be known, and never draw concluſions till they have eſtabliſhed principles.

SYMPHONIA, in botany; a genus of plants, belonging to the claſs of *monodelphia*, and order of *pentandria*.—There is one piſtil. The corolla is globular, and the berry five celled. There is only one ſpecies yet diſcovered, the globulifera.

SYMPHONY, in muſic, properly denotes a conſonance or concert of ſeveral ſounds agreeable to the ear, whether vocal or inſtrumental, called alſo *harmony*. See HARMONY.

SYMPHYSIS, in anatomy, one of the kinds of junctures or articulation of the bones. See ANATOMY, n° 2.

Cutting the SYMPHYSIS *of the Pubes*. See MIDWIFERY, Part II. Chap. VII.

SYMPHYTUM, COMFREY, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *monogynia;* and in the natural ſyſtem, ranging under the 41ſt order *aſperifoliæ*. The limb of the corolla is tubular and ventricoſe, and the throat is ſhut with awl ſhaped rays. There are three ſpecies; the officinale, tuberoſum, and orientale.—The officinale is a Britiſh plant. The ſtem is about two feet high, round, branched, green, and rough. The radical leaves are very large and rough; thoſe on the ſtalk are decurrent, and alternate. The flowers grow on looſe ſpikes, and are either of a yellowiſh or purple colour. It grows on the banks of rivers, and flowers from May to October.

SYMPLOCE, συμπλοκη, in rhetoric a figure, where the ſame word is repeated ſeveral times in the beginning and end of a ſentence, including the ANAPHORA and EPITROPHE: thus, *Quis legem tulit? Rullus. Quis majorem populi partem ſuffragiis privavit? Rullus. Quis comitiis præfuit? Idem Rullus.*

SYMPLOCOS, in botany: A genus of plants belonging to the claſs of *polyadelphia*, and to the order of *polyandria;* and in the natural ſyſtem ranging under thoſe the order of which has not been determined. The calyx is quinquefid and inferior: the corolla is pentapetalous: the ſtamina are attached to the tube of the corolla in a fourfold ſeries. Only one ſpecies, the martinicenſis, is mentioned by Linnæus; but l'Heritier of the Academy of Sciences at Paris had added four more, the ciponima, arechea, tinctoria, and alſtonia.

SYMPOSIARCH, in antiquity, the director or manager of an entertainment. This office was ſometimes performed by the perſon at whoſe charge the entertainment was provided; ſometimes by another named by him; and at other times, eſpecially in entertainments provided at the common expence, he was elected by lot, or by the ſuffrages of the gueſts.

SYMPTOM, in medicine, any circumſtance which indicates the exiſtence, nature, or ſtage of a diſeaſe. Pain, waking, drowſineſs, convulſions, ſuppreſſion of urine, difficulties of breathing and ſwallowing, coughs, diſtaſtes, nauſeas, thirſts, ſwoonings, faintings, looſeneſs, coſtiveneſs, dryneſs and blackneſs of the tongue, are the principal *ſymptoms* of diſeaſes. See MEDICINE, n° 41, and 58.

SYMPTOMATICAL, in medicine, is a term often uſed to denote the difference between the primary and ſecondary cauſes in diſeaſes: thus a fever from pain is ſaid to be ſymptomatical, becauſe it ariſes from pain only.

SYNÆRESIS, CONTRACTION, in grammar, a figure whereby two ſyllables are united in one; as *vemens* for *vehemens*.

SYNAGOGUE, among the Jews, was a place where people met to worſhip God. Authors are not agreed about the time when the Jews firſt began to have ſynagogues:—Some will have them as old as the Ceremonial Law, and others fix their beginning to the times after the Babyloniſh captivity. They erected ſynagogues not only in towns and cities, but alſo in the country, eſpecially near rivers, that they might have water for their purifications and ceremonious waſhings. No ſynagogue was built in any town, unleſs there were ten perſons of leiſure in it; but there might be many in one town, or in one quarter of a town, provided it was very populous. Jeruſalem is ſaid to have contained 480. The chief things belonging to a ſynagogue were, 1. The ark or cheſt, made after the model of the ark of the covenant, containing the *Pentateuch*. 2. The pulpit and deſk in the middle of the ſynagogue, in which he that was to read or expound the law ſtood. 3. The ſeats or pews for the people. 4. The lamps to give light at evening ſervice, and the feaſt of dedication. 5. Rooms or apartments for the utenſils and alms cheſts. The ſynagogue was governed by a council or aſſembly, over whom was a preſident, called *The Ruler of the Synagogue*. Theſe are ſometimes called *Chiefs of the Jews*, *The Rulers*, *the Prieſts* or *Elders*, *the Governors*, *The Overſeers*, *The Fathers of the Synagogue*. Their buſineſs was to puniſh the diſobedient by cenſures, by excommunication, or by penalties, ſuch as fines and ſcourging; to take care of the alms, which are frequently called by the name of righteouſneſs. The chief ruler, or one of the rulers, gave leave to have the law read and expounded, and appointed who ſhould do it. In every ſynagogue, there were ſeveral miniſters who had different offices aſſigned to them. Service was performed three times a day, viz. in the morning, in the afternoon, and at night; at the time of morning ſacrifice, evening ſacrifice, and after the evening ſacrifice on Mondays, Thurſdays and Saturdays, there was a more forcible obligation upon the people to attend than upon the other days. There are ſynagogues at London, Amſterdam, Rotterdam, Avignon, Metz, &c.

Wilſon's Archæological Dictionary.

SYNALŒPHA, in grammar, a contraction of ſyllables, performed principally, by ſuppreſſing ſome vowel or diphthong at the end of a word, on account of another vowel or diphthong at the beginning of the next. As, *ill' ego*, for *ille ego*, &c.

> *Conticuer' omnes intentiqu' ora tenebant.* Virg.

It is called by the Latins *colliſio*.

SYNARTHROSIS, } See ANATOMY, n° 2.
SYNCHONDROSIS, }

SYNCELLUS, or SINCELLUS, an ancient officer in the family of the patriarchs, and other prelates of the eaſtern church. The word, in the corrupt Greek, συγκηλλος, ſignifies a perſon who lies in the chamber with another; a *chamber-fellow*, or *chum*. The ſyncellus was an eccleſiaſtic, who lived with the patriarch of Conſtantinople, to be a witneſs of his conduct; whence it is, that the ſyncellus was alſo called the *patriarch's eye*, becauſe his buſineſs was to obſerve and watch. The other prelates had alſo their ſyncelli, who were clerks living in the houſe with them, and even lying in the ſame chamber, to be witneſſes of the purity of their manners. Afterwards the office degenerated into a mere dignity; and there were made ſyncelli of churches.—At laſt it became a title of honour, and was beſtowed by the emperor on the prelates themſelves; whom they called *pontifical ſyncelli*, and *ſyncelli Auguſtales*.

SYNCHRONISM denotes the happening of ſeveral things at the ſame time. See CHRONOLOGY.

SYNCOPATION, in muſic denotes a ſtriking or beating of time, whereby the diſtinction of the ſeveral times or parts of the meaſure is interrupted. However, it is more properly uſed for the connecting the laſt note of any meaſure, or bar, with the firſt of the following meaſure, ſo as only to make one note of both. A ſyncope is ſometimes alſo made in the middle of a meaſure. Syncopation is alſo uſed when a note of one part ends or terminates on the middle of a note of the other part. This is otherwiſe denominated *binding*. It is likewiſe uſed for a driving note; that is, when ſome ſhorter note at the beginning of a meaſure, or half meaſure, is followed by two, three, or more longer notes before another ſhort note occurs,

curs, equal to that which occaſioned the driving, to make the number even, *e. gr.* when an odd crotchet comes before two or three minims, or an odd quaver before two, three, or more crotchets. In ſyncopated or driving notes, the hand or foot is taken up, or put down, while the note is ſounding.

SYNCOPE, FAINTING; a deep and ſudden ſwooning, wherein the patient continues without any ſenſible heat, motion, ſenſe, or reſpiration, and is ſeized with a cold ſweat over the whole body; all the parts, in the mean time, turning pale and cold, as if he was dead. See MEDICINE, nº 98. and 272.

SYNCOPE, in grammar, an eliſion or retrenchment of a letter or ſyllable out of the middle of a word, as *caldus* for *calidus*.

SYNDIC, in government and commerce, an officer, in divers countries, intruſted with the affairs of a city or other community, who calls meetings, makes repreſentations and ſolicitations to the miniſtry, magiſtracy, &c. according to the exigence of the caſe.

SYNECDOCHE, in rhetoric, a kind of trope frequent among orators and poets. See ORATORY, nº 56.

SYNECPHONESIS, in grammar, a coalition, whereby two ſyllables are pronounced as one; being much the ſame as SYNALOEPHA and SYNÆRESIS.

SYNEUROSIS. See ANATOMY, nº 2.

SYNGENESIA, (συν and γενεσις, "congeneration)," the name of the 19th claſs in Linnæus's artificial ſyſtem; comprehending thoſe plants which have the anthers united into a cylinder. The orders are ſix: 1. Polygamia æqualis. 2. Polygamia ſuperflua. 3. Polygamia fruſtranea.. 4. Polygamia neceſſaria. 5. Polygamia ſegregata. 6. Monogamia. The five firſt orders contain the compound flowers, and form a claſs truly natural.

SYNGNATHUS, PIPE-FISH, according to Linnæus, a genus belonging to the claſs of *amphibia*, and order of *nantes*, but arranged by Gmelin more properly under the claſs of *piſces*, and order of *branchioſtegi*. The head is ſmall; the roſtrum ſomewhat cylindrical, long, and turned up at the point, where the mouth is placed, which is covered with a lid or valve. The gills are covered in the ſame manner. The body is covered with a ſtrong cruſt, and has no ventral fins. There are eight ſpecies; the tetragonus, typhele, acus, pelagicus, æquoreous, ophidion, barbarus, and hippocampus. Three of theſe are found in the Britiſh ſeas, *viz*.

1. The *barbarus*, or long pipe-fiſh. One deſcribed by Sir Robert Sibbald, was two feet in length; that examined by Mr Pennant only 16 inches. The noſe was an inch long, compreſſed ſidewiſe, and the end of the lower mandible turned up; the aperture of the mouth was very ſmall. The irides were red; behind each eye was a deep brown line. The body, in the thickeſt part, was about equal to a ſwan's quill, hexangular from the end of the dorſal fin; from thence to the tail, quadrangular. The belly was ſlightly carinated, and marked along the middle with a duſky line. Under the tail, commencing at the anus, is a ſulcus or groove ſix inches and a half long, covered by two longitudinal valves, which concealed a multitude of young fiſh. On cruſhing this part, hundreds may be obſerved to crawl out.

2. The *acus*, or ſhorter pipe-fiſh, is thicker than the former, yet it has been ſeen of the length of 16 inches. The middle of the body in ſome is hexangular, in others heptangular. The mouth is formed like that of the former: the irides are yellow: cloſe behind the head are the pectoral fins, which are ſmall and ſhort. On the lower part of the back is one narrow fin; beyond the vent the tail commences, which is long and quadrangular. At the extremity is a fin round and radiated. The body is covered with a ſtrong cruſt, elegantly divided into ſmall compartments. The belly is white; the other parts are brown.

3. The *ophidion*, or little pipe-fiſh, ſeldom exceeds five inches in length, is very ſlender, and tapers off to a point. It wants both the pectoral and tail fins; is covered with a ſmooth ſkin, not with a cruſt as the two former kinds are. The noſe is ſhort, and turns a little up; the eyes are prominent. On the back is one narrow fin. This ſpecies is not viviparous: on the belly of the female is a long hollow, to which adhere the eggs, diſpoſed in two or three rows. They are large, and not numerous. The ſynonym of *ſerpent* is uſed in ſeveral languages to expreſs theſe fiſh: the French call one ſpecies *orueul*, from a ſort of ſnake not unlike the blindworm: the Germans call it *meherſchlange*; and the corniſh the *ſea-adder*.

The Sea-horſe, which was claſſed by Artedi under the Syngnathus, is now, by latter ichthyologiſts, arranged under TRICHECUS; which ſee.

SYNOCHA, and SYNOCHUS, in medicine, the names of two ſpecies of continued fever. See MEDICINE, nº 164.

SYNOD, in aſtronomy, a conjunction or concourſe of two or more ſtars or planets, in the ſame optical place of the heavens.

SYNOD ſignifies alſo a meeting or aſſembly of eccleſiaſtical perſons to conſult on matters of religion.

Of theſe there are four kinds, viz. 1. *General*, or *œcumenical*, where biſhops, &c. meet from all nations. Theſe were firſt called by the emperors, afterwards by Chriſtian princes; till in latter ages the pope uſurped to himſelf the greateſt ſhare in this buſineſs, and by his legates preſided in them when called. 2. *National*, where thoſe of one nation only come together, to determine any point of doctrine or diſcipline. The firſt of this ſort which we read of in England, was that of Herudford or Hertford, in 673, and the laſt was that held by cardinal Pole, in 1555. 3. *Provincial*, where thoſe only of one province meet, now called the *convocation*. 4. *Dioceſan*, where thoſe of but one dioceſe meet, to enforce canons made by general councils, or national and provincial *ſynods*, and to conſult and agree upon rules of diſcipline for themſelves. Theſe were not wholly laid aſide, till by the act of ſubmiſſion, 25. Hen. VIII. c. 19. it was made unlawful for any *ſynod* to meet, but by royal authority. See COUNCIL and CONVOCATION.

SYNODS, *Provincial, in the Government of the Church of Scotland*. See PRESBYTERIANS, nº 14.

SYNODALS, or SYNODIES, were pecuniary rents (commonly of two ſhillings), paid to the biſhop, or archdeacon, at the time of their Eaſter viſitation, by every pariſh prieſt. They were thus called, becauſe uſually paid in ſynods; becauſe anciently biſhops uſed to viſit and hold their dioceſan ſynods once.—For the ſame reaſon, they are ſometimes alſo denominated *ſynodalica*; but more uſually, *procurations*.

SYNODICAL, ſomething belonging to a ſynod. Thus, ſynodical epiſtles are circular letters written by the ſynods to the abſent prelates and churches; or even thoſe general ones directed to all the faithful, to inform them of what had paſſed in the ſynod.

SYNOECIA, in Grecian antiquity, a feaſt celebrated at Athens in memory of Theſeus's having united all the petty communities of Attica into one ſingle commonwealth; the ſeat whereof was at Athens, where all the aſſemblies were to be held. This feaſt was dedicated to Minerva; and, according to the ſcholiaſt on Thucydides, it was held in the month *Metagitnion*.

SYNONYOMUS, is applied to a word or term that has the ſame import or ſignification with another.

Several works have been compoſed for the expreſs purpoſe of explaining ſynonymous words. In 1777 a work was publiſhed on the Latin ſynonyma at Paris by M. Gardin Dumeſnil. The abbé Girard publiſhed one on the ſynonymous terms of the French language many years ago. Another was publiſhed on the ſame ſubject in the year 1785 by the abbé Roubaud. An account of the Engliſh ſynonyma was publiſhed by an anonymous author in 1766; which is a cloſe imitation, and in ſome parts a literal tranſlation, of the abbé Girard's *Synonymes François*. We recollect, too, of ſeeing ſome eſſays of Mrs Piozzi on the ſame ſubject.

SYNOVIA, in medicine, a term uſed by Paracelſus and his ſchool for the nutritious juice proper and peculiar to each part. Thus they talk of the ſynovia of the joints, of the brain, &c.

SYNTAX, in grammar, the proper conſtruction or due diſpoſition of the words of a language into ſentences and phraſes. See GRAMMAR and LANGUAGE.

SYNTHESIS, in logic, denotes a branch of method, oppoſite to analyſis.

In the ſyntheſis or ſynthetic method, we purſue the truth by reaſons drawn from principles before eſtabliſhed or aſſumed, and propoſitions formerly proved; thus proceeding by a regular chain, till we come to the concluſion. Such is the method in Euclid's Elements, and moſt demonſtrations of the ancient mathematicians, which proceed from definitions and axioms, to prove propoſitions, &c. and from thoſe propoſitions proved to prove others. This method we alſo call *compoſition*, in oppoſition to *analyſis* or *reſolution*. See ANALYSIS.

SYPHILIS. See MEDICINE, n° 350.

SYPHON. See HYDROSTATICS, n° 25, 26. Some uncommon phenomena in nature may be accounted for upon the principles of the ſyphon; as for inſtance, that of reciprocating ſprings. See PNEUMATICS, n° 373.

1 At what time built.

2 Government originally monarchical.

3 Soon becomes democratical.

SYRACUSE, once a celebrated city of Sicily, and the capital of the iſland. It was built, according to Thucydides and Strabo, by Archias, one of the Heraclidæ, who came from Corinth into Sicily in the ſecond year of the 11th Olympiad, deriving its name from a neighbouring marſh named *Syraco*. What form of government firſt prevailed in the city is not known. Many have ſuppoſed it originally to have been governed by kings: but if this was the caſe, the monarchical government muſt have continued only for a very ſhort time; ſince Ariſtotle, Diodorus Siculus, and Juſtin, mention it as being very early ſubject to a democracy. The hiſtory, however, is obſcure and unimportant till the time of Gelon, when it firſt began to make a conſpicuous figure.

4 Gelon ſeizes on the ſovereignty.

Gelon was born in the city of Gela in Sicily, of the family of Telines, who had been created prieſt of the infernal gods. He ſignalized himſelf in a war carried on by Hippocrates tyrant of Gela againſt the Syracuſians, whom he defeated in a pitched battle, and had well nigh taken their city afterwards. Having thus become very powerful among his countrymen, he ſoon found means to ſeize on the ſovereignty for himſelf. In a ſhort time, having put himſelf at the head of ſome Syracuſian exiles, he marched towards that place, where he was received with loud acclamations by the faction to which they belonged; and by their means obtained poſſeſſion of the city.

5 Takes ſeveral cities, and removes the inhabitants to Syracuſe.

Gelon, in order to people the capital of his new dominions, firſt demoliſhed the neighbouring city of Camarina, and tranſplanted the inhabitants to Syracuſe. Soon after, entering into a war with the Megareans, he defeated them, took and raſed their cities, and in like manner tranſplanted the people. Syracuſe thus became very powerful, and full of inhabitants; and the friendſhip of Gelon was courted both by Athens and Lacedæmon at the time of the Perſian invaſion. His aſſiſtance, however, was afterwards rejected, as he inſiſted upon being made commander in chief either of the fleet or the army. In the mean time the Carthaginians had entered into a treaty with the Perſians; by which it was agreed, that the former ſhould attack thoſe of the Greek name in Sicily and Italy, in order to divert them from aſſiſting one another. Sicily was accordingly invaded by the Carthaginians with a vaſt army; but they were utterly overthrown by Gelon, as is related under the article CARTHAGE, n° 7.—9. After this victory, the people out of gratitude obliged him to take upon himſelf the title of king; which till that time he had refuſed. A decree alſo paſſed without oppoſition, by which the crown was ſettled on his two brothers Hiero and Thraſybulus after his death.

6 Defeats the Carthaginians, and takes the title of king.

7 His excellent reign.

The new king, inſtead of keeping his ſubjects in greater awe, ſtudied the more to make them happy as he found his power increaſed; and, according to Diodorus Siculus, was the firſt man who became more virtuous by being raiſed to a throne. He was particularly famous for his honeſty, truth, and ſincerity; is ſaid never to have wronged the meaneſt of his ſubjects, nor ever to have promiſed a thing which he did not perform.

8 Gelon dies and is ſucceeded by Hiero.

Gelon died in the year 471 B. C. after having reigned three or four years; and was ſucceeded by his brother Hiero, whoſe character is differently drawn by different hiſtorians. He was twice engaged in a war with the Agrigentines, and drove from their habitations the people of Catana and Naxus, ſettling in their room a colony of Syracuſians and Peloponneſians. He is highly celebrated in the odes of Pindar; and it is certain that his court was the reſort of men of wit and learning, to whom he behaved in the moſt courteous manner and with the greateſt liberality.

9 Thraſybulus, a tyrant.

10 Popular government reſtored.

11 Petaliſm introduced, but ſoon after aboliſhed.

In 459 B. C. Hiero was ſucceeded by Thraſybulus; who proving a tyrant, was in ten months driven out, and a popular government reſtored; which continued for the ſpace of 55 years. Several perſons continued for ſome time to aſpire at the ſovereign power; and to rid themſelves of theſe aſpiring geniuſes, the inhabitants made a law not unlike that of the oſtraciſm at Athens. By this law they were to write on a leaf the names of thoſe whom they ſuppoſed to be powerful enough to aſpire at the crown; and when the leaves were counted, he who had the moſt ſuffrages againſt him was, without further inquiry, baniſhed for five years. This method of weakening the intereſts of the overgrown citizens was called *petaliſm*, from the Greek word πεταλον, ſignifying a leaf; but being found to be productive of great inconveniences, by driving out of the country all thoſe who were moſt capable of governing the commonwealth, the law was repealed ſoon after it had been enacted.

12 The Siculi ſubdued.

13 Syracuſians become haughty.

14 Invaded by the Athenians without ſucceſs.

About this time the Syracuſians entered into a war with the Siculi, which terminated in the total ſubjection of the latter; after which Syracuſe became ſo powerful, that it in a manner gave law to the whole iſland. The Greek cities indeed enjoyed a perfect liberty; but they all acknowledged Syracuſe as their metropolis: by degrees, however, the latter began to aſſume ſuch an authority over them as was totally inconſiſtent with liberty; and this occaſioned many wars, which involved them in much diſtreſs and danger. They began with the Leontines, whoſe territory they laid waſte, and reduced their city to great ſtraits. Leontini was an Athenian colony; and this furniſhed the Athenians, who had already meditated the conqueſt of Sicily, with a pretence to attack the Syracuſians with their whole force. Under colour of aſſiſting their countrymen, therefore, they ſent a fleet of 250 ſail to Sicily: but the Leontines, ſenſible that their pretended allies aimed at nothing leſs than the conqueſt of the whole iſland, concluded a peace with Syracuſe; and the diſappointed Athenians vented their rage upon thoſe who had adviſed and conducted the expedition.

15
A new invaſion.

In 416 B. C. a diſpute happening between the inhabitants of Egeſta and Selinus concerning ſome lands which the latter had ſeized, the Egeſtines applied for aſſiſtance to Agrigentum, Syracuſe, and even to Carthage. But as none of theſe ſtates choſe to intereſt themſelves in their quarrel, they applied at laſt to the Athenians, who joyfully accepted of the opportunity of again interfering in the affairs of Sicily. Though the Egeſtines were but an inconſiderable people, they had engaged to pay all the troops that ſhould be employed in the war; but this appearing doubtful to the Athenians, they ſent ambaſſadors to inquire into the ſtate of the

16
Athenians impoſed on by the Egeſtines.

iſland in general, and particularly that of Egeſta. The Egeſtines impoſed on theſe ambaſſadors by producing a great number of gold and ſilver veſſels which they had borrowed for the purpoſe; ſo that the populace of Athens, dreaming of nothing but conqueſts to be made without any expence, became obſtinately bent on the war. Nicias, a man of great influence at Athens, attempted to ſhow, that as Athens was then engaged in a dangerous war with Sparta, it was impoſſible to ſpare a force ſufficient to reduce the iſland; but the contrary opinion being eſpouſed by Alcibiades, at that time the moſt eloquent ſpeaker in Athens, Nicias was over-

17
Ill-grounded confidence of the Athenians.

ruled, and obliged to engage in the expedition. The force he required was only 5000 land forces and 100 galleys, with which, however inadequate to the purpoſe it may ſeem, the Athenians were ſo ſure of ſucceſs, that the officers, before they ſet ſail, had a conference with the ſenate concerning the diſpoſal of the Sicilians. In this conference it was agreed, that the Selinuntines and Syracuſians their ſuppoſed allies ſhould be carried off and ſold for ſlaves, and the reſt obliged to pay an annual tribute and live according to the Athenian laws.

With theſe ſanguine expectations the Athenian forces embarked to the number of 7000; for ſuch was their eagerneſs for the expedition, that 2000 more enliſted themſelves than Nicias had required. They firſt ſailed to the iſland of Egina, and from thence to Corcyra, where they had appointed the place of rendezvous for their allies and the tranſports. On their arrival they ſet ſail again, and landed on the coaſt of Italy, with a view to engage ſome of the Italian cities in their quarrel; but finding this impoſſible, they ſent ſome ſhips to cruiſe off the coaſt of Sicily, in order to find out a proper place for landing, and at the ſame time to know what treaſure the Egeſtines could contribute towards carrying on

18
Find out the deceit of the Egeſtines.

the war, which had been undertaken for their ſake. Theſe, on their return, acquainted the generals, that the Egeſtines had impoſed on them, and were a poor indigent people, who had only 30 talents in the treaſury. On this information a council of war was called, in which Nicias gave it as his opinion that they ſhould ſail to Selinus, which had been the firſt occaſion of this expedition; and then, if the Egeſtines performed their promiſe, and ſupplied the army with a month's pay, to oblige the Selinuntines and Egeſtines to come to an agreement, and then return to Athens without engaging in ſuch an expenſive war. Alcibiades, however, again oppoſed Nicias; thinking it highly diſhonourable to return home without doing any thing, after having been at the expence of fitting out an armament. He therefore, urged, that they ſhould ſolicit the cities of Sicily to enter into a confederacy againſt the Syracuſians and Selinuntines; and, in caſe they found them diſpoſed to come into their meaſures, to attack either Syracuſe or Selinus. Another of the Athenian generals was for laying ſiege immediately to Syracuſe; but the opinion of Alcibiades prevailing, they ſet ſail far Sicily. Having accordingly landed in that iſland,

19
Reduce ſeveral places.

they reduced ſeveral places; but Alcibiades in the mean time being recalled, Nicias and Lamachus were left to conduct the war as they beſt could. At firſt they were ſucceſs-

20
Defeat the Syracuſians, and poſſeſs themſelves of a ſtrong poſt.

ful, poſſeſſing themſelves of a ſtrong poſt, and put the Syracuſians to flight; ſoon after which they received conſiderable ſupplies both of men, money, and proviſions, from Athens, as well as from their Sicilian allies. The Syracuſians alſo received aſſiſtance from the Lacedæmonians under the command of an experienced officer named *Gylippus*. Before theſe arrived, the Athenians had poſſeſſed themſelves of an important poſt named *Epipolæ*, which being a very ſteep hill, ſtood without the city and commanded it. Immediately after this the city was inveſted in form. The

21
Syracuſe inveſted.

inhabitants made frequent and vigorous ſallies; but were always repulſed with loſs. In one of theſe ſallies Lamachus was ſlain; and thus Nicias became ſole commander. He then cauſed the canals to be cut by which water was conveyed into the city; upon which the Syracuſians began to

22
Gylippus arrives with ſome Spartans to the relief of Syracuſe.

think of capitulating. From this, however, they were ſoon after prevented by the arrival of Gylippus with the Spartan auxiliaries. On this they prepared for making vigorous ſallies, in order to facilitate the entrance of Gylippus. While they were making theſe preparations, Gylippus himſelf appeared at the head of 3000 foot and 200 horſe. Making directly for Epipolæ, where Nicias had fortified himſelf in a caſtle named *Labdalon*, he drew up his ſmall army under the walls; and ſent an herald to Nicias, letting him know

23
Takes a fort and enters the city.

that he would allow him only five days to leave Sicily. To this meſſage Nicias returned no anſwer; but Gylippus ſoon after attacked the fort, carried it by ſtorm, and put to the ſword all the Athenians that were in it. This opened for him a way into the city, where he was received with loud acclamations.

The fortune of the war was again changed. The Athenians gained an advantage by land, but were next day defeated with conſiderable loſs. The Syracuſians received freſh ſupplies from Corinth, and the Athenians from their own country. Many engagements both by ſea and land took place, in which the ſucceſs was ultimately in favour of

24
Athenians totally defeated at ſea.

the Syracuſians. At laſt the Athenian affairs were totally ruined by the loſs of a ſea-fight, in which 60 of their ſhips were taken or deſtroyed, and the reſt left quite unſerviceable. In this deſperate ſituation it was determined to abandon their ſhips, and retire that very night to the city of their confederates. The Syracuſian commander, ſuſpecting that this would be the caſe, ordered all his forces to be in readineſs to prevent them from effecting their purpoſe. But as the people were then in the height of their rejoicing for the late victory, they refuſed to take up arms again until they

25
Outwitted by the Syracuſian general.

had reſted for ſome days. On this Hermocrates the general ſent to the Athenian camp ſome horſemen, who were to paſs for friends, and to adviſe Nicias not to quit his camp, which was well fortified, ſince the Syracuſians lay in ambuſh for him, and had ſeized on all the paſſes leading to the cities of their allies. To this falſe advice Nicias gave too eaſy credit, and did not march out till the third day, when his antagoniſt Hermocrates had prevailed upon his forces to march

26
Haraſſed in their retreat.

out. The Athenians and their allies alſo marched out to the number of no leſs than 40,000; but finding themſelves ſhut up on all ſides and being obliged to fight their way through every outlet, they ſoon ſunk into the deepeſt deſpair. Nicias did his utmoſt to encourage them; and at laſt ſucceeded ſo far that they marched out in two bodies,

27
Part of the army ſurrenders.

both drawn up in proper order. The vanguard led by Nicias continued to keep together, and advanced in good order; but half the rear, commanded by Demoſthenes, loſt their way in the night, and were obliged to ſurrender. Nicias being informed of this misfortune, offered to pay the whole expence of the war, provided he was allowed to march off with his men. But this being rejected, he ſet out, tho' galled all the way by ſhowers of darts from his enemies.

28 The reſt defeated with great ſlaughter.

Arriving at a river called *Aſinarus*, they ruſhed into it without any order; in which confuſion the Syracuſian cavalry attacked them ſo deſperately, that 18,000 periſhed, and the river for many miles was dyed with their blood. On this occaſion the Athenians were ſo preſſed with thirſt, that, unmindful of their danger, they drank the waters of the river all bloody as they were, which gave their enemies the better opportunity of ſlaughtering them without reſiſtance.

29 The remainder ſurrender, and are cruelly uſed.

The remainder ſurrendered, on the ſingle condition of having their lives ſaved; but the terms were ſhamefully broken by the Syracuſians. The generals were firſt ignominiouſly whipt, and then put to death: the common ſoldiers were thruſt down into quarries, where they were allowed only two ſmall meaſures of flour and one of water a-day; and where, being crowded upon one another, they ſuffered inexpreſſible miſeries for many months. Moſt of them periſhed by this cruel treatment, and the few who ſurvived were ſold for ſlaves.

30 New invaſion by the Carthaginians.

The war was ſcarce ended, when a new and formidable invaſion by the Carthaginians took place; but the event of that expedition was as unfortunate to the Carthaginians as the former had been, of which a particular account is given under the article CARTHAGE, n° 12. *et ſeq.*

In the mean time, however, a conſiderable revolution had happened in Syracuſe. The city of Agrigentum had been taken by the Carthaginians, and of the few inhabitants who eſcaped, ſome fled to Syracuſe, where they accuſed the Syracuſian commanders of having betrayed the city into the hands of the enemy.

31 Riſe of Dionyſius.

Dionyſius, a man of great valour and addreſs, but who had become very obnoxious to the populace; took this opportunity of attempting to retrieve his credit. He therefore ſupported the accuſations brought againſt his countrymen by the Agrigentines, and even impeached the magiſtrates as having a ſecret intelligence with the enemy, and attempting to introduce an oligarchy. As his ſpeech was entirely levelled againſt the more wealthy citizens, it was very agreeable to the lower claſs: the commanders were inſtantly degraded; and others, among whom was Dionyſius, were appointed. Having once gained this point, he began to conſider how he might get all his colleagues turned out. For this purpoſe he never joined in any council of war with the other commanders, nor imparted to them his reſolutions, giving out that he could not truſt them, and that they had more regard for their own intereſt than the welfare of their country. But while he was proceeding in this manner, the more prudent part of the citizens, perceiving what he aimed at, complained of him to the ſenate and magiſtrates, and fined him as a diſturber of the public peace. According to the laws, the fine was to be paid before he could ſpeak in public, and the circumſtances of Dionyſius did not allow him to diſcharge it. In this dilemma he was aſſiſted by Philiſtus the hiſtorian, a man of great wealth, who not only paid this fine for him, but encouraged him to ſpeak his mind freely, as it became a zealous citizen to do, promiſing to pay all the fines that ſhould be laid upon him.

Being extricated out of this difficulty, Dionyſius next proceeded to inveigh, with all the eloquence he was maſter of, againſt thoſe who by means of their power or intereſt were able to oppoſe his deſigns, and by degrees brought them into diſcredit. His next ſcheme was to get thoſe exiles recalled whom the nobility had baniſhed at different times; as thinking that they would ſupport him with all their power, as well out of gratitude as out of hatred to the oppoſite party. Having gained this point alſo, he next found means to ingratiate himſelf with the ſoldiery to ſuch a degree, that, under pretence of taking proper meaſures for reſiſting the Carthaginians, he was choſen commander in chief, with abſolute and unlimited power.

32 Is choſen generaliſſimo.

This was no ſooner done, than, pretending that his life was in danger, he choſe out 1000 men for his guard, whom he attached to his intereſt by great promiſes. As no perſon durſt now oppoſe him, he poſſeſſed himſelf of the citadel, where all the arms and proviſions were kept; after which he publicly took the title of king of Syracuſe in the year 404 B. C.

33 Becomes king of Syracuſe.

The Syracuſians did not tamely ſubmit to their new maſter: but Dionyſius managed matters ſo well, that their frequent revolts anſwered no other purpoſe than more certainly to entail ſlavery on themſelves; and he was allowed to poſſeſs the throne without much oppoſition till his death, which happened in the year 366 B. C.

34 Dionyſius II.

On the death of Dionyſius, he was ſucceeded by his ſon, called alſo *Dionyſius*. He was naturally of a mild and peaceable temper, averſe from cruelty, and inclined to learning; but his father, to whom all merit, even in his own children, gave umbrage, ſtifled as far as poſſible his good qualities by a mean and obſcure education. He no ſooner aſcended the throne, than Dion, brother to Ariſtomache the other wife of Dionyſius the Elder, undertook to correct the faults of his education, and to inſpire him with thoughts ſuitable to the high ſtation in which he was placed.

35 Put under the care of Plato by his uncle Dion, whom he baniſhes.

For this purpoſe he ſent for the philoſopher Plato, under whoſe care he immediately put the young king. This inſtantly produced a reformation on Dionyſius; but the courtiers, dreading the effects of the philoſoper's inſtructions, prevailed on him to baniſh Dion, and to keep Plato himſelf in a kind of impriſonment in the citadel. At laſt, however, he ſet him at liberty; upon which Plato returned to his own country.

Dion, in the mean time, viſited ſeveral of the Grecian cities, and at laſt took up his reſidence in Athens; but the honours which were everywhere paid him, raiſed ſuch jealouſies in the breaſt of the tyrant, that he ſtopped his revenue, and cauſed it to be paid into his own treaſury. In a ſhort time Dionyſius again ſent for Plato; but finding it impoſſible to diſſolve the friendſhip between him and Dion, diſgraced, and placed him in a very dangerous ſituation, in the midſt of aſſaſſins who hated him.

36 Uſes Plato ill, and provokes Dion to revenge.

Not daring, however, to offer him any violence, he allowed him ſoon after to depart; revenging himſelf on Dion, whoſe eſtate he ſold, and gave his wife Arete in marriage to Timocrates one of his own flatterers.

Dion now reſolved to revenge himſelf on the tyrant for the many injuries he had ſuſtained, and at once to deliver his country from the oppreſſion under which it groaned.

37 Dion raiſes troops for dethroning the tyrant.

He began with raiſing foreign troops privately, by proper agents, for the better execution of his deſign. Many Syracuſians of diſtinction entered into his ſcheme, and gave him intelligence of what paſſed in the city; but of the exiles, of whom there were upwards of 1000 diſperſed up and down Greece, only 25 joined him; ſo much were they awed by the dread of the tyrant.

38 His force very ſlender at firſt.

The troops were aſſembled at the iſland of Zacynthus, in number only about 800; but who had all been tried on many occaſions, were well diſciplined, and capable of animating by their example the forces which Dion hoped to find in Sicily. When they were about to ſail, Dion acquainted them with his deſign, the boldneſs of which at firſt occaſioned no ſmall conſternation among them; but Dion ſoon removed their fears, by telling them that he did not lead them as ſoldiers, but as officers, to put them at the head of the Syracuſians and all the people of Sicily, who were ready to receive them with open arms.

39 Is in great danger.

arms. Having then embarked in two ſmall trading veſſels, they arrived in 12 days at Cape Pachynum near Syracuſe. Their pilot adviſed them to land immediately, leſt they ſhould be overtaken by a violent ſtorm, which he perceived was approaching; but Dion, judging it improper to land ſo near the enemy, commanded him to put to ſea again, and double the Cape.—This was no ſooner done that the ſtorm came on; and the two veſſels were driven on the coaſt of Africa, where they were in great danger of being loſt. At laſt they arrived at the port of Minoa, not far from Agrigentum. Here they received intelligence that Dionyſius had ſet ſail for Italy, attended by a fleet of 80 galleys. On this Dion reſolved to take advantage of the tyrant's abſence; and immediately ſet ſail for Syracuſe. On his march he prevailed upon the inhabitants of Agrigentum, Gela, Camarina, and other cities, to join him. As ſoon as he entered the territories of Syracuſe, multitudes flocked to him; and as nobody appeared to oppoſe him, he boldly entered the city, where he quickly found himſelf at the head of 50,000 men.

40 Enters Syracuſe without oppoſition.

As ſoon as he had landed in Sicily, Timocrates, to whom his wife Arete had been given by Dionyſius, and to whom the care of the city had been left, diſpatched a courier to let the tyrant know the danger in which he was. The meſſenger, when almoſt at his journey's end, found himſelf ſo much oppreſſed by fatigue, that he could not help lying down on the ground to take ſome reſt. In the mean time, a wolf, ſmelling ſome meat which he had in his wallet, came to the place and carried off the bag in which was the meat, together with the diſpatches. By this means Dionyſius was prevented from receiving a timely account of Dion's arrival; ſo that when he entered the citadel by ſea, ſeven days after Dion's arrival, he found his affairs in a deſperate ſituation.

41 Dionyſius arrives, but is totally defeated.

Upon this he had recourſe to artifice; and having amuſed the Syarcuſians by a feigned negotiation, until he obſerved that they kept a negligent guard, he attacked them all at once with ſuch fury, that he had almoſt taken the city. But Dion encouraged the ſoldiers by his example ſo much, that he at laſt obtained a complete victory; for which they preſented him with a crown of gold.

42 Ingratitude of the Syracuſians to Dion.

It was not long, however, before the ungrateful Syracuſians began to think of conferring quite different rewards on their benefactor. Dionyſius had the addreſs to render him ſuſpected by the multitude; at the ſame time that Heraclides, an excellent officer, but a ſecret enemy to Dion, did all that lay in his power to ſink his credit. In a ſhort time Dionyſius was obliged to fly into Italy: after which Heraclides, in order to ingratiate himſelf with the populace, propoſed a new diviſion of lands; inſinuating, that they could never enjoy perfect liberty as long as there was ſo much inequality in wealth and power among the citizens. This ſcheme was oppoſed by Dion, in conſequence of which a general combination was formed againſt him; and he was deſerted by all excepting the foreign troops whom he had brought with him into the iſland.

43 He is obliged to leave the city.

The Syracuſians ſolicited even theſe to abandon the cauſe of their general: but their offers were rejected with diſdain; and Dion, with his faithful adherents, getting clear of the tumultuous and riotous populace, took the road to Leontini. The rabble purſued him, but were ſoon driven back: and Dion reſided for ſome time at Leontini, where he was received with all the reſpect due to his character.

44 A new advantage gained over the Dionyſians.

In the mean time, the citadel ſtill continued in the hands of the adherents of Dionyſius. Being blocked up on all ſides, they were reduced to great ſtraits, and were actually making propoſals of capitulation, when Nypſius, an experienced general, and greatly attached to Dionyſius, appeared with a numerous ſquadron of galleys, and a large fleet of tranſports laden with proviſions. The general landed his men, and got them into the citadel; but almoſt all his galleys and ſhips laden with corn were ſunk or taken.

45 The inhabitants maſſacred by the garriſon of the citadel.

This victory prevented the ruin of the Syracuſians; for, giving themſelves up to feaſting and debauchery, the enemy ſallied out in the night time from the citadel, and maſſacred the citizens without mercy. Being thus made ſenſible of the error they had committed, an embaſſy was ſent to Dion, intreating him to return and ſave the city a ſecond time. To this he agreed without heſitation; and inſtantly ſet out on his march, but in the mean time, as the ſoldiers of Dionyſius ſatiated with ſlaughter, had retired into their fortreſs, the urgrateful Syracuſians began to repent of their having ſent an embaſſy to Dion. The chief commanders, therefore, ſent meſſengers to ſtop his march; but as ſome of his friends ſent deputies to him at the ſame time, deſiring him to pay no regard to the former meſſage, he proceeded on his journey. The infatuated multitude ſeized the gates in order to diſpute his entrance; but they paid dear for their frenzy.

46 A ſecond maſſacre, and the city ſet on fire.

The Dionyſians again ſallied out upon them, and made ſuch ſlaughter, that one would have thought they had left none alive in the city. As the troops of the tyrant well knew that Dion was haſtening to the relief of the city, they uſed their utmoſt endeavours to deſtroy it entirely before his arrival; for, after they had murdered all the inhabitants they could find, they ſet fire to the houſes, by which great numbers periſhed.

47 The Dionyſians defeated with great ſlaughter by Dion.

During this confuſion Dion unexpectedly arrived; and having briſkly attacked the enemy, at laſt defeated them with great ſlaughter, driving the remainder into the citadel. During the reſt of the night, inſtead of refreſhing themſelves after their fatigues, they aſſiſted in extinguiſhing the fire; which was not done without great danger and difficulty. The citadel ſoon after ſurrendered; and Dion allowed Apollocrates the tyrant's ſon, who commanded there, to retire with five galleys to his father. As ſoon as Dion entered the citadel, he was met by his ſiſter and wife Arete, whom he received with affection, notwithſtanding her having lived ſo long with Timocrates. He then left the Syracuſians in poſſeſſion of the citadel, rewarded his followers, diſmiſſed his guards, and continued to live like a private citizen.

As ſoon as Dion had got poſſeſſion of the city, Heraclides had ſubmitted to him, and been received into favour; but as his ſeditious and turbulent behaviour ſtill continued, Dion at laſt gave orders to put him to death.

48 Dion becomes melancholy, and is murdered.

This action, however neceſſary, ſo affected the mind of Dion, that he became melancholy; and ever after imagined himſelf haunted by a frightful ſpectre, reſembling a woman of gigantic ſtature, with the haggard looks and air of a fury. In a ſhort time after he loſt his life, through the baſe treachery of Calippus, or Gylippus, who pretended to be his intimate friend, and who immediately after cauſed his wife and ſiſter to be carried to priſon.

Calippus having thus removed Dion, ſoon made himſelf maſter of Syracuſe, where he commited all manner of cruelties; but was driven out, and forced to fly to Rhegium, where he was murdered with the ſame dagger which had killed Dion.

49 Dionyſius reſtored.

In 350 B. C. Dionyſius again made himſelf maſter of Syracuſe; and being exaſperated by his paſt misfortunes, tyrannized worſe than ever. The Syracuſians firſt had recourſe to Icetas tyrant of Leontini; but as the Carthaginians took this opportunity to invade them with a powerful fleet and army, they were obliged to apply to the Corinthians. By them Timoleon, a celebrated commander, was ſent to the aſſiſtance of the Syracuſians, whom he found in a very diſtreſſed ſituation; Icetas being maſter of the city, the Carthaginians of the harbour, and Dionyſius of the citadel. As all parties were equally the enemies of Dionyſius, Syracuſe.

50 Surrenders to Timoleon, and keeps a ſchool at Corinth.

ſius, he found it impoſſible to hold out, and therefore ſurrendered himſelf to Timoleon, by whom he was ſent to Corinth; where at laſt he was reduced to the neceſſity of teaching a ſchool for his ſupport.

51 Cowardice of the Carthiginians.

After the expulſion of the tyrant, Timoleon withdrew to Catana, leaving only 400 Corinthians under the command of an experienced officer named *Leon*, to guard the citadel. Theſe were immediately beſieged by Icetas and the Carthaginians, but Timoleon found means to relieve them in ſpite of all oppoſition; and having diſperſed emiſſaries through the army of Mago the Carthaginian general, exhorting the mercenary Greeks to forſake him, he was ſo much intimidated, that in ſpite of all the remonſtrances Icetas could make, he ſet ſail for Africa, leaving his colleague to carry on the war in the beſt manner he could.

52 Citadel of Syracuſe and other forts demoliſhed by Timoleon.

53 He repeoples the city.

54 Dies, and is honoured as a god.

The day after the departure of Mago, Timoleon aſſaulted the city ſo briſkly, that the troops of Icetas were driven from the walls, and the Corinthians became maſters of the place. Timoleon, by ſound of trumpet, invited the inhabitants to come and aſſiſt in demoliſhing the citadel and other caſtles, which he called the *neſts of tyrants*; after which he cauſed edifices to be erected in the place where the citadel had ſtood, for the adminiſtration of juſtice. He found the city in a moſt miſerable ſituation: for many having periſhed in the wars and ſeditions, and others having fled to avoid the oppreſſion of tyrants, Syracuſe, once ſo wealthy and populous, was now become almoſt a deſert; inſomuch that the horſes were fed on the graſs which grew on the market-place. Timoleon ſupplied the city with inhabitants from Corinth and other cities of Greece, at the ſame time that great multitudes from Italy and the other parts of Sicily reſorted thither. Timoleon diſtributed the lands among them *gratis*; but ſold the houſes, and with the money ariſing from the ſale eſtabliſhed a fund for the ſupport of the poor. Having thus reſtored Syracuſe, he in like manner delivered all the Greek cities of Sicily from the tyrants who had taken poſſeſſion of them, all of whom he put to death. After this he reſigned his authority, and led a retired life, honoured in the higheſt degree by the Syracuſians, and by all the cities in Sicily. After his death he was honoured as a god; the expence of his funeral was defrayed by the public; ſports, with horſe-races and gymnaſtic exerciſes, were held annually on the day of his death; and it was decreed, that whenever the Syracuſians were at war with the barbarians, they ſhould ſend to Corinth for a general.

55 Syracuſe again falls under the power of tyrants.

56 Pyrrhus king of Epirus invited into Sicily.

57 Conquers a great part of the iſland.

58 Behaves in a haughty manner, and is obliged to return into Italy.

59 Haraſſed by the Mamertines.

60 Aſtoniſhing exploit of Pyrrhus.

For 20 years the Syracuſians enjoyed the fruits of Timoleon's victories; but new diſturbances ariſing, in a ſhort time another tyrant ſtarted up, who exceeded all that had gone before him in cruelty and other vices. This was the celebrated Agathocles, of whoſe exploits againſt the Carthaginians a full account is given under the article CARTHAGE, n° 33—53. He was poiſoned by one Mœnon in the year 289 B. C. after having reigned 28 years, and lived 95.—A ſucceſſion of tyrants followed, till at laſt the city, being held by two rivals, Tœnion and Soſiſtratus, who made war within the very walls, Pyrrhus king of Epirus was invited into Sicily, in order to put an end to theſe diſtractions. He willingly complied with the invitation; and was everywhere received with loud acclamations, as the deliverer not only of Syracuſe, but of all Sicily. As he had a fine army of 30,000 foot and 5000 horſe, with a fleet of 200 ſail, he drove the Carthaginians from place, to place, till he left them only the two ſtrong poſts of Eryx and Lilybæum. The former of theſe he took by aſſault, and was himſelf the firſt man who mounted the walls, after having killed a great number of Africans with his own hand. The Mamertines likewiſe, who had conquered a conſiderable part of the iſland, were everywhere defeated and driven out, till at laſt they were ſhut up in the city of Meſſana. The Carthaginians, alarmed at the rapidity of his conqueſts, ſent ambaſſadors with propoſals of peace upon very advantageous terms; but Pyrrhus, puffed up with the expectation of reducing the whole iſland, refuſed to hearken to any terms unleſs they would inſtantly abandon it. So firm was he in the belief of this, that he cauſed his ſon take upon him the title of *king of Sicily*; but in the mean time, having diſpleaſed the Sicilians by his arbitrary behaviour, they deſerted from him in ſuch numbers that he was glad to ſet out for Italy, for which retreat the embaſſies he received from the Samnites, Tarentines, and other Italians, furniſhed him with an honourable pretext. He embarked in the ſhips which he had brought with him from Italy; but was met at ſea by the Carthaginians, who ſunk 70 of his veſſels, and diſperſed or took the reſt; ſo that he ſaved himſelf in Italy only with 12 veſſels, the poor remains of a fleet of 200 ſail. No ſooner were the Mamertines appriſed of his departure, than they diſpatched a body of 18,000 men to haraſs him after his landing. Theſe, having paſſed the ſtraits before him, poſted themſelves in the road which Pyrrhus muſt take in marching by land to Tarentum; and concealing themſelves among woods and rocks, attacked him unexpectedly, and with great reſolution. But Pyrrhus behaved on this occaſion with his uſual bravery. The attack being made on his rear, he haſtened thither, and made a dreadful ſlaughter of the enemy, till a wound on his head obliged him to retire. As he was ſuppoſed to be diſabled by this wound, a proud Mamertine, of an extraordinary ſize, and ſhining in bright armour, advanced, and with a loud voice challenged the king of Epirus if he was yet alive, to a ſingle combat. Pyrrhus immediately turned about, and making a dreadful appearance by reaſon of the blood which ran down his face, flew at this new champion, on whoſe head he diſcharged ſuch a furious blow, that he cleft his body aſunder; one half falling to the right, and the other to the left. This incredible feat, which has ſince been aſcribed to other warriors, perhaps with as much truth as to Pyrrhus, ſo much intimidated the Mamertines, that they allowed his troops to continue their march unmoleſted.

61 Hiero choſen general of the Syracuſian forces.

62 Is elected king of Syracuſe.

After the departure of Pyrrhus, Hiero the ſon of Hierocles, a deſcendant of Gelon the firſt king of Syracuſe, was choſen general of the forces, along with another named *Artemidorus*. The two generals had nothing more at heart than to put an end to the confuſion and diſorder which reigned in the city; for which reaſon they entered it at the head of their forces. On this occaſion Hiero diſcovered extraordinary talents for government. By mere dint of inſinuation and addreſs, without ſhedding blood, or hurting a ſingle citizen, he calmed the minds of the people; reconciled the factions; and ſo gained the affections of all, that he was inveſted with the whole civil as well as military power in the ſtate. Soon after this, he married the daughter of one of the firſt citizens; and having diſtinguiſhed himſelf by his exploits againſt the Mamertines, was unanimouſly elected king of Syracuſe, in the year 265 B. C.

63 Lives in ſtrict friendſhip with the Romans.

Some time after Hiero's acceſſion to the throne, he again defeated the Mamertines, and reduced them to ſuch ſtraits, that they were obliged to call in the Romans to their aſſiſtance. The conſequences of this have been fully related under the articles ROME and CARTHAGE. Hiero, who had allied himſelf with the Carthaginians being himſelf defeated by the Romans, and finding his allies unable to protect him againſt the power of that republic, concluded an alliance with them; and continued faithful to them even in the time of the ſecond Punic war, when they were in the greateſt diſtreſs. In his reign flouriſhed the celebrated mathematician Archimedes, whoſe genius he employed in fortifying the city of Syracuſe, by innumerable machines, in ſuch a manner as rendered it abſolutely impregnable to every method of attack known at that time.

64
Hieronymus allies with the Carthaginians.

Hiero died about 211 B. C. and was ſucceeded by his grandſon Hieronymus: but he imprudently forſook the counſels of his grandfather, and entered into an alliance with the Carthaginians. Soon after this he was murdered, in conſequence of his tyranny and cruelty, and the greateſt diſorders took place in the city; which Hannibal, though then in Italy, found means to foment, in hopes of keeping the Syracuſians in his intereſt. This indeed he effected; but as his own affairs in Italy began to decline*, he could not prevent Marcellus from landing in Sicily with a formidable army, which the Sicilians could by no means reſiſt.

* See Carthage, nº 123.

65
Syracuſe inveſted.

Syracuſe was ſoon inveſted; but the machines invented by Archimedes baffled all attempts to take it by aſſault. It was 22 miles in compaſs, and conſiſted properly of five cities in one, viz. Ortygia, Acradina, Tyche, Neapolis, and Epipolæ.—Ortygia was a ſmall iſland very near the continent, and might be called the *citadel of Syracuſe*, being joined to Acradina by a bridge.

66
Great force of the Romans by ſea and land.

The immenſe preparations which the conſul had made for taking the city by ſtorm, could not have failed to accompliſh his purpoſe, had the place been otherwiſe defended than by the contrivance of Archimedes. The Roman fleet conſiſted of 60 quinqueremes, beſides a far greater number of other ſhips. The decks were covered with ſoldiers armed with darts, ſlings, and bows, to drive the beſieged from the ramparts, which on the ſide of Acradina were waſhed by the ſea, and to facilitate the approach to the walls.

67
Machine invented by Marcellus.

But a machine of Marcellus's own invention was what he chiefly depended on. He had faſtened together ſidewiſe eight galleys of different lengths, which made but one large body, and were rowed only by the oars of the outermoſt galleys. Theſe eight galleys thus joined, ſerved only as a baſis for a machine, which was raiſed up higher than the higheſt towers of the walls, and had at the top a platform guarded with parapets in front and on each ſide. This machine was called a *ſambuca*, from its reſemblance to a muſical inſtrument of that name, not unlike an harp.

68
Deſtroyed by Archimedes.

The conſul's deſign was to bring his ſambuca to the foot of the walls of Acradina; but, while it was at a conſiderable diſtance (and it advanced very ſlow, being moved only by two ranks of rowers), Archimedes diſcharged from one of his engines a vaſt ſtone, weighing, according to Plutarch's account, 1250 pounds, then a ſecond, and immediately after a third; all which, falling upon the ſambuca with a dreadful noiſe, broke its ſupports, and gave the galleys upon which it ſtood ſuch a violent ſhock that they parted, and the machine which Marcellus had raiſed upon them at a vaſt trouble and expence was battered to pieces.

69
Incredible effects of the machines of Archimedes.

At the ſame time, ſeveral other machines, which were not viſible without the walls, and conſequently did not leſſen the confidence of the Romans in the aſſault, played inceſſantly upon their ſhips, and overwhelmed them with ſhowers of ſtones, rafters, and beams pointed with iron; inſomuch that Marcellus, being at a loſs what to do, retired with all poſſible haſte, and ſent orders to his land-forces to do the ſame; for the attack on the land-ſide was attended with no better ſucceſs, the ranks being broken and thrown into the utmoſt confuſion by the ſtones and darts, which flew with ſuch noiſe, force, and rapidity, that they ſtruck the Romans with terror, and daſhed all to pieces before them.

Marcellus, ſurpriſed, though not diſcouraged, at this artificial ſtorm, which he did not expect, held a council of war, in which it was reſolved, the next day before ſun-riſe, to come up cloſe under the wall, and keep there. They were in hopes by this means to ſecure themſelves againſt the terrible ſtorm of ſtones and darts which fell on the ſhips when at a diſtance. But Archimedes had prepared engines which were adapted to all diſtances. When the Romans therefore had brought their ſhips cloſe under the wall, and thought themſelves well covered, they were unexpectedly overwhelmed with a new ſhower of darts and ſtones, which fell perpendicularly on their heads, and obliged them to retire with great precipitation. But they were no ſooner got at ſome diſtance, than a new ſhower of darts overtook them, which made a dreadful havock of the men, while ſtones of an immenſe weight, diſcharged from other machines, either diſabled or broke in pieces moſt of their galleys. This loſs they ſuſtained, without being able to revenge it in the leaſt on the enemy. For Archimedes had placed moſt of his engines behind the walls, and not only out of the reach, but even out of the ſight, of the enemy; ſo that the Romans were repulſed with a dreadful ſlaughter, without ſeeing the hand that occaſioned it; as if they had been fighting, to uſe Plutarch's expreſſion, not with men, but with the gods themſelves. What moſt haraſſed the Romans in the attack by ſea, was a ſort of crow with iron claws, faſtened to a long chain, which was let down by a kind of lever. The weight of the iron made it fall with great violence, and drove it into the planks of the galleys. Then the beſieged, by a great weight of lead at the other end of the lever, weighed it down, and conſequently raiſed up the iron of the crow in proportion, and with it the prow of the galley to which it was faſtened, ſinking the poop at the ſame time into the water. After this the crow letting go its hold all of a ſudden, the prow of the galley fell with ſuch force into the ſea, that the whole veſſel was filled with water, and ſunk. At other times, the machines, dragging ſhips to the ſhore by hooks, daſhed them to pieces againſt the points of the rocks which projected under the walls. Other veſſels were quite lifted up into the air, there whirled about with incredible rapidity, and then let fall into the ſea, and ſunk, with all that were in them. How theſe ſtupendous works were effected, few, if any, have hitherto been able to comprehend.

The troops under the command of Appius ſuffered no leſs in this ſecond attack than the fleet. In the whole ſpace of ground which the army, when formed, took up, the laſt files as well the as firſt were overwhelmed with ſhowers of darts and flints, againſt which they could not poſſibly defend themſelves. When they had with infinite trouble brought the mantelets and covered galleries, under which they were to work the rams, near the foot of the wall, Archimedes diſcharged ſuch large beams and ſtones upon them as cruſhed them to pieces. If any brave Roman ventured to draw too near the wall, iron hooks were immediately let down from above, which, taking hold of his clothes or ſome part of his body, lifted him up in the air and daſhed out his brains with the fall. Marcellus, though at a loſs what to do, could not however forbear expreſſing himſelf with pleaſantry: Shall we perſiſt, ſaid he to his workmen, in making war upon this Briareus, upon this giant with an hundred hands? But the ſoldiers were ſo terrified, that if they ſaw upon the walls only a ſmall cord, or the leaſt piece of wood, they immediately turned their backs and fled, crying out, that Archimedes was going to diſcharge ſome dreadful machine upon them.

70
The ſiege turned into a blockade.

The conſuls, finding themſelves thus defeated in every attempt, turned the ſiege into a blockade, reduced moſt of the other places in the iſland, and defeated the forces which were ſent againſt them; and at laſt Marcellus made himſelf maſter of Syracuſe itſelf, of which the following account is given by Mr Hooke.

71
Mr Hooke's account of the taking of Syracuſe.

"He took the opportunity of a feſtival, when the ſoldiers and citizens had drunk plentifully, to make a detachment ſcale the walls of Tyche, in that part of it which was neareſt to Epipolæ, and which was ill-guarded. He preſently after poſſeſſed himſelf of Epipolæ; whereupon the inhabitants of Neapolis, as well as Tyche, ſent deputies to him, and ſubmitted. Marcellus granted life and liberty to all of free condition, but gave up thoſe quarters of the city to be plundered.

“Notwithſtanding this, there was a great deal yet to do. Acradina and Ortygia, which were ſtrongly fortified, ſtill held out; Hippocrates and Hamilco arrived with their troops to the relief of the beſieged; and the Romans were forced to exert all their bravery and ſkill to maintain the advantages they had gained.

“But now a plague made terrible havock in both armies. At the firſt breaking out of the peſtilence the Sicilians, who ſerved under Hippocrates and Hamilco, diſbanded themſelves, and returned to their reſpective homes; but all the Carthaginian ſoldiers periſhed, together with thoſe two generals. The Romans ſuffered leſs by the infection; becauſe, having been a long time before Syracuſe, they were ſeaſoned to the air and water of the country.

“About this time Bomilcar arrived on the coaſt of Sicily from Carthage, with a fleet of 130 galleys and 700 ſhips of burden; but was long hindered by contrary winds from doubling the Cape of Pachynum. Epicydes, fearing the Carthaginian might ſail back to Africa, left the command of Acradina to the generals of the mercenaries, and went to Bomilcar, in order to perſuade him to fight the Roman fleet. The admiral would not engage, but ſailed away to Tarentum with all his galleys, ordering his ſhips of burden to return to Africa. Epicydes, thus fruſtrated of his hopes, and knowing himſelf unable to defend a city already half taken, retired to Agrigentum; whereupon the Syracuſians maſſacred the commanders appointed by him, choſe new prætors to govern in the town, and ſent deputies to Marcellus to treat of peace. In the mean time, the deſerters, fearing to be given up to the vengeance of the Romans, perſuaded the mercenaries that they alſo would have the ſame fate. Inſtantly the ſoldiers ran to arms, put to death the new prætors, together with many of the Syracuſians, and plundered part of the city. After this ſlaughter they choſe ſix generals, three to command in Acradina, and three in Ortygia. Upon the return of the deputies from Marcellus, the mercenaries finding that their caſe was different from that of the deſerters, and that there was no deſign againſt their lives, became perfectly ſatisfied, and the negotiation went on. During the courſe of the treaty, Marcellus found means to corrupt Mericus, a Spaniard, one of the ſix generals choſen by the ſoldiers, and engaged him to admit the Romans into that part of the city where he commanded. Mericus, the better to accompliſh this deſign, feigned an extraordinary zeal for the preſervation of that place; pretended not to like that deputies ſhould have leave to go out and in at pleaſure; and propoſed, that for the greater ſecurity of the town, each general ſhould have a diſtinct quarter aſſigned him, and be reſponſible for any neglect of duty in it. The motion was agreed to; and upon the diviſion, that diſtrict of Ortygia which extended from the fountain of Arethuſa to the mouth of the great port fell to his care. Marcellus, informed of what was done, took his meaſures accordingly. He ſent a body of troops to that ſide where Mericus commanded, and the Spaniards admitted them at the gate of Arethuſa. At the ſame time, the proconſul ordered a falſe attack to be made on Acradina; which drawing almoſt all the ſoldiers of the garriſon thither, Ortygia was in a manner left defenceleſs. Foreſeeing this, he had detached another party of ſoldiers to take advantage of it. Theſe entered Ortygia almoſt without fighting; upon which the deſerters made their eſcape, the Romans giving them way; and the Syracuſians in Acradina, thus delivered from the fear of the deſerters, immediately opened their gates to Marcellus, who thereby became maſter of the whole city.

72
The city plundered, and Archimedes killed.

“And now the conqueror, who is ſaid to have wept during the ſiege with compaſſion for the inhabitants, gave up both Ortygia and Acradina to be plundered by his army, after he had ſecured the late king's treaſures for the uſe of his republic, and the ſtatues, paintings, and principal ornaments of Syracuſe to illuſtrate his triumph. The ſoldiers had orders to ſpare the lives of the citizens; but they were cruel in their avarice, ſlew many of them, and among the reſt the incomparable Archimedes. He was very intent on a demonſtration in geometry, and calmly drawing his lines, when a ſoldier entered the room, and clapped a ſword to his throat. “Hold! (ſaid Archimedes) one moment, and my demonſtration will be finiſhed.” But the ſoldier, equally regardleſs of his prayer and his demonſtration, killed him inſtantly. There are different accounts of the manner of his death; but all agree that Marcellus regretted it extremely, and ſhowed a ſingular favour to his relations for his ſake.”

73
Syracuſe deſtroyed by the Saracens.

The city of Syracuſe continued ſubject to the weſtern empire till its declenſion, when the iſland of Sicily, being ravaged by different barbarians, the capital alſo underwent various revolutions; till at laſt, in the 9th century, it was ſo deſtroyed by the Saracens, that very few traces of its ancient grandeur are now to be ſeen. “The ancient city of Syracuſe was of a triangular form, and conſiſted of five parts or towns. The circuit, according to Strabo, amounted to 180 ſtadia, or 22 Engliſh miles and four furlongs. An account (ſays Mr Swinburne) which I once ſuſpected of exaggeration; but, after ſpending two days in tracing the ruins, and making reaſonable allowances for the encroachments of the ſea, I was convinced of the exactneſs of his meaſurement.

Travels in the two Sicilies, vol. ii. p. 327, &c.

“At preſent it is ſtrongly fortified towards the land, and the ditches of the baſtions form the communications between the two havens. It is very weak towards the ſea, but the ſhelves render it hazardous to debark on that ſide. The garriſon is one of the beſt appointed in the kingdom, but the heights of Acradina command the works.

“About eighteen thouſand inhabitants are now contained in it. The dwellings are far from being memorials of ancient Syracuſan architecture or opulence. In any other ſituation they might be thought tolerable; but to obſervers who reflect on the ſtyle of thoſe buildings that probably once covered the ſame ground, the preſent edifices muſt have a mean appearance. The ancient temple of Minerva is now turned into a cathedral. The walls of the cella are thrown down, and only as much left in pillars as is neceſſary to ſupport the roof; the intercolumniations of the peryſtile are walled up. This temple is built in the old Doric proportions uſed in the reſt of Sicily; its exterior dimenſions are 185 feet in length and 75 in breadth. There are alſo ſome remains of Diana's temple, but now ſcarcely diſcernible. Beſides theſe, there are few ruins in the iſland; and one is ſurpriſed that any ſhould exiſt in a place which has been ſo often laid waſte by enemies, and ſo often ſhaken by earthquakes.

“Every object here imprints a melancholy ſenſation on the mind, while it draws a compariſon between the preſent humble ſtate of things and their once flouriſhing condition. The ancients have left pompous deſcriptions of the traffic carried on in this well ſituated port, the almoſt incredible wealth poſſeſſed by its citizens, and the ſplendid edifices upon which they laviſhed a great part of their riches. I had already viewed (ſays Mr Swinburne) the deſert ſites of many great ancient cities, and had as often mourned over their remains, but never did I feel the impreſſion of pity and regret ſo ſtrong as in wandering among the ruins of Syracuſe."

SYRIA, a very ancient kingdom of Aſia, lying between the Mediterranean on the weſt, the Euphrates on the eaſt, and Arabia Deſerta, Phœnicia, and Peleſtine, on the ſouth.

1
Names, di-
iſions, &c.
f ancient
yria.

In ancient times this country was called *Aram*, from Aram the youngeſt ſon of Shem, who ſettled here; but in proceſs of time the name came to be changed into *Syria*, from one *Syrus*, according to ſome; though others think it is only a contraction of the word *Aſſyria*. At firſt it was undoubtedly parcelled out into ſeveral petty ſtates; all of which ſeem afterwards to have been reduced under ſubjection to the four principal ones, Zobah, Damaſcus, Hamath, and Geſhur. Afterwards the whole country was divided into two parts only, viz. Cœleſyria and Phœnicia; though the Phœnicians, Idumeans, Jews, Gazites, and Azotites, or the whole country of the Philiſtines, was included. After the death of Alexander, Syria, in the great extent of the word, was divided, according to Strabo, into Comagene, Seleucis of Syria, Cœleſyria, Phœnice on the ſea-coaſt, and Judea in the midland. Ptolemy, however, ſubdivides theſe; and in the Proper Syria reckons only Comagene, Pieria, Cyrrhiſtica or Cyrrheſtica, Seleucis, Caſſiotis or Caſiotis, Chalybonitis, Chalcidice or Chalcidene, Apamene, Laodicene, Phœnicia Mediterranea, Cœleſyria and Palmyrene.

The hiſtory of the ancient Syrians, till the time of their being carried away by the kings of Aſſyria, is totally unknown, excepting a few particulars which may be gathered from Scripture, and which it is needleſs here to repeat. During the continuance of the Aſſyrian, Babylonian, and Perſian monarchies, the hiſtory of this country affords nothing remarkable; but after the death of Alexander, it gave name to a very conſiderable empire, which makes a conſpicuous figure in ancient hiſtory. At this time, however, it was not confined to Syria properly ſo called, but comprehended all thoſe vaſt provinces of the Upper Aſia which formed the Perſian empire; being, in its full extent, bounded by the Mediterranean upon one ſide, and the river Indus on the other.

2
Seleucus
the firſt
king of
Syria after
Alexander
the Great.

The firſt king was Seleucus, one of the generals of Alexander the Great; who, after the death of that conqueror, being made governor of Babylon, was tempted, by the example of Alexander's other captains, to ſet up for himſelf.

3
Attempts
to deſtroy
Eumenes.

Eumenes, who had ſincerely at heart the intereſt of Alexander's family, ſolicited his aſſiſtance againſt Antigonus, who had openly revolted; but Seleucus not only refuſed this aſſiſtance, but attempted to deſtroy Eumenes himſelf with his whole army, by cutting the ſluices of the Euphrates, and laying under water the whole plain where they were encamped. Eumenes, however, found means to eſcape the danger without the loſs of a man. Upon this Seleucus endeavoured to gain over his troops: but finding that impoſſible, he made a truce with Eumenes, and granted him a ſafe paſſage through his province; but at the ſame time ſent an expreſs to Antigonus, deſiring him to fall upon him before he was joined by the governors of Upper Aſia. Antigonus did not fail to follow his advice; but having prevailed againſt Eumenes through treachery, he next thought of bringing Seleucus himſelf under ſubjection.

4
Obliged by
Antigonus
to fly into
Egypt.

On his return to Babylon, therefore, after having been feaſted with his whole army by Seleucus, he demanded of him an account of the revenues of his province. Receiving an unfavourable anſwer to this queſtion, Antigonus was ſo much exaſperated, that Seleucus, not thinking himſelf a match for him at that time, thought proper to fly into Egypt.

By the flight of Seleucus, Antigonus was left maſter of all his provinces; but his ſon Demetrius being afterwards defeated by Ptolemy at Gaza, Seleucus began to think of recovering what he had loſt.

5
Attempts
the recovery
of Babylon with a
very ſlender
force.

Being furniſhed by Ptolemy with 1000 foot and 200 horſe, he ſet out with that ſlender force to attempt the recovery of Babylon. Nothing could have a more deſperate appearance than this undertaking; yet Seleucus was not diſcouraged. On his arrival at Carrhæ in Meſopotamia, partly by force and partly by perſuaſion, he prevailed on the Macedonians who garriſoned that place to revolt from Antigonus and join him. Being thus reinforced, he entered the territories of Babylon, where new ſupplies were continually added to his army; his ancient ſubjects flocking to him from all parts, and declaring themſelves ready to ſtand by him with their lives and fortunes. This happened in conſequence of the lenity with which they had been treated by Seleucus; whereas Antigonus was univerſally deteſted on account of his ſeverity.

6
Becomes
maſter of
the city.

—As he approached the city, thoſe who favoured Antigonus retired into the citadel, but were ſoon obliged to ſurrender; and in that fortreſs Seleucus found his children, friends, and domeſtics, whom Antigonus had kept priſoners ever ſince his flight into Egypt.

Seleucus having thus made himſelf maſter of Babylon, in the year 312 B. C. began to prepare for encountering Antigonus, who he knew would ſoon attack him with all his force.

7
Defeats
Nicanor,
and reduces
Media and
Suſiana.

Nicanor, governor of Media under Antigonus, firſt advanced againſt him at the head of 10,000 foot and 7000 horſe: but Seleucus, with only 3000 foot and 400 horſe, having drawn him into an ambuſh, cut off almoſt the whole of his army, and ſuch of the ſoldiers as had eſcaped the ſlaughter willingly enliſted under his banner.

The conſequence of this victory was the ſubmiſſion of all Media and Suſiana; which alarming Antigonus, he ſent his ſon Demetrius with an army of 5000 Macedonian foot, 10,000 mercenaries, and 4000 horſe. Seleucus was then in Media; and Patrocles, whom he had left to take care of Babylon, finding his force inadequate to that purpoſe, compelled the inhabitants to leave the city and diſperſe themſelves in the adjacent countries, while he himſelf, with what troops he had, retired into two forts, which he thought could eaſily be defended. When therefore Demetrius entered Babylon, he was ſurpriſed to find it deſerted, upon which he inſtantly attacked the forts. One was quickly reduced; but as the other held out till the expiration of the time which had been allowed him by his father, he left 5000 foot and 1000 horſe under the command of Archelaus to carry on the ſiege. With the reſt he marched away, ſuffering his ſoldiers to live at diſcretion as he went along; which ſo provoked the Babylonians, that they were ever after attached to Seleucus as if he had been their natural prince.

On the return of Seleucus to Babylon, he eaſily drove out the troops left by Antigonus, recovered the caſtle which he had garriſoned, and ſettled his authority on ſuch a firm foundation, that it could never afterwards be moved.

8
Nicanor
again defeated
and killed.

Having then marched again into Media, he defeated and killed with his own hand Nicanor or Nicator, whom Antigonus had ſent againſt him; after which, having ſettled the affairs of Media, he reduced all Perſia, Bactria, and Hyrcania, ſubjecting to his new empire theſe and all the other provinces on this ſide the Indus which had been conquered.

Seleucus being now maſter of all the countries which lie between the Euphrates and the Indus, took the title of king of Babylon and Media. But, not ſatisfied with theſe poſſeſſions, ample as they were, he croſſed the Indus, in order to conquer thoſe regions which had ſubmitted to Alexander beyond that river. But, during the time that the generals of Alexander had been making war upon his family and up-

9 Cedes India to Sandracottus for 500 elephants.

on one another, one Sandracottus, a native of India, had driven out the Macedonians, and made himſelf maſter of the whole country. He oppoſed Seleucus with an army of 600,000 men and a prodigious number of elephants; which intimidated the Macedonian ſo much, that he offered to leave Sandracottus in quiet poſſeſſion of his dominions, provided he would furniſh him with 500 elephants. To this Sandracottus readily aſſented; upon which Seleucus marched back into the weſt againſt Antigonus, and, in conjunction with Lyſimachus and Ptolemy, engaged and totally defeated and killed him at Ipſus.

10 Defeats Antigonus, and builds many cities.

After this Seleucus marched into Upper Syria, which he reduced entirely, and built the city of Antioch on the Orontes. In the ſame country be built ſeveral other cities; one of which he called *Seleucia*, from his own name; another *Apamea*, from his wife Apama, the daughter of one Artabazus a Perſian; and a third *Laodicea*, from his mother Laodice. He firſt entered into an alliance with Demetrius, and married Stratonice his daughter; but ſoon after aſſiſted Lyſimachus and Ptolemy to deprive him of the beſt part of his dominions. Thus Demetrius being reduced ſo low that he could give him no farther jealouſy, Seleucus betook himſelf to the building of another city which he called likewiſe *Seleucia*, and which ſtood on the place where the city of Bagdad now ſtands. Beſides theſe, he built a great many others; 16 of which he called *Antioch*, from the name of his brother Antiochus; nine *Seleucia*, from his own name; three *Apamea*, from Apama his firſt wife; one *Stratonicea*, from his ſecond wife Stratonice; and ſix *Laodicea*, from his mother Laodice.

In 284 Seleucus entered into a war with Lyſimachus, with whom he had hitherto lived in ſtrict amity. Out of 36 general officers left by Alexander the Great, they two only ſurvived, and both were upwards of 70 years old. Nevertheleſs they were both filled with the ambition and animoſity of young men. The two armies met at a place called *Curopedion* in Phrygia, where an obſtinate engagement took place.

11 Defeats and kills Lyſimachus.

Victory was long doubtful: but at laſt Lyſimachus was run through with a ſpear, and died on the ſpot; on which his troops betook themſelves to flight, and left Seleucus maſter of their baggage. This victory added to the poſſeſſions of Seleucus all thoſe provinces which had formerly been ſubject to Lyſimachus. The former exulted much in his good fortune; being chiefly pleaſed that he was now the laſt of Alexander's captains, and by this victory became, as he ſtyled it, *the conqueror of conquerors*; and on this account he is generally called *Nicator*, or *the conqueror*.

12 Is himſelf treacherouſly murdered.

His triumph, however, on this occaſion, was but ſhort-lived; for, ſeven months after, as he was marching towards Macedon to take poſſeſſion of that kingdom, he was treacherouſly murdered by Ptolemy Ceraunus, on whom he had conferred innumerable favours. Philetærus prince of Pergamus purchaſed his body at a great price from Ptolemy, and ſent it to his ſon Antiochus; who, with extraordinary pomp, burned it in Seleucia on the ſea-coaſt, erecting on the place a magnificent chapel which he called from his ſurname *Nicatorium*.

13 Antiochus Soter.

Seleucus was ſucceeded by his ſon Antiochus Soter, who held the empire 19 years. He reſigned to Antigonus Gonatus all pretenſions to the crown of Macedon; and having engaged in a war with Eumenes king of Pergamus, he was defeated by him, and obliged to yield up part of his dominions.

14 Antiochus Theos.

He died in 261 B. C. and was ſucceeded by his ſon Antiochus Theos; who having engaged in a war with Ptolemy Philadelphus king of Egypt, the Parthians and Bactrians took an opportunity, to revolt, and could never afterwards be reduced. In 246 B. C. he was poiſoned by his wife Loadice, whom he had divorced for Berenice daughter to Ptolemy, with whom he made peace on the revolt of the Bactrians. On the death of Ptolemy, Antiochus divorced Berenice, and took back Laodice; who, to ſecure herſelf againſt the effects of his fickle diſpoſition, poiſoned him, as we have juſt mentioned, and raiſed to the throne her own ſon, named *Seleucus Callinicus*.

15 Seleucus Callinicus.

Not thinking herſelf ſafe, however, as long as Berenice lived, Laodice began immediately to concert meaſures, for putting both her and her ſon to death. Berenice attempted to ſave herſelf by retiring to Daphne, where ſhe ſhut herſelf up in an aſylum built by Seleucus Nicator. There ſhe was cloſely beſieged by the ſons of Seleucus; of which the cities of Aſia having intelligence, formed a confederacy in her favour. Her brother the king of Egypt alſo haſtened to her relief with a conſiderable army; but before either of theſe could come to her aſſiſtance, both ſhe and her ſon were barbarouſly murdered, with all the Egyptians who attended them.

16 Great part of his dominions conquered by Ptolemy Euergetes.

Ptolemy, on hearing the melancholy news of his ſiſter's death determined to take the moſt ſevere vengeance on her murderers. Joining his forces to thoſe of the Aſiatics, he carried every thing before him. Having in the firſt place put an end to the life of Laodice, he made himſelf maſter of all Syria and Cilicia; then paſſing the Euphrates, he ſubdued all the country as far as Babylon and the Tigris; and had not the progreſs of his arms been interrupted by a ſedition which obliged him to return to Egypt, it is more than probable that he would have ſubdued the whole Syrian empire. As ſoon as he was returned, Seleucus attempted to revenge himſelf; but his fleet being deſtroyed by a violent ſtorm, and his land army defeated by Ptolemy, he concluded a truce for ten years. During all this time the Parthian prince had eſtabliſhed himſelf ſo firmly on the throne, that it was in vain to think of diſpoſſeſſing him.

17 Seleucus defeated and taken priſoner by the Parthians.

However, as ſoon as his other affairs would permit, Seleucus undertook an expedition againſt Arſaces the Parthian monarch; by whom he was utterly defeated, taken priſoner, and carried into Parthia, where he died four years after. He was ſucceeded by his eldeſt ſon Seleucus Ceraunus, a weak prince, who was poiſoned by a conſpiracy of two of his officers, when he had reigned one year; after which his brother Antiochus, ſurnamed the *Great*, aſcended the throne in 225 B. C.

18 Antiochus the Great.

In the very beginning of his reign, two of his generals, Alexander and Molo, rebelled againſt him. The former had been appointed governor of Perſia, and the latter of Media, but they, deſpiſing the king's youth, refuſed to obey. The occaſion of this revolt is ſaid to have been their dread of the cruelty of Hermias the king's prime miniſter; and as they hoped to draw into their ſchemes Achæus governor of the provinces of Aſia Minor, they doubted not of ſucceſs. In this, however, they failed; but this did not diſcourage them from proceeding in their rebellion. Epigenes, the commander of the troops about the king's perſon, adviſed him to march without delay againſt the rebels; but as Hermias reproached him with treachery and a deſign to betray the king into the hands of his enemies, Antiochus ſent two of his generals into the eaſt, while he himſelf undertook an expedition againſt Ptolemy Philadelphus, with a view of recovering Cœleſyria.

19 Undertakes an unſucceſsful expedition againſt Egypt.

In this attempt, however, he was diſappointed; and the generals whom he had ſent into the eaſt were totally defeated and their troops cut off: upon which he determined to lay aſide for the preſent his Syrian enterpriſe, and march in perſon againſt the rebels. This was again oppoſed by Hermias; but as he found it impoſſible to alter the king's mind, the treacherous miniſter found means to get Epigenes the author of this project executed, under pretence of holding a correſpondence with Molo one of the rebel chiefs. Antiochus in the mean time purſued his

20
Suppreſſes one rebellion, but is embarraſſed by another.

21
Is defeated by the Egyptians, but ſuppreſſes the rebellion.

his march againſt the rebels, whom he defeated in a pitched battle; upon which their chiefs laid violent hands on themſelves. On his return he received the ſubmiſſion of the Atropatii, a barbarous people in Media; and put to death his prime miniſter Hermias, whom he found hatching treacherous deſigns againſt him. During his lifetime, however, the traitor, by accuſing Achæus of treaſon, had obliged him to revolt in his own defence; ſo that the king had ſtill two important wars on his hands, viz. that with Ptolemy king of Egypt, and the other againſt Achæus. After ſome deliberation, he reſolved to march firſt againſt the king of Egypt; and was at firſt very ſucceſsful, reducing many cities in Cœleſyria and Paleſtine, and defeating the Egyptians in a pitched battle: but in the year 217 B. C. being worſted in the battle of Raphia, he was obliged to abandon all his conqueſts; of which Ptolemy immediately took poſſeſſion, and Antiochus was obliged to cede them to him, that he might be at leiſure to purſue the war againſt Achæus.

22
His ſucceſſes in the eaſt.

Antiochus having made vaſt preparations for his expedition, ſoon reduced Achæus to ſuch diſtreſs, that he was obliged to ſhut himſelf up in the city of Sardis, which he defended for ſome time with great bravery; till at laſt, being betrayed by two Cretans, he was delivered up to the king, and by his order put to death. Antiochus then undertook an expedition againſt the Parthians, whom he obliged to conclude a peace on very advantageous terms. He then turned his arms againſt the king of Bactria, whom he alſo compelled to agree to his terms; one of which was, that he ſhould give him up all his elephants. For the confirmation of the treaty, the king of Bactria ſent his ſon to Antiochus; who being taken with his majeſtic mien and agreeable converſation, gave him one of his daughters in marriage. He then croſſed Mount Caucaſus, and entered India: where having renewed his alliance with the king of that country, he received alſo of his elephants, which increaſed his ſtock to 150. From India he marched into Arachoſia, Drangiana, and Carmania, eſtabliſhing order and diſcipline in all thoſe countries: then paſſing through Perſia, Babylonia, and Meſopotamia, he returned to Antioch, after an abſence of ſeven years.

23
Enters into a league with Philip of Macedon againſt the king of Egypt.

In the year 204 B. C. Antiochus entered into a league with Philip of Macedon, on purpoſe to deprive Ptolemy Epiphanes, the infant king of Egypt, of all his dominions. The Egyptians, however, put the young king under the tuition of the Romans; who immediately required the confederate princes to deſiſt from any enterpriſe againſt the king of Egypt, under the penalty of incurring the diſpleaſure of the republic. After delivering this meſſage, M. Emilius Lepidus, one of the ambaſſadors, repaired to Egypt, where he took upon himſelf the office of regent and guardian to the young king. Having regulated affairs there in the beſt manner he could, he returned to Rome, after having appointed one Ariſtomenes, an Acarnanian, to be chief miniſter to the king. Ariſtomenes being a man of prudence and fidelity, acquitted himſelf very well in his new ſtation. Having taken care to recruit his army as well as he could, he ſent one Scopas, a man of great authority among the Ætolians, into that country, to raiſe auxiliaries. Scopas ſoon raiſed an army of 6000 Ætolians, at that time reputed the beſt ſoldiers in the world; and having joined the Egyptian army, reduced all Judea, put a garriſon into the caſtle at Jeruſalem, and, on the approach of winter, returned to Alexandria loaded with booty.

24
Deſtroys the Egyptian army.

Theſe exploits, however, were performed when Antiochus was abſent in Aſia Minor; and no ſooner was he returned, than the face of affairs was changed. Scopas was defeated in a pitched battle, where one half of his men were deſtroyed. He himſelf eſcaped to Sidon, where he ſhut himſelf up with 10,000 of his ſoldiers; but Antiochus having inveſted the place, Scopas was reduced to the neceſſity of ſurrendering at diſcretion. The king purſued his conqueſts; recovered all Paleſtine and Cœleſyria; after which he invaded Aſia Minor, in hopes of reducing it alſo, and reſtoring the Syrian empire to the ſame extent it had in the time of Seleucus Nicator.

25
His conqueſts checked by the Romans.

The free cities in Aſia Minor immediately had recourſe to the Romans, who ſent an embaſſy to Antiochus on the occaſion; but as both parties put on thoſe haughty and imperious airs to which they thought the greatneſs of their power gave them a right, no ſatisfaction was given, but every thing tended to an open rupture.

26
Hannibal flees to him for protection.

While matters were in this ſituation, Hannibal the Great being obliged to leave his own country, fled to Antiochus: from whom he met with a gracious reception. As Hannibal had, while a child, ſworn perpetual enmity againſt the Romans, he uſed all his eloquence to perſuade Antiochus to make war with them; and as the many victories which he had gained over them left no room to doubt of his capacity, Antiochus doubted nothing of being able, by his aſſiſtance, to conquer that haughty people. Several embaſſies paſſed between the two nations; but chiefly with a deſign, on the part of Antiochus, to gain time. Hannibal endeavoured to draw his countrymen into the confederacy againſt Rome, but without effect.

27
Antiochus neglects the advice of Hannibal.

Antiochus having ſtrengthened himſelf by ſeveral alliances, at laſt reſolved to begin the war in earneſt. To conſult on the meaſures proper to be taken, he called a council of war; but excluded from it the only man whoſe advice he ought to have followed; namely, Hannibal the Carthaginian. The reaſon of this was, that he had become jealous of him from the too great intimacy, as he thought, which he had kept with the Roman ambaſſadors. However, in this council it was agreed that the war ſhould be immediately commenced. The king himſelf was prevailed upon by the Ætolians to paſs over into Greece, and at the ſame time entirely to reject the advice which Hannibal had formerly given, of ſending him with an army into Italy. Here he was made generaliſſimo of all the Greek forces; but made none of thoſe efforts that had formerly obtained him the title of Great. Indeed it now plainly appeared, not only that he was incapable of carrying on war againſt ſuch enemies as the Romans, but even of accepting proper advice when it was given him. In another council, into which Hannibal was admitted, that commander adviſed the king, before he undertook any thing elſe, to uſe his utmoſt endeavours to gain over Philip of Macedon; which, he ſaid, was a ſtep ſo important, that if it could be gained, they might, without much ado, become maſters of all Greece. But if Philip could not be prevailed on to make war on the Romans, he was of opinion that the king ſhould ſend his ſon Seleucus into Macedon at the head of an army, and thus prevent Philip from giving the Romans any aſſiſtance. But he ſtill maintained, that the only way to defeat the Romans was to ſend an army into Italy. This advice was again rejected; and the king imprudently became the aggreſſor, by falling on a body of 500 Romans before war had been declared. He alſo make king Philip his enemy, by entertaining the regent of Athamania, who was a pretender to the crown of Macedon.

28
His ſhameful behaviour.

To complete all, he himſelf fell in love, though above 50 years of age, with a beautiful young woman of Chalcis, whom he married; and became ſo great a ſlave to this paſſion, that he entirely neglected his affairs; the army gave themſelves up entirely to diſſipation and debauchery, and every trace of military diſcipline vaniſhed.

In the year 191 B. C. Antiochus was raiſed from his lethargy by a declaration of war againſt him at Rome, and ſet out for Ætolia. His army at this time amounted to no more than 10,000 foot and 500 horſe. He had been made

29
Is defeated by the Romans at Thermopylæ.

to believe that he would receive a vaſt reinforcement in Ætolia: but when he came to make the experiment, he ſoon found his miſtake; all the troops he could raiſe there amounted to no more than 4000 men. With this force, ſo exceedingly inadequate to the purpoſe, he was obliged to oppoſe the Roman army, who were advancing in conjunction with the Macedonians, and had already made ſurpriſing progreſs. Antiochus ſeized the Straits of Thermopylæ; but was driven from them by the Romans, the king himſelf being the firſt that fled. Almoſt his whole army was deſtroyed in the battle or in the purſuit, and Antiochus returned with diſgrace into Aſia.

Soon after his return, Antiochus equipped a fleet of 200 ſail; on which he immediately embarked for the Thracian Cherſoneſus, now Crim Tartary, where he fortified the cities of Lyſimachia, Seſtus, and Abydos, with others in that neighbourhood, to prevent the Romans from croſſing the Helleſpont.

30
His fleet defeated by that of the Romans.

In the mean time Polyxenidas the Syrian admiral ſent intelligence to the king that the Roman fleet had appeared off Delos; upon which he deſired him to ſeek them out and engage them at all events. He did ſo, and was defeated with the loſs of 40 ſhips taken or ſunk in the engagement. This was ſoon after revenged by the deſtruction of the Rhodian fleet by the artifice of Polyxenidas; but in the end the king's affairs went everywhere to wreck.

31
Meets with two other defeats, and becomes like one infatuated.

Having laid ſiege to the city of Pergamus, he was obliged to raiſe it with loſs; the Phœnician fleet commanded by Hannibal was defeated by the Rhodians; and ſoon after the Syrian fleet under Polyxenidas was utterly defeated by the Romans. Antiochus was ſo much diſheartened by theſe repeated defeats, that he appeared like one infatuated. Inſtead of fortifying more ſtrongly thoſe cities which lay on the frontiers of his kingdom, he entirely deſerted them: and thus Lyſimachia and Abydos, the two keys to Aſia, fell into the hands of the Romans without the leaſt reſiſtance.

The arrival of the Romans in Aſia ſtruck Antiochus with ſuch terror, that he inſtantly ſued for peace.

32
Sues for peace, but is refuſed.

The terms he offered were indeed very advantageous, but by no means agreeable to the expectations of the Romans. They therefore gave him this final anſwer: 1. That ſince he had drawn upon himſelf the war, he ſhould defray the whole expence of it; 2. That he ſhould reſtore liberty in general to all the Greek cities in Aſia; and, 3. That to prevent future hoſtilities, he ſhould relinquiſh all Aſia on this ſide Mount Taurus. Theſe terms, however, ſtill appeared to him ſo intolerable, that he reſolved to continue the war; and determined alſo to take the moſt imprudent method of carrying it on, namely, by hazarding all on the event of a general engagement. The king encamped near Magneſia, and ſtrongly fortified his camp. The Romans inſulted him in his trenches, and propoſed to attack his fortifications if he continued to decline an engagement. At laſt the king, thinking it would be ſhameful for him longer to refuſe an engagement, being at the head of an army far more numerous than that of the enemy, in a friend's country, and in the midſt of his allies, reſolved at all events to accept the challenge, and accordingly prepared for a deciſive battle.

33
Battle of Magneſia.

The Roman army conſiſted of four legions, partly Romans and partly Latins, each legion at this time containing 5500 men, and of 7000 auxiliaries ſent by the kings of Pergamus and Macedon; but of theſe 2000 were ordered to guard the camp during the action. The Romans were poſted in the centre, and the Latins in the two wings, the left of which extended to the river. On the ſide of the right wing, to cover and ſupport it, the conſul poſted the auxiliary troops of Eumenes, a ſmall body of horſe, and ſome Trallians and Cretans lightly armed. Sixteen elephants which the Romans had were placed behind the army by way of corps-de-reſerve, the conſul not thinking it proper to oppoſe them to thoſe of the enemy, which were far more numerous, being in all 52, and beſides excelled the Roman elephants in ſtrength, height, and courage, the former being brought from India and the latter from Africa. As for the Syrian army, all the nations of the eaſt ſeemed to be aſſembled to ſupport the cauſe of Antiochus. But the main ſtrength of it conſiſted in 16,000 foot, armed after the Macedonian manner, who compoſed the phalanx. This body faced every way, was armed with long pikes, and taught to fight in cloſe order, as the ſoldiers of Alexander the Great had formerly been. Antiochus did not draw up his phalanx as uſual, but divided it into 10 companies ſeparated from each other, placing, in the ſpaces between each of the companies, an elephant loaded with a tower full of armed men. On the right of the phalanx was drawn up in a line part of the cavalry, viz. 1500 Aſiatic Gauls, 3000 horſe armed cap-a-pee, and 1000 more, the flower of the Median cavalry. At ſome diſtance from theſe followed the cavalry of the king's houſehold richly clothed, and wearing bucklers plated over with ſilver. In the ſame line 1200 Scythians on horſeback, armed with bows and arrows, made a great figure, being all choſen men, and of an extraordinary ſize. The light-armed troops, to the number of 3000, partly Trallians and partly Cretans, with 10,000 Myſian archers and 4000 men more, partly Cyrtœans armed with ſlings, partly Perſians armed with bows, and partly Arabians mounted on dromedaries, cloſed the right wing, which was led on by the king in perſon, ſurrounded by a body of Syrians and Lydians well mounted, but not heavily armed. The left wing was commanded by Seleucus and Antipater; the former the king's ſon, and the latter his nephew, and diſpoſed thus: Cloſe to the phalanx were poſted 1500 Galatians and 2000 Cappadocians, which king Ariarathes had ſent to the aſſiſtance of his father-in-law. Next to theſe were placed 2700 auxiliaries ſent from different countries; theſe were followed by 3000 cuiraſſiers well mounted; and, laſtly, in the flank of this wing marched 2000 horſe lightly armed. At ſome diſtance were placed ſeveral ſmall bodies of light-armed troops both foot and horſe; among which were 2500 Galatian horſe, ſome Tarentines, Cretans, Carians, Cilicians, &c. The phalanx, which was in the centre, was commanded by three officers of diſtinction, viz. Minio, Zeuxis, and Philip. A vaſt number of chariots, armed with hooks and ſcythes, were drawn up before the firſt line, as were likewiſe a great many elephants carrying towers with ſeveral floors, all filled with ſlingers and archers; beſides many camels, animals then unknown to the Roman troops, mounted by Arabians armed with ſwords ſix feet long, that the riders might from their backs reach the enemy. The Romans had never ſeen a more numerous army, nor one more finely adorned; nevertheleſs they never ſhowed ſo great a contempt for an army as for this which they were now going to attack.

On the day of the battle the weather proved very favourable to the Romans; for a thick fog riſing in the morning, the day was almoſt turned into night, ſo that the Syrian commanders could not have all the corps under their command in view, on account of their great extent, nor ſend them proper orders in time; whereas the fog was not thick enough to prevent the Roman generals from ſeeing their ſeveral bodies at the greateſt diſtance, as they took up but little ground. Beſides, the damp which was occaſioned by the fog ſlackened the ſtrings of the enemy's bows, ſo that the Aſiatics who uſed them could ſhoot their darts and arrows but faintly. The whole dependence of Antiochus in the firſt attack was on his armed chariots, which were to cut their way into the Roman army. For this purpoſe they

34 Gallant behaviour of Eumenes.

35 The Syrians defeated.

had long halberts faſtened to their poles, and ſharp hooks to their axle-trees; the former were about the height of a man's head, and the latter almoſt ſwept the ground, and cut off the legs of all who ſtood in their way. But Eumenes undertook to render them uſeleſs, and even fatal, to the enemy. This brave prince, putting himſelf at the head of the bowmen and ſlingers, ordered them to charge, not in a body, but divided in platoons, and to aim only at the horſes in the chariots. Accordingly, as ſoon as the chariots moved, Eumenes advanced at the head of his men, who pouring on them from every quarter darts, ſtones, and javelins, and at the ſame time ſhouting as loud as they could, ſo frightened the horſes that they could no longer be kept in order, but ſcouring up and down, and turning againſt their own troops, fell on the Arabians who ſupported them, which occaſioned a great confuſion in that quarter. Thoſe in the Syrian army who were at a diſtance, hearing the noiſe and outcries, and not knowing the cauſe of them, were ſtruck with no ſmall terror. After this advantage, the Roman cavalry advanced, and fell on thoſe whom the chariots had put in diſorder. The Syrians being already intimidated, after a faint reſiſtance gave way; and the Romans made a great ſlaughter of their men and horſes, both being borne down with the weight of their heavy armour. Eumenes charged the left-wing, in which Seleucus commanded, with ſuch vigour, that he put it to flight; and the fugitives flying to the phalanx for protection, put that body likewiſe in diſorder: which Domitius obſerving, advanced againſt it at the head of his legionaries, but could not break it till he ordered his men to attack the elephants; which, as before obſerved, were placed in the ſpaces between the companies. The Romans had learned, in their wars with Pyrrhus and Hannibal, not to fear thoſe monſters which were once ſo terrible to them. They attacked them, therefore, with great reſolution; and driving them againſt the phalanx, put that body into diſorder, by means of thoſe very animals which had been poſted there for its defence.

36 And their camp taken.

But in the mean time advice was brought that the left wing of the Romans was in great danger. Antiochus, who had obſerved that the flanks of the left wing were quite open and uncovered, the four ſquadrons which covered it having joined the reſt of the cavalry to fall upon the enemy's left wing, had charged it at the head of all his auxiliaries, not only in front but in flank. The Roman infantry, ſeeing themſelves in imminent danger of being ſurrounded and hemmed in on all ſides, fled in great diſorder to their camp, which was guarded by 2000 men under the command of a legionary tribune called *Æmilius*. This man ſeeing the Romans flying towards him, marched out at the head of all his troops to meet them; and after having bitterly reproached them for their cowardice and ignominious flight, ordered his men to draw their ſwords, and cut in pieces ſuch as ſhould advance one ſtep farther, or refuſe to face about againſt the enemy. This order, given ſo ſeaſonably, and put in execution without mercy againſt ſome, had the deſired effect. Thoſe who were flying firſt halted; and then, being both reinforced and encouraged by Æmilius, returned under his conduct to wipe off the diſhonour of their flight. At the ſame time Attalus the brother of Eumenes, having left the right wing on his receiving advice that the left was in danger, arrived very ſeaſonably with 200 horſe. Antiochus obſerving that the troops which had fled were returning to the battle, and that the enemy's right wing was ready to fall upon him, turned his horſe about and fled. This ſerved in a manner as a ſignal for the reſt of the troops, for the whole Syrian army immediately turned their backs. Eumenes alone purſued them at the head of the cavalry, and made a moſt dreadful havock of the fugitives. The Romans walking over heaps of dead bodies, eſpecially where the phalanx ſtood, marched up to the Syrian camp, attacked, and plundered it. The riches they found in it are not to be deſcribed: but the taking of it coſt the Romans a new battle, which proved more fatal to the Syrians than that in the field; for the Romans having, in ſpite of a moſt deſperate reſiſtance, forced the intrenchments, gave no quarter, but put all to the ſword without diſtinction. There fell this day in the battle, in the purſuit, and in the plunder of the camp, 50,000 foot and 4000 horſe; 1500 were taken priſoners, and 15 elephants. In the conſular army there were but 300 foot killed and 25 horſe. Eumenes had only 15 of his men killed; ſo that this victory, as we are told by the ancients, ſeemed a prodigy to all nations both of the eaſt and weſt.

Antiochus retired to Sardis with as many of his forces that had eſcaped the ſlaughter as he could draw together. From Sardis he ſoon marched to rejoin his ſon Seleucus, who had fled to Apamea. As for the conſul, he took advantage of the king's defeat and flight, making himſelf maſter of all the neighbouring countries. Deputies haſtened to him from all parts; the cities of Thyatira, Magneſia, Trallis, Magneſia in Caria, all Lydia, and Epheſus itſelf, though highly favoured by Antiochus, declared for the Romans. Polyxenidas, upon the news of the king's defeat, left the port of Epheſus, and ſailed to Patara, where he landed with a very ſmall guard, and returned by land into Syria. The conſul took the road to Sardis, which opened its gates to him. As he ſtopped there, his brother Africanus, as ſoon as his health allowed him, came and joined him in that city, and congratulated him on the glory he had ſo lately acquired.

Antiochus finding his affairs in a bad ſituation both by ſea and land, and not daring to appear before the conſular army in the field, ſent Antipater his brother's ſon, and Zeuxis, who had been governor of Lydia and Phrygia, to ſue for a peace. They were ordered to treat chiefly with the elder brother, of whoſe clemency and good nature Antiochus entertained a high opinion. Accordingly, on their arrival at Sardis, where the conſul then was with his brother, they addreſſed the latter, and were by him preſented to the conſul. Their ſpeech was very ſubmiſſive, and ſuch as became a vanquiſhed people.

37 Antiochus obtains peace on very hard terms.

Hereupon a council was ſummoned, and after long debates the ambaſſadors were called in; and Scipio Africanus being deſired by the conſul to acquaint the deputies with the reſolutions of the aſſembly, is ſaid to have expreſſed himſelf in the following terms: "We are ſenſible that the victory which we have lately gained is owing to the gods, and therefore ſhall treat the vanquiſhed with moderation, demanding little more of them now than we did at our firſt entering into Aſia. Antiochus ſhall obtain a peace upon the following terms: That he give up his pretenſions to Europe, confine his dominions to Aſia beyond Mount Taurus; and that he pay 15,000 Euboec talents for the expences of the war; 500 down, 2500 when the ſenate and people ſhall confirm the articles, and 1000 more every year for 12 years together. We alſo inſiſt upon his ſatisfying king Eumenes, and his paying him the 400 talents he owes him, and what remains due for the corn which his father ſent to the king of Syria. It is likewiſe the pleaſure of the council that you deliver up to us Hannibal the Carthaginian, Thoas the Ætolian, Mneſilochus the Acarnanian, and Philo and Eubulus two Chalcidians; for theſe have been the authors of our diviſions, the incendiaries who kindled the preſent war. Laſtly, the king of Syria, for a further proof of his ſincerity, ſhall give us 20 ſuch hoſtages as we ſhall chooſe, of whom Antiochus his youngeſt ſon ſhall be one."

The ambaſſadors of Antiochus had been ordered to refuſe no terms; and therefore theſe were accepted, and the whole affair concluded. So that the Syrian ambaſſadors now prepared to ſet out for Rome, to get the conditions of peace propoſed by Scipio ratified there. In the mean time, the conſul dividing his army into three bodies, put it into winter-quarters; one part continued at Magneſia, another was ſent to Trallis, and the third to Epheſus, where the Scipios took up their quarters. There they received a new embaſſy from Antiochus, with the hoſtages he had promiſed, the Roman priſoners and deſerters, and the ſtrangers which the conſul had demanded, except Hannibal, who after the king's defeat had fled out of his dominions; and Thoas the Ætolian, who, as ſoon as he heard that a treaty was on foot between Antiochus and the Romans, had returned to Ætolia, where a war was likely to break out between that republic and Rome. L. Aurelius Cotta was ſent with the ambaſſadors to Rome, to acquaint the ſenate with the particulars of the treaty. When they appeared before the conſcript fathers, they ſpoke with great ſubmiſſion, and only deſired them to ratify the articles which the Scipios had offered to their maſter. The ſenate, after examining them ordered that a treaty of peace ſhould be concluded with Antiochus, and the articles of it engraved on braſs, and fixed up in the Capitol. They only added one clauſe, which was, That the Syrians ſhould change every year all their hoſtages, except the ſon of king Antiochus, who ſhould continue at Rome as long as the republic thought fit. The peace being thus ratified, and all Aſia on this ſide Mount Taurus delivered into the hands of the Romans, the Greek cities were by them reſtored to their liberty, the provinces of Caria and Lydia given to the Rhodians, and all the reſt that had belonged to Antiochus beſtowed upon Eumenes.

38 His death. Antiochus did not long ſurvive his misfortune at Magneſia. Some tell us, that being greatly puzzled how to raiſe the ſum he had engaged to pay to the Romans, he ſeized on the riches which had for many ages been depoſited in a temple of Jupiter Belus in the province of Elymais; upon which the populace roſe in arms, and ſlew him and all his attendants. Others inform us, that he was killed at an entertainment by one of his gueſts.

39 Syria becomes a Roman province. Antiochus the Great died in 187, and with him the glory of the Syrian empire. The Romans now gave laws to the kings of Syria, inſomuch, that when Antiochus Epiphanes the grandſon of Antiochus the Great heſitated at obeying the commands of the ſenate, one of the ambaſſadors drew a circle round him with a rod on the floor, and told him that he ſhould not go out of that ſpot before he had told him what he was to do. The moſt remarkable tranſactions of this prince are his wars with the Jews, and perſecutions of them; of which a full account is given under the article Jews. After a variety of uſurpers and tyrants, the kingdom of Syria fell under Tigranes king of Armenia in the year 83 B. C.; and upon his overthrow by the Romans, it became a province of the dominions of the republic. From them it was taken by the Saracens in the reign of the caliph Omar, and is now a province of Turkey in Aſia.

40 Climate, ſoil, &c. of the country. Syria is in ſome meaſure only a chain of mountains, varying in their levels, ſituation, and appearances. The part of the country, however, next the ſea is in general low, and beſides this there are ſeveral extenſive valleys. The climate on the ſea-coaſt and in theſe valleys is very hot; but in the higher parts of the country it bears a good deal of reſemblance to that of France. Syria is exceedingly fertile, and the variety of its productions is very great. Beſides wheat, rye, barley, beans, and the cotton plant, which is cultivated everywhere, Paleſtine abounds in ſeſamum, from which oil is procured, and doura as good as that of Egypt. Maize thrives in the light ſoil of Balbec, and even rice is cultivated with ſucceſs on the borders of the marſhy country of Havula. They have lately begun to plant ſugar-canes in the gardens of Saide and of Bairout, and they find them equal to thoſe of the Delta. Indigo grows without cultivating on the banks of the Jordan, in the country of Biſan, and only requires care to make it of an excellent quality. The hill-ſides of Latakia produce tobacco. Gaza produces dates like Mecca, and pomegranates like Algiers; Tripoli affords oranges equal to thoſe of Malta; Bairout figs like thoſe of Marſeilles, and bananas not inferior to thoſe of St Domingo; Aleppo enjoys the excluſive advantage of producing piſtachios; and Damaſcus juſtly boaſts of poſſeſſing all the fruits known in our provinces. Its ſtony ſoil ſuits equally the apples of Normandy, the plums of Touraine, and the peaches of Paris. Twenty ſorts of apricots are reckoned there, the ſtone of one of which contains a kernel highly valued through all Turkey. The cochineal plant, which grows on all that coaſt, contains perhaps that precious inſect in as high perfection as it is found in Mexico and St Domingo. Volney's Travels, vol. i.

The inhabitants may be divided into three principal claſſes: the deſcendants of the Greeks of the Lower Empire; the Arabs, their conquerors; and the Turks, the preſent ruling power: and theſe again, the firſt into three, the ſecond into four, claſſes; beſides three wandering tribes of Turkomen, Curds, and Bedouin Arabs. The ancient inhabitants before the Greeks under Alexander are entirely loſt. The inhabitants are in general of a middling ſtature, and the eyes of the women almoſt everywhere beautiful, and their ſhape correct and well proportioned. The general language is Arabic. Syriac is a dead language.

SYRINGA, the Lilac, in botany: A genus of plants belonging to the claſs of *diandria*, and order of *monogynia*; and in the natural ſyſtem ranging under the 44th order, *Sepiariæ*. The crolla is quadrifid, and the capſule is bilocular. There are three ſpecies, the vulgaris, perſica, and ſuſpenſa. The two firſt are natives of Perſia, and the laſt of Japan.—The *vulgaris*, which is diſtinguiſhed by ovate heart-ſhaped leaves, was cultivated in Britain about the year 1597 by Mr John Gerard.—The *perſica*, which has lanceolate leaves, was cultivated in 1658; but how long both ſpecies might have been introduced into Britain before theſe dates, it is perhaps impoſſible to aſcertain.

SYRINGE, a well-known inſtrument, ſerving to imbibe or ſuck in a quantity of fluid, and to ſquirt or expel the ſame with violence. The word is formed from the Greek συριχξ, or the Latin *ſyrinx* "a pipe,"—A ſyringe is only a ſingle pump, and the water aſcends in it on the ſame principle as in the common ſucking-pump. See Hydrostatics, n° 25, *et ſeq.*

SYRUP, in pharmacy, a ſaturated ſolution of ſugar, made in vegetable decoctions or infuſions. See Pharmacy, ch. xxiii.

SYSTEM, in general, denotes an aſſemblage or chain of principles or concluſions, or the whole of any doctrine, the ſeveral parts whereof are bound together, and follow or depend on each other; in which ſenſe we ſay a *ſyſtem of philoſophy*, a *ſyſtem of divinity*, &c. The word is formed from the Greek συϛημα "compoſition, compages."

System, in the animal economy, the *vaſcular*, the *nervous*, and the *cellular*. See Anatomy.

System, in muſic, an aſſemblage of the rules for harmony, deduced from ſome common principle by which they are reunited; by which their connection one with another is formed; from whence, as from their genuine ſource, they natively flow; and to which, if we would account for them, we muſt have recourſe. See the articles Chromatic, Diatonic, Enharmonic, Harmony, Interval, and Music.

System, in botany. See Botany, page 430.

System, in aſtronomy. See Astronomy.

SYSTOLE, in anatomy, the contraction of the heart, whereby the blood is drawn off its ventricles into the arteries; the oppoſite ſtate to which is called the *diaſtole*, or *dilatation of the heart*. See Anatomy, n° 124.

SYSTYLE, in architecture, that manner of placing columns where the ſpace between the two ſhafts conſiſts of two diameters or four modules.

SYZYGY, Syzygia, in aſtronomy, a term equally uſed for the conjunction and oppoſition of a planet with the ſun. The word is formed from the Greek *συζυγια*, which properly ſignifies *conjunctio*. On the phenomena and circumſtances of the ſyzygies a great part of the lunar theory depends. See Astronomy.

T.

T or t, the 19th letter and 16th conſonant of our alphabet; the ſound whereof is formed by a ſtrong expulſion of the breath through the mouth, upon a ſudden drawing back of the tongue from the fore part of the palate, with the lips at the ſame time open. The proper ſound of *t* is expreſſed in moſt words beginning or ending with that letter; as in *take*, *tell*, *hot*, *put*. *Ti* before a vowel has the ſound of *ſi*, or rather of *ſhi*, as in *creation*, except when *ſ* precedes, as in *queſtion*; and in derivatives from words ending in *ty*, as, *mighty*, *mightier*. *Th* has two ſounds; the one ſoft, as *thou*, *father*; the other hard, as *thing*, *think*. The ſound is ſoft in theſe words, *then*, *thence*, and *there*, with their derivatives and compounds; and in the words *that*, *this*, *thus*, *thy*, *they*, *though*; and in all words in which *th* comes between two vowels, as, *whether*, *rather*; and between *r* and a vowel, as *burthen*.

In abbreviations, amongſt the Roman writers, T. ſtands for *Titus*, *Titius*, &c.; Tab. for *Tabularius*; Tab. P. H. C. *Tabularius Provinciæ Hiſpaniæ Citerioris*; Tar. *Tarquinius*; Ti. *Tiberius*; Ti. F. *Tiberii filius*; Ti. L. *Tiberii libertus*; Ti. N. *Tiberii Nepos*; T. J. A. V. P. V. D. *tempore judicem arbitrumve poſtulat ut det*; T. M. P. *terminum poſuit*; T. M. D. D. *terminum dedicavit*; Tr. *trans*, *tribunus*; Tr. M. or Mil. *tribunus militum*; TR. PL. DES. *tribunus plebis deſignatus*; TR. AER. *tribunus ærarii*; TRV. CAP. *triumviri capitales*; T. P. or TRIB. POT. *tribunicia poteſtate*; Tul. H. *Tullus Hoſtilius*.

Amongſt the ancients, T, as a numeral, ſtood for *one hundred and ſixty*; and with a daſh at top, thus, $\overline{\text{T}}$, it ſignified *one hundred and ſixty thouſand*. In muſic, T ſtands for *tutti*, "all, or altogether."

TABANUS, the breeze-fly: a genus of inſects belonging to the order of *diptera*. The mouth is extended in a fleſhy proboſcis, terminated by two lips. The roſtrum is furniſhed with two pointed palpi placed on each ſide of the proboſcis, and parallel to it. Gmelin has enumerated 38 ſpecies; of which three only are found in Great Britain, the bovinus, pluviatilis, and cœcutiens.

1. The *bovinus*, or great horſe fly, has a grey head; the eyes almoſt of a black brown, occupying the greateſt part of it. The thorax is of a grey colour; the abdomen is yellowiſh, with a triangular white ſpot on the middle of every ring, which conſtitutes a longitudinal band of ſpots, the point of which is directed towards the thorax. The thighs are blackiſh, and the legs yellow. The wings are ſomewhat duſky, with brown veins of a deeper dye. This inſect is the terror of horned cattle, horſes, &c. Its mouth is armed with two ſharp hooks which penetrate their hide; while with its proboſcis, which is ſhaped like a ſting, it ſucks their blood, of which it is very greedy. The puncture of the tabanus is keen and painful. The inſect is very common in damp woods and meadows, eſpecially during the great heats, when it is moſt troubleſome. The horned cattle are ſometimes ſo moleſted by their ſtings, that they go mad, run down precipices, tear themſelves on the ſtumps of trees, ſtones, &c.

2. The *pluviatilis* is of an aſhen grey colour; its eyes are green, with brown ſtreaks. The thorax is brown, marked with about ſeven longitudinal grey lines; the wings, which are brown and aſh-coloured, are dotted over with ſmall white ſpots, and have a black ſpot on the margin; the legs are ſurrounded with brown and white rings alternately. This ſpecies is very common in meadows, and is about four lines in length.

3. The *cæcutiens* has a brown head; eyes green and brown, with black ſpots; the thorax brown with black ſpots; the abdomen above, yellow with triangular brown ſpots; yellow legs, and white wings with black and brown ſpots. The length is four lines and a half.

TABARCA, a little iſland lying oppoſite to a ſmall town of that name, which divides the maritime coaſts of Tunis and Algiers, in Africa, two miles from the land, in poſſeſſion of the noble family of the Lamellini of Genoa, who have here a governor and a garriſon of 200 men to protect the coral fiſhery. N. L. 36. 50. E. Long. 9. 16.

TABASHEER, a Perſian word, ſignifying a hard ſubſtance found in the cavities of the bamboo or Indian reed, and highly valued as a medicine in the Eaſt Indies. Though ſome account was given of the tabaſheer by the Arabian phyſicians, no accurate knowledge of it was obtained till Dr Ruſſel favoured the public with his obſervations on it.

According to this gentleman's information, the tabaſheer is produced from the female bamboo, which is diſtinguiſhed from the male by the largeneſs of its cavity. It is eaſy to diſcover, without opening them, what bamboos contain it, as they make a rattling noiſe when ſhaken. Dr Ruſſel having examined a bamboo brought from Vellore, conſiſting of ſix joints, found no appearance of tabaſheer in two of them: all the reſt contained ſome, but of various quality and quantity; the whole amounting to about 27 grains. The beſt was of a bluiſh white reſembling ſmall fragments of ſhells, harder alſo than the reſt, but which might be eaſily crumbled between the fingers into a gritty powder; and when applied to the tongue and palate, had a ſlight ſaline and teſtaceous taſte; the weight not exceeding four grains. The colour of the reſt was cineritious, rough on the ſurface, and more friable; having ſome particles of a larger ſize intermixed, but light, ſpongy, and ſomewhat reſembling pumice ſtones; which appearance our author ſuppoſes, led the Arabians to think that fire was concerned in the production. The two middle joints were of a pure white colour within, and lined with a thin film. In theſe the tabaſheer was principally found. The other joints, particularly the two upper ones, were diſcoloured within; and in ſome parts of the cavity was found a blackiſh ſubſtance in grains or in powder, adhering to the ſides, the film being there obliterated.

In two or three of the joints a ſmall round hole was found at top and bottom, which ſeemed to have been perforated by ſome inſect.

Garzius informs us, that it is not found in all bamboos, nor in all the branches indiſcriminately, but only in thoſe growing about Biſnagur, Batecala, and one part of the Malabar coaſt. Dr Ruſſel was informed by a letter from a medical gentleman attending the embaſſy to the Nizam, that though Tabaſheer bears a high price at Hydrabad, it is never brought thither from Biſnagur; and that ſome of what is ſold in the markets comes from the paſs of Atcour in Canoul; and ſome from Emnabad, at the diſtance of about 80 miles to the north weſt; but that the moſt part comes from Maſulipatam. That ſold in the markets is of two kinds; one at the rate of a rupee *per* dram, but the other only half that price; the latter, however, is ſuppoſed to be factitious, and made up moſtly of burnt teeth and bones. Dr Ruſſel himſelf alſo, is perſuaded that the Tabaſheer met with in commerce is greatly adulterated. The abovementioned gentleman likewiſe informed the doctor that tabaſheer was produced in great quantities at Sylhat, where it is ſold by the pound, from one rupee to one and an half; forming a conſiderable article of trade from Bengal to Perſia and Arabia. There is, however, a third kind, much ſuperior to either of the two above deſcribed; differing not only in its ſuperior whiteneſs, but likewiſe in being much leſs mixed with heterogeneous particles; being likewiſe much harder, heavier, and ſcarcely in any degree friable by the finger.

From the experiments of Dr Ruſſel, it appears that the tabaſheer is the juice of the bamboo thickened and hardened to a certain degree. Its chemical qualities, as far as we have heard, have not yet been minutely examined. The following obſervations on its medical effects were taken from a Perſian work, intitled the "Tofut ul Monein of Mahommed Monein Hoſeiny," by Mr Williams, a ſurgeon in the ſervice of the Eaſt India company. The tabaſheer puts a ſtop to bilious vomitings and to the bloody flux. It is alſo of ſervice in caſes of palpitation of the heart, in faintings, and for ſtrengthening thoſe members of the body that are weakened by heat. It is uſeful alſo for the piles, and for acute or burning fevers, and for puſtules in the mouth (thruſh); and, given with oxymel, is of ſervice againſt reſtleſſneſs, melancholy, and hypochondriacal affections. The habitual internal uſe of it is prejudicial to the virile powers. It is alſo ſaid to be prejudicial to the lungs. Its correctives are the gum of the pine and honey. The doſe of it is to the weight of two d'herems, or ſeven maſhás

TABBY, in commerce, a kind of rich ſilk which has undergone the operation of tabbying.

TABBYING, the paſſing a ſilk or ſtuff under a calendar, the rolls of which are made of iron or copper variouſly engraven, which bearing unequally on the ſtuff renders the ſurface thereof unequal, ſo as to reflect the rays of light differently, making the repreſentation of waves thereon.

TABELLIO, in the Roman law, an officer or ſcrivener, much the ſame with our notaries-public, who are often called *tabelliones*.

TABERNACLE, among the Hebrews, a kind of building, in the form of a tent, ſet up, by expreſs command of God, for the performance of religious worſhip, ſacrifices, &c. during the journeying of the Iſraelites in the wilderneſs; and, after their ſettlement in the land of Canaan, made uſe of for the ſame purpoſe till the building of the temple of Jeruſalem. It was divided into two parts; the one covered, and properly called the *tabernacle;* and the other open, called the *court*. The curtains which covered the tabernacle were made of linen, of ſeveral colours, embroidered. There were ten curtains, twenty eight cubits long and four in breadth. Five curtains faſtened together made up two coverings, which covered up all the tabernacle. Over theſe there were two other coverings; the one of goat's hair, the other of ſheep's ſkins. The holy of holies was parted from the reſt of the tabernacle by a curtain made faſt to four pillars, ſtanding ten cubits from the end. The length of the whole tabernacle was 32 cubits, that is, about 50 feet; and the breadth 12 cubits, or 19 feet. The court was a ſpot of ground 100 cubits long, and 50 in breadth, encloſed by 20 columns, each 20 cubits high and 10 in breadth, covered with ſilver, and ſtanding on copper baſes, five cubits diſtant from one another; between which there were curtains drawn, and faſtened with hooks. At the eaſt end was an entrance, 20 cubits wide, covered with a curtain hanging looſe.

Feaſt of TABERNACLES, a ſolemn feſtival of the Hebrews, obſerved after harveſt, on the 15th day of the month Tiſri, inſtituted to commemorate the goodneſs of God, who protected the Iſraelites in the wilderneſs, and made them dwell in booths, when they came out of Egypt. On the firſt day of the feaſt, they began to erect booths of the boughs of trees, and in theſe they were obliged to continue ſeven days. The booths were placed in the open air, and were not to be covered with cloths, nor made too cloſe by the thickneſs of the boughs; but ſo looſe that the ſun and the ſtars might be ſeen, and the rain deſcend through them. For further particulars of the celebration of this feſtival, ſee LEVIT. ch. xxiii.

TABERNÆ (anc. geog.) See *Tres Tabernæ*.

TABERNÆMONTANA, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *monogynia;* and in the natural ſyſtem arranged under the 30th order, *Contortæ*. There are two horizontal follioles, and the ſeeds are immerſed in pulp. There are eight ſpecies, all of foreign growth.

TABLE, a moveable piece of furniture, uſually made of wood or ſtone, and ſupported on pillars or the like, for the commodious reception of things placed thereon.

TABLE is alſo uſed for the fare or entertainment ſerved up.

TABLE, in mathematics, ſyſtems of numbers calculated to be ready at hand for the expediting aſtronomical, geometrical, and other operations.

Table-Book. See WRITING.

Table-Mountain, a mountain of Africa, being the moſt weſterly cape or promontory in that part of the world, and near the Cape of Good Hope. The bay which is formed thereby is called the *Table-bay*.

Laws of the Twelve Tables, were the firſt ſet of laws of the Romans; thus called either becauſe the Romans then wrote with a ſtyle on thin wooden tablets covered with wax; or rather, becauſe they were engraved on tables or plates of copper, to be expoſed in the moſt noted part of the public forum. After the expulſion of the kings, as the Romans were then without any fixed or certain ſyſtem of law, at leaſt had none ample enough to take in the various caſes that might fall between particular perſons, it was reſolved to adopt the beſt and wiſeſt laws of the Greeks. One Hermodorus was firſt appointed to tranſlate them, and the decemviri afterwards compiled and reduced them into ten tables. After a world of care and application, they were at length enacted and confirmed by the ſenate and an aſſembly of the people, in the year of Rome 303. The following year they found ſomething wanting therein, which they ſupplied from the laws of the former kings of Rome, and from certain cuſtoms which long uſe had authoriſed: all theſe being engraven on two other tables, made the law of the twelve tables, ſo famous in the Roman juriſprudence, the ſource and foundation of the civil or Roman law.

Tables of the Law, in Jewiſh antiquity, two tables on which were written the decalogue, or ten commandments, given by God to Moſes on mount Sinai.

TABOO, a word uſed by the South Sea iſlanders, nearly of the ſame import as prohibited or interdicted. It applies equally to perſons and things, and is alſo expreſſive of any thing ſacred, devoted, or eminent.

TABOR, a mountain of Galilee, about 12 miles from the city of Tiberias. It riſes in the form of a ſugar-loaf, in the midſt of an extenſive plain, to the height of 30 ſtadia, according to Joſephus. The aſcent is ſo eaſy, that one may aſcend on horſeback. On the top there is a plain two miles in circumference.

The ſituation of Mount Tabor is moſt delightful. Riſing amidſt the plains of Galilee, it exhibits to the enchanted eye a charming variety of proſpects. On one ſide there are lakes, rivers, and a part of the Mediterranean; and on the other a chain of little hills, with ſmall valleys, ſhaded by natural groves, and enriched by the hands of the huſbandmen with a great number of uſeful productions. Here you behold an immenſity of plains interſperſed with hamlets, fortreſſes, and heaps of ruins; and there the eye delights to wander over the fields of Jezrael or Mageddon, named by the Arabs *Ebn Aamer*, which ſignifies "the field of the ſons of Aamer." A little farther you diſtinguiſh the mountains of Hermon, Gilboa, Samaria, and Arabia the Stony. In ſhort, you experience all thoſe ſenſations which are produced by a mixture and rapid ſucceſſion of rural, gay, gloomy, and majeſtic objects.

Mariti's Travels, vol. ii.

It was upon this enchanting mount that the apoſtle Peter ſaid to Chriſt, "It is good for us to be here: and let us make three tabernacles; one for thee, and one for Moſes, and one for Elias."

Flavian Joſephus, governor of Galilee, cauſed the ſummit of this mountain, for the ſpace of two miles and a half, to be ſurrounded with walls. The inhabitants of Tabor long braved the power of the Roman armies; but being deprived of water in conſequence of the great heats, they were forced to ſurrender at diſcretion to Placidus, the general of Veſpaſian.

Several churches were built upon this mountain by St Helen, who founded here alſo ſome monaſteries. Of the two moſt remarkable, one was dedicated to Moſes, and inhabited by Cenobites of the order of St Benedict, who followed the Latin rites: the other was dedicated to the prophet Elias by monks of the order of St Baſil, attached to the Greek rites. The kings of Hungary erected here alſo a pretty ſpacious convent for ſome monks belonging to that nation, of the order of St Paul the firſt hermit. Tabor was alſo the ſeat of a biſhop, dependant on the patriarchate of Jeruſalem.

When Godfrey of Bouillon ſeized on this mountain, he repaired the ancient churches, which were beginning to fall into ruins. Under Baldwin I. in 1113, the Saracen troops retook Tabor; and their ſanguinary fury gained as many victories as there were prieſts and Cenobites. This mountain again fell into the hands of the Chriſtians; but the Catholic ſtandard was not long diſplayed on it. Saladin pulled it down the year following, and deſtroyed all the churches. The Chriſtians retook it once more in 1253; and their zeal made them rebuild all the ſacred places. At this time Rome being accuſtomed to give away empires, Pope Alexander IV. granted Tabor to the Templars, who fortified it again. At length, in the courſe of the year 1290, the ſultan of Egypt deſtroyed and laid waſte the buildings of this mountain, which could never be repaired afterwards; ſo that at preſent it is uninhabited.

TACAMAHACA, in pharmacy, a ſolid reſin, improperly called a *gum* in the ſhops. It exudes from a ſpecies of poplar; and is in repute for mitigating pain and aches, and is alſo reckoned a vulnerary.

TACCA, in botany: A genus of plants belonging to the claſs of *dodecandria*, and order of *trigynia*. The flower is above. The corolla has ſix petals, and is vaulted. The calyx is hexaphyllous; the fruit a dry, angular, three-celled berry. There is only one ſpecies known, the pinnatifida.

TACITUS (Caius Cornelius), a celebrated Roman hiſtorian, and one of the greateſt men of his time, appears to have been born about the year of Rome 809 or 810, and applied himſelf early to the labours of the bar, in which he gained very conſiderable reputation. Having married the daughter of Agricola, the road to public honours was laid open to him in the reign of Veſpaſian; but during the ſanguinary and capricious tyranny of Domitian, he, as well as his friend Pliny, appears to have retired from the theatre of public affairs. The reign of Nerva reſtored theſe luminaries of Roman literature to the metropolis, and we find Tacitus engaged, in the year 850, to pronounce the funeral oration of the venerable Virginius Rufus, the colleague of the emperor in the conſulſhip, and afterwards ſucceeding him as conſul for the remainder of the year.

Murphy's Tranſlation of Tacitus.

The time of his death is not mentioned by any ancient author, but it is probable that he died in the reign of Trajan.

His works which ſtill remain are, 1. Five books of his Hiſtory. 2. His Annals. 3. A Treatiſe on the different Nations which in his time inhabited Germany: and, 4. The Life of Agricola his father-in-law. There is alſo attributed to him a Treatiſe on Eloquence, which others have aſcribed to Quintilian. The Treatiſe on the Manners of the Germans was publiſhed in 851.—In the year 853, Pliny and Tacitus were appointed by the ſenate to plead the cauſe of the oppreſſed Africans againſt Marius Priſcus, a corrupt proconſul, who was convicted before the fathers; and the patriot orators were honoured with a declaration that they had executed their truſt to the entire ſatisfaction of the houſe. The exact time when Tacitus publiſhed his hiſtory is uncertain, but it was in ſome period of Trajan's reign, who died ſuddenly, A. U. C. 870, A. D. 117.—The hiſtory compriſes a period of 27 years, from the acceſſion of Galba, 822, to the death Domitian, 849. The hiſtory being finiſhed, he did not think he had completed the tablature of ſlavery; he went back to the time of Tiberius: and the ſecond work, which, however, comes firſt in the order of chronology, includes a period of 54 years, from the acceſſion of Tiberius, 767, to the death of Nero, 821: this work is his "Annals."

It is remarkable, that princes and politicians have always held the works of Tacitus in the higheſt eſteem; which look as if they either found their account in reading them, or where pleaſed to find courts, and the people who live in them, ſo exactly deſcribed after the life as they are in his writings. Part of what is extant was found in Germany by a receiver of Pope Leo X. and publiſhed by Beroaldus at Rome in 1515. Leo was ſo much charmed with Tacitus, that he gave the receiver a reward of 500 crowns; and promiſed not only indulgences, but money alſo and honour, to any one who ſhould find the other part; which it is ſaid was afterwards brought to him. Pope Paul III. as Muretus relates, wore out his Tacitus by much reading it; and Coſmo de Medicis, who was the firſt great duke of Tuſcany, and formed for governing, accounted the reading of him his greateſt pleaſure. Muretus adds, that ſeveral princes, and privy-counſellors to princes, read him with great application, and regarded him as a ſort of oracle in politics. A certain author relates, that Queen Chriſtina of

Biographical Dictionary.

Tacitus.

Sweden, though extremely fond of the Greek tongue, which ſhe made "the diverſion of her leiſure hours, was not reſtrained by that from her ſerious ſtudies; ſo ſhe called among others Tacitus's Hiſtory, ſome pages of which ſhe read conſtantly every day." Laſtly, the late Lord Bolingbroke, an authority ſurely of no mean rank, calls him, "a favourite author," and gives him manifeſtly the preference to all the Greek and Roman hiſtorians.

Baillet Vie de Des Cartes, tom. ii.

Study of Hiſtory, letter v.

No author has obtained a more ſplendid reputation than Tacitus. He has been accounted, and with good reaſon, the moſt cultivated genius of antiquity; and we muſt not ſeek for his parallel in modern times. It is impoſſible not to admire and recommend his intimate knowledge of the human heart, the ſpirit of liberty which he breathes, and the force and vivacity with which he perpetually expreſſes himſelf. The reader of taſte is ſtruck by the greatneſs of his thoughts and the dignity of his narration; the philoſopher by the comprehenſive powers of his mind; and the politician by the ſagacity with which he unfolds the ſprings of the moſt ſecret tranſactions. Civil liberty and the rights of mankind never met with a bolder or a more able aſſerter: ſervitude, debaſement, and tyranny, appear not in the writings of any other author in juſter or more odious colours. He has been cenſured as obſcure; and indeed nothing can be more certain than that he did not write for the common maſs of men. But to thoſe who are judges of his compoſitions, it is no matter of regret that his manner is his own, and peculiar. Never were deſcription and ſentiment ſo wonderfully and ſo beautifully blended; and never were the actions and characters of men delineated with ſo much ſtrength and preciſion. He has all the merits of other hiſtorians, without their defects. He poſſeſſes the diſtinctneſs of Xenophon without his uniformity; he is more eloquent than Livy, and is free from his ſuperſtition; and he has more knowledge and judgment than Polybius, without his affectation of reaſoning on every occaſion.

One of the beſt editions of the works of Tacitus was publiſhed at Paris by Brotier, in 4 vols. 4to. There have been four tranſlations of his works into Engliſh; the firſt by Greenway and Sir Henry Saville, in the reign of Elizabeth; the ſecond by Dryden and others; the third by Gordon, which is remarkable for affectation of ſtyle, though ſome think it bears a ſtriking reſemblance to the original; and the fourth and beſt by Murphy, in 1793, in 4 vols 4to.

Tack ‖ Tactics.

TACK, a rope uſed to confine the foremoſt lower corners of the courſes and ſtay-ſails in a fixed poſition, when the wind croſſes the ſhip's courſe obliquely. The ſame name is alſo given to the rope employed to pull out the lower corner of a ſtudding-ſail or driver to the extremity of its boom.

The main-ſail and fore-ſail of a ſhip are furniſhed with a tack on each ſide, which is formed of a thick rope tapering to the end, and having a knot wrought upon the largeſt end, by which it is firmly retained in the clue of the ſail. By this means one tack is always faſtened to windward, at the ſame time that the ſheet extends the ſail to the leeward.

Tack, is alſo applied, by analogy, to that part of any ſail to which the tack is uſually faſtened.

A ſhip is ſaid to be on the ſtarboard or larboard tack, when ſhe is cloſe-hauled, with the wind upon the ſtarboard or larboard ſide; and in this ſenſe the diſtance which ſhe ſails in that poſition is conſidered as the length of the tack; although this is more frequently called *board*. See that article.

To Tack, to change the courſe from one board to another, or turn the ſhip about from the ſtarboard to the larboard tack, in a contrary wind. Thus a ſhip being cloſe-hauled on the larboard tack, and turning her prow ſuddenly to windward, receives the impreſſion of the wind on her head-ſails, by which ſhe falls off upon the line of the ſtarboard-tack. Tacking is alſo uſed in a more enlarged ſenſe, to imply that manœuvre in navigation by which a ſhip makes an oblique progreſſion to the windward, in a zigzag direction. This, however, is more uſually called *beating*, or *turning to windward*. See Navigation, Sailing, and *Naval Tactics*.

Falconer's Marine Dictionary.

Tack, in Scots law. See Law, n° clxvii.

TACKLE, among ſeamen, denotes all the ropes or cordage of a ſhip uſed in managing the ſails, &c.

TACKSMAN. See Tenure.

TACTICS, in the art of war, is the method of diſpoſing forces to the beſt advantage in order of battle, and of performing the ſeveral military motions and evolutions. See War.

NAVAL TACTICS;

Or, The Military Operations of Fleets.

1 Definition.

Naval tactics is the art of ranging fleets in ſuch order or diſpoſition, as may be judged moſt convenient, either for attacking, defending, or retreating, to the greateſt advantage; and to regulate their ſeveral movements accordingly. It is not a ſcience eſtabliſhed on principles abſolutely invariable, but founded on ſuch reaſons as the alteration and improvement of arms muſt neceſſarily occaſion in a courſe of time and experience; from which alſo will naturally reſult a difference in the conſtruction of ſhips, in the manner of working them, and, in fine, in the total diſpoſition and regulation of fleets and ſquadrons. We ſhall curſorily run through this ſucceſſion and change of arms, &c. to the preſent improvement of our lines of battle, in order to make us the more ſenſible of the reaſons which have induced the moderns to prefer ſo advantageous a choice as they now follow in the arrangement of their ſhips.

2 Hiſtory.

The ancient galleys were ſo conſtructed as to carry ſeveral banks of oars, very differently diſpoſed from thoſe in our modern galleys, which, however, vary the leaſt of any others from their ancient model. Advanced by the force of their oars, the galleys ran violently aboard of each other, and by the mutual encounter of their beaks and prows, and ſometimes of their ſterns, endeavoured to daſh in pieces, or ſink their enemies.

The prow, for this purpoſe, was commonly armed with a brazen point or trident, nearly as low as the ſurface of the ſea, in order to pierce the enemy's ſhips under the water. Some of the galleys were furniſhed with large turrets, and other acceſſions of building, either for attack or defence. The ſoldiers alſo annoyed their enemies with darts and ſlings, and, on their nearer approach, with ſwords and javelins; and in order that their miſſive weapons might be directed with greater force and certainty, the ſhips were equipped with ſeveral platforms, or elevations above the level of the deck. The ſides of the ſhip were fortified with a thick fence of hides, which ſerved to repel the darts of their adverſaries, and to cover their own ſoldiers, who thereby annoyed the enemy with greater ſecurity.

As the invention of gunpowder has rendered uſeleſs many of the machines employed in the naval wars of the ancients, the great diſtance of time has alſo conſigned many of them to oblivion: ſome few are, nevertheleſs, recorded in ancient authors, of which we ſhall endeavour to preſent a ſhort deſcription. And firſt,

The Δελφιν was a large and maſſy piece of lead or iron, caſt in the form of a dolphin. This machine being ſuſpended by blocks at their maſt-heads or yard-arms, ready for a proper occaſion, was let down violently from thence into the adverſe ſhips; and either penetrated through their bottom, and opened a paſſage for the entering waters, or by its weight immediately ſunk the veſſel.

The Δρεπανον was an engine of iron crooked like a ſickle, and fixed on the top of a long pole. It was employed to cut aſunder the ſlings of the ſail-yards, and, thereby letting the ſails fall down, to diſable the veſſel from eſcaping, and incommode her greatly during the action. Similar to this was another inſtrument, armed at the head with a broad two-edged blade of iron, wherewith they uſually cut away the ropes that faſtened the rudder to the veſſel.

Δορατα ναυμαχα, a ſort of ſpears or maces of an extraordinary length, ſometimes exceeding 20 cubits, as appears by the 15th Iliad of Homer, by whom they are alſo called μακρα.

Κεραιαι were certain machines uſed to throw large ſtones into the enemy's ſhips.

Vegetius mentions another engine which was ſuſpended to the main-maſt, and reſembled a battering-ram; for it conſiſted of a long beam and an head of iron, and was with great violence puſhed againſt the ſides of the enemy's galleys.

They had alſo a grappling-iron, which was uſually thrown into the adverſe ſhip by means of an engine: this inſtrument facilitated the entrance of the ſoldiers appointed to board, which was done by means of wooden bridges, that were generally kept ready for this purpoſe in the fore-part of the veſſel. See the article CORVUS.

The arms uſed by the ancients rendered the diſpoſition of their fleets very different, according to the time, place, and circumſtances of the engagement. They generally conſidered it an advantage to be to windward, and to have the ſun ſhining directly on the front of their enemy. The order of battle chiefly depended on their power of managing the ſhips, or of drawing them readily into form; and on the ſchemes which their officers had concerted. The fleet being compoſed of rowing veſſels, they lowered their ſails previous to the action; they preſented their prows to the enemy, and advanced againſt each other by the force of their oars. Before they joined battle, the admirals went from ſhip to ſhip, and exhorted their ſoldiers to behave gallantly. All things being in readineſs, the ſignal was diſplayed by hanging out of the admiral's galley a gilded ſhield, or a red garment or banner. During the elevation of this, the action continued; and by its depreſſion, or inclination towards the right or left, the reſt of the ſhips were directed how to attack or retreat from their enemies. To this was added the ſound of trumpets; which began in the admiral's galley, and continued round the whole fleet. The fight was alſo begun by the admiral's galley, by grappling, boarding, and endeavouring to overſet, ſink, or deſtroy the adverſary, as we have above deſcribed. Sometimes, for want of grappling irons, they fixed their oars in ſuch a manner as to hinder the enemy from retreating. If they could not manage their oars as dexterouſly as their antagoniſt, or fall alongſide ſo as to board him, they penetrated his veſſel with the brazen prow. The veſſels approached each other as well as their circumſtances would permit, and the ſoldiers were obliged to fight hand to hand till the battle was decided: nor indeed could they fight otherwiſe with any certainty, ſince the ſhorteſt diſtance rendered their ſlings and arrows, and almoſt all their offenſive weapons, ineffectual, if not uſeleſs. The ſquadrons were ſometimes ranged in two or three right lines, parallel to each other; being ſeldom drawn up in one line, unleſs when formed into an half-moon. This order indeed appears to be the moſt convenient for rowing veſſels, that engage by advancing with their prows towards the enemy. At the battle of Ecnomus, between the Romans and the Carthaginians, the fleet of the former was ranged into a triangle, or a ſort of wedge in front, and towards the middle of its depth of two right parallel lines. That of the latter was formed into a rectangle, or two ſides of a ſquare, of which one branch extended behind, and as the opening of the other proſecuted the attack, was ready to fall upon the flank of ſuch of the Roman galleys as ſhould attempt to break their line. Ancient hiſtory has preſerved many of theſe orders, of which ſome have been followed in later times. Thus in a battle A. D. 1340, the Engliſh fleet was formed in two lines, the firſt of which contained the larger ſhips, the ſecond conſiſted of all the ſmaller veſſels, uſed as a reſerve to ſupport the former whenever neceſſary. In 1545, the French fleet under the command of the Mareſchal d'Annebault, in an engagement with the Engliſh in the Channel, was arranged in the form of a creſcent. The whole of it was divided into three bodies, the centre being compoſed of 36 ſhips, and each of the wings of 30. He had alſo many galleys; but theſe fell not into the line, being deſigned to attack the enemy occaſionally. This laſt diſpoſition was continued down to the reigns of James I. and Louis XIII.

Meanwhile, the invention of gunpowder in 1330 gradually introduced the uſe of fire-arms into naval war, without finally ſuperſeding the ancient method of engagement. The Spaniards were armed with cannon in a ſea-fight againſt the Engliſh and the people of Poitou abreaſt of Rochelle in 1372; and this battle is the firſt wherein mention is made of artillery in our navies. Many years elapſed before the marine armaments were ſufficiently provided with fire-arms. So great a revolution in the manner of fighting, and which neceſſarily introduced a total change in the conſtruction of ſhips, could not be ſuddenly effected. In ſhort, the ſquadrons of men of war are no longer formed of rowing veſſels, or compoſed of galleys and ſhips of the line; but entirely of the latter, which engage under ſail, and diſcharge the whole force of their artillery from their ſides. Accordingly, they are now diſpoſed in no other form than that of a right line parallel to the enemy; every ſhip keeping cloſe-hauled upon a wind on the ſame tack. Indeed the difference between the force and manner of fighting of ſhips and galleys, rendered their ſervice in the ſame line incompatible. When we conſider therefore the change introduced, both in the conſtruction and working of the ſhips, occaſioned by the uſe of cannon, it neceſſarily follows, that ſquadrons of men of war muſt appear in the order that is now generally adopted.

The machines which owe their riſe to the invention of gunpowder have now totally ſupplanted the others; ſo that there is ſcarce any but the ſword remaining, of all the weapons uſed by the ancients. Our naval battles are therefore almoſt always decided by fire-arms, of which there are ſeveral kinds, known by the general name of *artillery*. In a ſhip of war, fire-arms are diſtinguiſhed into cannon mounted on carriages ſwivel-cannon, grenadoes, and muſquetry. See CANNON, &c. Beſides theſe machines, there are ſeveral others uſed in merchant ſhips and privateers, as cohorns, carabines, fire-arrows, organs, ſtink pots, &c.

The writers on naval tactics have been but few, indeed, conſidering the importance of the ſubject; and the only countries that have produced writers on this ſubject, ſo far as we know, are France and Britain, particularly the firſt. One would be led to imagine that Britain, from its inſular ſituation, having bred ſo great a number of excellent ſeamen, History.

and having ſo often been engaged in naval conteſts, would naturally have produced a number of writers on this, as well as on ſubjects of much leſs conſequence to it as a nation. The reader will, however, no doubt be ſurpriſed to hear, that we have only one ſcientific treatiſe on naval tactics, intitled *An Eſſay on Naval Tactics, &c.* by John Clerk, Eſq; of Elden, near Edinburgh; and all the other treatiſes publiſhed in Britain on this ſubject being either tranſlations from the French, or remarks upon the French authors (A). Some of the principal French treatiſes on naval tactics are the following: 1. *L'Art des Armées Navales, ou Traité des Evolutions Navales*, par Paul L'Hoſte, 1 vol. folio, printed at Lyons 1727. This book was tranſlated and publiſhed by Chriſtopher O'Bryen, Eſq; in 4to, in 1762. 2. *Tactique Navale, ou Traité des Evolutions et des Signaux*, par M. le Viſcompte de Morogues, 4to, Paris 1763. 3. *Le Manœuvrier*, par M. Bourdé de Villehuet. 4. *L'Art de Guerre en Mer, ou Tactique Navale, &c.* par M. le Viſcompte de Grenier. Tranſlations of the two laſt have appeared in Engliſh in 4to in 1788, under the name of the *Chevalier de Sauſeuil;* and a tranſlation of parts of the three laſt is in the 2d vol. of the Elements and Practice of Rigging and Seamanſhip, publiſhed at London in 1794. Other books on evolutions and tactics are, *Théorie de la Manœuvre des Vaiſſeaux*, Paris, 1689. *Pitot's Theory of Working Ships applied to Practice*, &c. tranſlated by Stone, 1743. *De la Manœuvre des Vaiſſeaux, ou Traité de Mechanique et de Dynamique, &c.* par M. Bouguer. *The Britiſh Mars*, &c. by William Flexney, 1763. *A Sea Manual*, by Sir Alexander Schomberg, 1789. *A View of the Naval Force of Great Britain*, &c. by an Officer of Rank, 1791, &c.

We ſhall occaſionally conſult all theſe works; and as ſome of them treat largely of the tactics in preſent uſe, while in others new ſyſtems are propoſed, our article will naturally be divided into two parts, keeping the preſent practice and propoſed innovations totally diſtinct from each other.

PART I. THE PRESENT SYSTEM OF NAVAL TACTICS.

CHAP. I. *Of the Orders of Sailing.*

3 Diviſion of a fleet into three ſquadrons, the van, centre, and rear.

A FLEET of ſhips of war is uſually divided into three diviſions or ſquadrons, called the *centre, van,* and *rear;* and each ſquadron has a commanding officer. The commander in chief, or admiral of the fleet, is in the centre column; the vice-admiral has the command of the van; and the rear admiral, that of the rear. The ſhips of each ſquadron are diſtinguiſhed by the poſition of their colours. The ſhips of the firſt or centre ſquadron carry their pendants at the main-top-gallant maſt head. The ſhips of the ſecond diviſion carry their pendants at the fore top-gallant maſt head, and thoſe of the third diviſion at the mizen-top maſt head. Each ſquadron ought, if poſſible, to conſiſt of the ſame number of ſhips; and alſo to be of the ſame force, ſo that each may be equally able to attack or repulſe the enemy; and when in a line, the ſeveral parts will be equally ſtrong. When the fleet is very numerous, each ſquadron is ſometimes ſubdivided in a ſimilar manner into three diviſions of centre, van, and rear.

When the fleet is formed in the line or order of battle, each admiral takes his poſt in the centre of his ſquadron, the commander in chief being in the middle of the line. If the enemy be not in ſight, the ſtore-ſhips, fire-ſhips, ſloops, &c. are to be to the windward of the fleet, becauſe they can be more eaſily ſupported, and can more readily obey the ſignals that may be made to them. There are frigates to the windward of the van and rear of the convoy, for the purpoſe of looking out for the enemy, and keeping thoſe veſſels in their proper ſtations. But if the enemy is in ſight, then all thoſe ſhips which are not to be in the line of battle are to be on the other ſide of the line with reſpect to the enemy. If the fleet is ſailing in three columns, the firſt or centre ſquadron is in the middle between the ſecond and third ſquadrons; one of which, according to circumſtances, forms the ſtarboard and the other the larboard column: and each admiral leads his reſpective diviſion. If the fleet is deſtined for a certain place at a conſiderable diſtance, it is generally formed into ſquadrons; but if cruiſing in expectation of meeting the enemy, the admiral naturally keeps his ſhips in ſuch ſailing poſitions as may be moſt advantageous to form for action as quickly as poſſible. Theſe various poſitions or arrangements are called *orders;* and that they may be better underſtood, it is neceſſary to premiſe the following definitions:

4 The ſtarboard.

The ſtarboard line of bearing, is that line upon which the ſhips of a fleet, being ranged, bear from each other upon a cloſe-hauled line, whatever courſe they may be ſteering; and ſo that, upon hauling their wind or tacking together as may be neceſſary, the ſhips will be in a line cloſe-hauled upon the ſtarboard tack.

5 And larboard lines of bearing.

The larboard line of bearing, is that line from which the ſhips of the fleet, by hauling their wind, or tacking together, may be formed in a line cloſe-hauled on the larboard tack.

6 The line abreaſt.

A fleet of ſhips is ſaid to be in the *line a-breaſt* when the ſhips keels are parallel to each other, and their mainmaſts in the ſame ſtraight line.

7 Bow and quarter line.

The bow and quarter line, is when the ſhips are ranged in a ſtraight line cutting their keels obliquely in the ſame angle. Hence at any intermediate ſhip, the ſhips towards one extremity of the line will be on the bow, and thoſe towards the other extremity will be on the quarter, of that ſhip.

8 Ships ſteering chequerwiſe.

If ſeveral ſhips ſtand on the ſame line and ſteer the ſame courſe, but different from that line, they are ſaid to be in *echiquier*, or *chequerwiſe.*

9 Manœuvre in ſucceſſion.

Manœuvre in ſucceſſion, is when a fleet, ranged in one of the orders of ſailing, and ſtanding on the ſame line, the ſame manœuvre is ſucceſſively performed by each ſhip as ſhe arrives at the wake of the van ſhip of the whole fleet, if in one line; or of the van ſhip of her particular diviſion when divided into ſquadrons. So that a fleet tacks or veers, bears away or comes to the wind in ſucceſſion, when all the ſhips of every line execute, one after another, the ſame manœuvre on the ſame point of the wake of the leading ſhip.

10 Five orders of ſailing.

The number of orders of ſailing is commonly aſſumed to be five; and denominated the *firſt, ſecond, third, fourth,* and *fifth* orders of ſailing; beſides an order of *battle*, an order of *retreat*, &c.

(A) The reaſon why Britain falls ſhort of the French in this reſpect, is, that in various ſea-ports in France there are academies eſtabliſhed for the expreſs purpoſe of educating thoſe intended for the navy in the various branches of naval ſcience; whereas, in Britain, there is only one academy eſtabliſhed at the expence of government, namely, The Marine Academy at Portſmouth; and, excepting navigation, ſcarcely any other branch of naval ſcience is taught in that ſeminary. It alſo requires great intereſt to be admitted. We are, indeed, well aware that there are boys educated for the ſea-ſervice in Chriſt's Hoſpital, London, and at Greenwich ſchool, &c. The education there is not, however, adapted for officers in the navy, being only writing, arithmetic, a little mathematics neceſſary to underſtand navigation, and navigation.

Plate ccccxciii.

11 Firſt order of ſailing.

In the firſt order of ſailing, the fleet is ranged on one of the lines of bearing, and each ſhip ſteering the ſame courſe. Thus, in fig. 1. let the wind be north, and the fleet ranged on the ſtarboard line of bearing, and let the ſhips ſteer any courſe, as ſouth-weſt. In this caſe, the fleet is ready to form the line on the ſtarboard tack by hauling the wind. Again, let the fleet be ranged on the larboard line of bearing, and ſteering the ſame courſe as before, as in fig. 2.; then the fleet is in a poſition ready to form the line on the larboard tack, by tacking.

In a numerous fleet this method of ſailing is defective; as the fleet will be too much extended, and therefore the communication between the van and the rear rendered more difficult than when in a more connected order. It is of uſe, however, when the enemy is in ſight, as then the fleet may be readily formed in order of battle; and in that caſe only, or in paſſing through a ſtrait, will it be neceſſary to range the fleet in this order.

12 Second order of ſailing.

In the ſecond order of ſailing the fleet is ranged on a line perpendicular to the direction of the wind, and ſteering any proper courſe. This order, which is repreſented in fig. 3. has the ſame defects as the former; and has alſo this diſadvantage attending it, that the fleet cannot ſafely tack in ſucceſſion from this order, as each ſhip at the time of tacking is in danger of falling on board the ſhip next aſtern; and therefore, if the line is cloſe, the ſhip aſtern muſt bear up conſiderably, in order to avoid being on board the ſhip ahead, which at that time is in ſtays.

13 Third order of ſailing.

The third order of ſailing is that in which the whole fleet is cloſe-hauled, ranged upon the two lines or lines of bearing, and therefore containing an angle of twelve points; the admiral's ſhip being at the angular point, and the whole fleet ſteering the ſame courſe. Thus, in fig. 4. the wind being ſuppoſed north, and the fleet cloſe-hauled on the ſtarboard tack: Then A being the admiral's ſhip, one part of the fleet bears from him weſt-north-weſt, and the other part eaſt-north-eaſt.

This order of ſailing is no doubt preferable to either of the former, as the ſhips are more collected, and can more diſtinctly perceive and obey the ſignals; but if the fleet is numerous, it will be too much extended.

14 Fourth order of ſailing.

In the fourth order of ſailing, the fleet is divided into ſix or more columns, as may be judged neceſſary: by which means the fleet is much more connected than in any of the former orders. The commanders, ranged upon the two lines of bearing, have their ſquadrons aſtern of them upon two lines parallel to the direction of the wind; the firſt ſhips of each column being, with reſpect to the commander of their ſquadron, the one on his ſtarboard and the other on his larboard quarter. The diſtance between the columns ſhould, however, be ſuch, that the fleet may readily reduce itſelf to the third order of ſailing, and from that to the order of battle. This order is adapted for fleets or convoys croſſing the ocean, and is repreſented in fig. 5. But as it requires much time to reduce a fleet from this order to that of battle, it is therefore defective when in preſence of an enemy.

15 Fifth order of ſailing.

The fifth and laſt order of ſailing is that in which the fleet is divided into three columns cloſe-hauled, and therefore parallel to each other; and alſo the reſpective ſhips abreaſt of each other. The van commonly forms the weather column; the centre diviſion, the middle column; and the rear diviſion, the lee column. Circumſtances may however require the van to be the lee column, and the rear the weather column. If the fleet is very numerous, each diviſion may be divided into two columns; and each admiral is to place himſelf at a little diſtance before, and in the direction of the middle of his diviſion. Fig. 6. and 7. repreſent this order of ſailing.

16 Method of finding the diſtance between the columns.

The diſtance between any ſhip and that adjacent to it in the ſame column, and alſo the interval between the columns, are regulated by the commander in chief according to circumſtances. The interval or perpendicular diſtance between the columns is commonly taken; ſuch as, that the angle contained between the line of the columns and an imaginary line joining one of the extreme ſhips of that column, and the ſhip at the other extremity of the adjacent column, may be about two points. The meaſure of this angle muſt however depend in part upon the length of the column; and when it is determined upon, the diſtance between the columns may be found by multiplying the length of one of the columns by the tangent of the above angle to the radius unity: whence, if that angle be taken equal to two points, the length of a column multiplied by the decimal .414 will give the diſtance between the columns. Thus let a column contain ſix ſhips; let the diſtance between each be 100 fathoms; and the length of each ſhip from the extremity of the bowſprit to the ſtern 46 fathoms; then the whole length of the column will be 776 fathoms. Now the above angle being taken equal to two points, the diſtance between the columns is equal to $776 \times .414 = 321\frac{1}{4}$ fathoms.

17 Order of battle.

The order of battle is formed by drawing up the ſhips of the fleet in a line nearly cloſe-hauled, and under an eaſy ſail; each ſhip being at a certain aſſigned diſtance from that next ahead, as a half or a whole cable's length. The fire-ſhips, with frigates ahead and aſtern, form a line parallel to the former, and to the windward of it if the enemy is to the leeward; but to the leeward if the enemy is to the windward. Without this line another is formed, parallel thereto, of the ſtore ſhips, &c. with frigates ahead and aſtern. Fig. 8. repreſents the order of battle, the fleet being on the ſtarboard tack.

18 Order of retreat.

In retreating from a ſuperior force, it is neceſſary to draw up the fleet in ſuch an order that it may, with the greateſt advantage, oppoſe or annoy the faſt ſailing veſſels of the enemy: for this purpoſe, the order of retreat commonly taken is that which is the inverſe of the third order of ſailing. As the fleet generally runs before the wind, the ſhips of the line are therefore ranged on the low lines of bearing; hence theſe lines contain an angle equal to 135 degrees. The admiral is at the angular point, and the frigates, tranſports, &c. are included within the wings to leeward. In place of running before the wind, the fleet may take any other proper direction; but ſtill the angle contained by the wings is to be 135°. This order of retreat is repreſented in fig. 9.

19 Order of convoy.

The order of convoy is that in which the ſhips are all in the wake of one another, ſteering on the ſame point of the compaſs, and forming a right line. If the fleet is numerous, it may be divided into three columns, which are to be ranged parallel to each other, that of the admiral occupying the middle, and all ſteering the ſame courſe.

Having defined the different orders of ſailing, we ſhall now proceed to ſhow the method of getting a fleet under way, and of bringing it to an anchor.

20 To get a fleet under way.

In order to get a fleet under way, the lee column is to get under way firſt, and bring to all at the ſame time, juſt as they find themſelves after caſting. The centre column is then to perform the ſame manœuvre, and caſt likewiſe as ſoon as the other column is brought to; and both columns will remain in that poſition till the weather column, which is ſtill apeak, having weighed, ſhall be alſo under way. The three columns may often be got under way all at once: but to execute this the fleet muſt all act together, and with equal ardour; for the weather ſhips muſt not, at any rate, be under way before the lee ones. If it be neceſſary to get immediately in order of battle, the weather columns are at once to bear away two points together, that they may take their poſts in the line of battle ahead of the lee column.

Orders of Sailing.

If the fleet be moored in a line, head to wind, the rear ſhip may get under way firſt, and haul immediately by the wind; the others in ſucceſſion, from the rear to the van, can eaſily take their ſtation in her wake, ſo that the rear ſhip will now become the leader. Or, the fleet may all get under way at the ſame time; but the van ſhip is to bring to, while the reſt, caſting the other way, would ſtand on by the wind on the ſame tack on which they have caſt, and come to tack ſucceſſively in her wake, to form the order of battle.

21 To bring a fleet to an anchor.

To bring a fleet to an anchor, it ought, if conſiderable, to anchor in three parallel lines, on one of the lines of bearing, and at the proper diſtance which the length of the columns require; the diſtance between the adjacent ſhips in the ſame column being about a cable's length. The van and rear of the columns are to correſpond with each other exactly in the direction of the wind, that they may with eaſe get under way, and form the order of battle with facility, ſo as to be able to diſpute the weather-gage with the enemy if he ſhould come in ſight. As this evolution is to be performed in moderate weather, the fleet being in three columns, they are all at the ſame time to bring their ſhip's head to the wind under their topſails, and let go their anchors together, clewing up their topſails with all poſſible diſpatch; putting the foot of the ſails in the tops, and looſening the ſheets before hauling them down; then veering away an equal quantity of cable to preſerve the aſſigned diſtance. When it blows ſo freſh as to require the topſails being reefed, two cables length may be kept between the ſhips, and even three if it be likely to blow hard.

If the fleet do not exceed 20 ſhips, they may anchor on one of the lines of bearing; or parallel to the coaſt, in places where trade-winds are common, provided they blow in the direction of the land; for, in all caſes, they muſt be in a condition to get under way at the firſt ſight of the enemy, whoſe approach is never to be waited for at anchor; becauſe, if it be dangerous for a ſingle ſhip, it muſt be ſtill more ſo for a fleet, the movements of which are interrupted by the difficulty there is in getting with celerity under way ſhips which are moored, and which, in that caſe, are not able mutually to ſupport one another, as is abſolutely requiſite in a fleet.

CHAP. II. *The Manner of Forming the ſeveral Orders of Sailing.*

22 To form the firſt order of ſailing.

THE firſt order of ſailing is formed as follows: As the fleet is ſuppoſed to be in no particular order, that ſhip which is to lead on the propoſed line of bearing on which the fleet is to ſail, runs to the leeward of the whole or greater part of the fleet, and then hauls her wind, carrying an eaſy ſail: each ſhip then endeavours to get into her proper ſtation, by chaſing the ſhip which is to be next ahead of her; and when in the wake of the leader, muſt take care to preſerve the aſſigned diſtance from the ſhip immediately ahead, by increaſing or diminiſhing the quantity of ſail: and if any of the fleet ſhould happen to be ſo far removed from her ſecond ahead as not to be able to chaſe her without getting out of her way towards the line, in that caſe ſhe muſt take her ſtation diſcretionally in a line with the leaders, and leave a proper interval. The fleet will now be formed in the line of battle; from which the firſt order of ſailing is formed by each ſhip bearing away at the ſame inſtant, and ſteering each the ſame propoſed courſe.

23 To form the ſecond order of ſailing.

To form the ſecond order of ſailing, the leader runs to the leeward of the whole, or of ſo many of the fleet as that each ſhip may eaſily fetch his wake, and then ſteers a courſe eight points from the wind, carrying an eaſy ſail. Each ſhip now gets into her proper ſtation, by chaſing that which is to be ahead of her; and when the whole fleet is formed in a line, which will be perpendicular to the direction of the wind, each ſhip bears away at the ſame inſtant, and the whole ſteer the ſame intended courſe.

Manner o Forming the ſeveral Orders o Sailing.

24 To form the third order of ſailing.

In the third order of ſailing the admiral is in the middle of his fleet. Now, the fleet being formed in a line, on one of the lines of bearing, as above directed, and the ſhips ſteering in the wakes of each other, or ten points from the wind, the leading or leewardmoſt ſhip firſt hauls her wind; the ſecond ſhip, as ſoon as ſhe is in the wake of the leader, hauls her wind alſo; and in like manner each ſhip until the admirals ſucceſſively haul their wind as ſoon as they have reached the wake of the leading ſhip; and at the ſame inſtant that the admiral's ſhip hauls her wind, the other, or ſternmoſt half of the fleet, do the ſame. The fleet will then be in the third order of ſailing, as repreſented in fig. 4. From this order of ſailing the fleet can be expeditiouſly formed into the line of battle on either tack.

25 To form the fourth order of ſailing.

As the fleet, in the fourth order of ſailing, is divided into ſix columns, and the three commanders ranged on the two lines of bearing, the commander in chief being at the angular point; in order, therefore, to form this order, the admirals range themſelves on the two lines of bearing, at a proper diſtance from each other, and ſteer the proper courſe; the ſhips of the ſeveral columns come each into its reſpective place, forming themſelves into lines in the direction of the wind, and parallel to each other, as in fig. 5.

26 To form the fifth order of ſailing.

In order to form the fifth order of ſailing, the three leading ſhips of the diviſions are to take their poſts abreaſt, and to leeward of each other, keeping their wind under an eaſy ſail. Then the ſhips of each ſquadron making ſail, will range themſelves in their reſpective ſtations, aſtern of their leaders, and keeping the ſame courſe; each ſhip preſerving the appointed diſtance from that next ahead; and the commanders of each diviſion, and each ſecond, third, &c. ſhip, are to keep themſelves mutually abreaſt of each other.

27 To form the order of battle.

To form the order of battle, it has already been obſerved, in the firſt order of ſailing, that the ſhip which is to lead runs to the leeward of the whole, and then hauls her wind upon the tack directed, carrying an eaſy ſail. Each ſhip then makes ſail according to her diſtance, and chaſes the ſhip which is to be immediately ahead of her in the line, and hauls in her wake in the line on which the van ſhip is moving.

28 To form the order of retreat.

The admiral, or ſhip appointed to make the angular point, runs to the leeward of the fleet, and brings to; then each ſhip runs to its reſpective ſtation in one of the lines of bearing, and brings to; one half of the fleet being on one of the lines of bearing, aſtern and in the wake of the admiral, and the other half on the other line of bearing, on the ſtarboard or larboard bow of the admiral. When this is accompliſhed, the whole fleet bears away before the wind: the two wings will now bear from the admiral two points before his beam, and ready to form the line of battle upon either tack; the ſhips on the admiral's ſtarboard bow being in the line of bearing for the larboard tack, and thoſe on his larboard bow in the line of bearing for the ſtarboard tack.

CHAP. III. *To Change from the ſeveral Orders of Sailing to the Line of Battle.*

29 To form the line battle fr the firſt der of ſai ing.

To form the line from the firſt order of ſailing: If the ſhips be running large on the tack anſwering to the line of bearing on which they are ſailing and the line to be formed on the ſame tack, all the ſhips haul the wind at the ſame time, or at leaſt each ſhip hauls her wind immediately after the next to windward: but if the fleet be on the other tack with o change from the Orders of ailing to e Line of Battle.

with reſpect to the line of bearing, all the ſhips haul their wind and tack together, or all veer together according to circumſtances. If the line of battle is to be formed on the other line of bearing, the leewardmoſt ſhip either veers or tacks, and hauls her wind: the reſt of the fleet veer or tack at the ſame time, and ſteer with the wind four points free; and each ſhip ſucceſſively, as ſoon as ſhe gets into the wake of the leader, hauls her wind. Hence the line of battle will be formed from the firſt order of ſailing. See figs. 10. and 11.

Plate ccccxciv.

30 rom the econd or- er of ſail- ng.

To form the line from the ſecond order of ſailing, the fleet running large or before the wind: All the ſhips of the fleet haul up together on the tack directed, preſenting their heads on the line upon which they are ranged, or eight points from the wind. The leading ſhip then hauls her wind, and is followed in ſucceſſion by the reſt. That the ſhips may not be too near each other, they make ſail as they haul their wind, or their ſeconds aſtern ſhorten ſail to open the order. See fig. 12.

31 rom the hird order f ſailing.

To change from the third order of ſailing to the line of battle: The ſhips being ſuppoſed going large, that wing which is in the line of bearing for the tack on which the line is to be formed, and the ſhip at the angular point, haul their wind at the ſame time; the ſhips of the other wing haul up together eight points from the wind; then each ſhip moves in this direction until ſhe reaches the wake of the other wing, where ſhe hauls cloſe up. See fig. 13.

32 rom the fth order f ſailing.

To form the line of battle on the ſame tack from the fifth order of ſailing: Let the weather column form the van, and the lee-column the rear. The centre brings to, or only keeps ſteerage-way; the weather column bears away two points, and hauls its wind as ſoon as it is ahead of the centre; the lee-column tacks together, and runs under a preſs of ſail, to gain the wake of the centre, when it retacks together and completes the line (ſee fig. 14.) This evolution may alſo be performed as follows: The weather-column brings to; the centre and lee columns tack together, and go away two points free: when the centre-column has gained the wake of the van, it retacks together, and brings to; and when the lee-column has gained the rear line, it retacks together, and then all ſtand on: otherwiſe the lee-column brings to; the centre goes under an eaſy ſail two points free, to get ahead of the rear-ſquadron; while the van carries a preſs of ſail, alſo two points free, to get ahead of the centre diviſions.

Hitherto the weather column has uniformly been ſuppoſed to form the van, and the lee-column the rear-diviſion: the line may, however, be formed by interchanging theſe columns in a variety of different ways, ſome of which are as follow.

33 The centre nd wea- ther co- lumns in- erchan- ging.

1. Let the weather and centre columns interchange: In this caſe the centre-column ſtands on, the weather-column bears away eight points, and as ſoon as it reaches the wake of the centre-column, which now forms the van, hauls up together: the lee-column tacks together, and goes under a preſs of ſail ſcarcely two points free, ſo as juſt to gain the rear of the line, and then retacks together, as in fig. 15. This evolution may alſo be performed by the lee-column bringing to; the centre ſquadron then bears away together one point, and as ſoon as it has gained the head of the line, hauls its wind; and the weather column bears away together three points, under an eaſy ſail; and when it has got into the wake of the van, hauls up together, forming the centre diviſion.

34 The centre nd lee-co- umns in- erchang- ng.

2. Let the centre and lee-columns interchange: The lee-column ſtands on cloſe-hauled, under an eaſy ſail; the weather column bears away two points under a preſs of ſail, until it reaches the head of the line, and then hauls up: the centre-column bears away eight points; and when in the wake of the lee-column, which is now the centre diviſion, hauls its wind. See fig. 16.

35 The weather and lee columns interchanging.

3. The weather and lee-columns interchanging: For this purpoſe, the lee-column ſtands on cloſe-hauled under a preſs of ſail; the centre-column bears away two points under an eaſy ſail, and hauls up as ſoon as it has come into the wake of the new van ſquadron; and the weather-column bears away eight points until it gains the wake of the centre-column, and then hauls up, as in fig. 17.

36 The centre forming the van and the weather the rear.

Plate ccccxcv.

4. The centre forming the van, and the weather-column the rear-diviſion: The lee-column brings to, the centre-column bears away together two points, and forms the line ahead of the new centre ſquadron; the weather-column veers away together ſeven points on the other tack, and forms the rear ſquadron. See fig. 18.

37 The lee-column forming the van and the centre the rear diviſion.

5. The lee-column to form the van, and the centre the rear diviſion: In order to this, the lee-column ſtands on under a preſs of ſail, the weather-column bears away together three points under an eaſy ſail, and the centre column bears away eight points; and each, when it has gained the wake of the new van, hauls its wind. See fig. 19.

38 To form the line on the other tack, the weather-column forming the van, &c.

To form the line of battle on the other tack from the fifth order of ſailing. The weather-column firſt tacks in ſucceſſion; the centre and lee columns ſtand on, the firſt under an eaſy ſail, and the ſecond under ſtill leſs ſail, according to the length of the columns; and the leaders tack when they gain the wake of the new-formed van, and each ſhip tacks in ſucceſſion as it reaches the wake of the abovementioned van (ſee fig. 20.) Very great care muſt be taken by the centre and lee-columns, leſt they draw too near the ſternmoſt ſhips of the van, and alſo each other.

39 The centre and weather columns interchanging.

To perform this evolution, the centre and weather columns interchanging: The weather column brings to, the centre column ſtands on until the leader judges he will be fully able to clear the weather-column, and then the centre-column tacks in ſucceſſion: when the laſt ſhip of this new-formed van has paſſed the weather-column, that column ſtands on, and each ſhip tacks in ſucceſſion as ſoon as it reaches the wake of the van. The lee-column ſtands on, and tacks in ſucceſſion as the ſhips attain the wake of the van, and at the ſame time carrying a moderate ſail, that there may be a ſufficient interval left for the weather-column to form the centre diviſion. See fig. 21.

40 The centre and lee-columns interchanging.

To form the line from the fifth order of ſailing on the other tack, the centre and lee-columns interchanging. The centre-column brings to; the weather-column tacks in ſucceſſion under very little ſail, and the lee-column ſtands on under a preſs of ſail: when the leader of the lee-column has gained the wake of the line, he tacks, and is followed in ſucceſſion by his diviſion. The centre-column is to fill and ſtand on, when the firſt ſhip of that column, and the laſt ſhip of the lee-column, bear from each other in a line perpendicular to the direction of the wind. See fig. 22.

41 The weather and lee columns interchanging.

To form the line on the other tack from the fifth order of ſailing, the weather and lee-columns interchanging: The weather and centre-columns bring to; the lee-column ſtands on under a preſs of ſail, until it can paſs ahead of the weather-column, and then tacks in ſucceſſion; the centre-column fills where its leading ſhip and the laſt ſhip of the lee-column bear from each other, in a line perpendicular to the direction of the wind, and tacks in ſucceſſion when it has gained the wake of the new van. In like manner, the weather-column fills when its leading ſhip and the laſt of the centre bear in a line perpendicular to the wind, and each ſhip tacks in ſucceſſion when it has gained the wake of the centre. See fig. 23.

42 The weather-column paſſing to the rear.

To form the line on the other tack, the centre forming the

To change from the Line of Battle to the Orders of Sailing.

the van, and the weather the rear diviſion: The weather-column brings to, the other columns make ſail and ſtand on, till they can paſs on the other tack ahead of the weather-column, when they tack in ſucceſſion. When both columns have paſſed the weather column, it fills, tacks in ſucceſſion, and forms the rear. See fig. 24.

43
The lee-column paſſing to the van.

To form the line on the other tack from the fifth order of ſailing, the lee column forming the van: The weather and centre columns bring to; the lee-column carries a preſs of ſail, and tacks in ſucceſſion when it can paſs a-head of the weather-column; and when the laſt ſhip of this new van has paſſed to the windward of the former weather-column, the van ſquadron ſhortens ſail, to give time for the other columns to form: the weather and centre columns fill at the ſame time, to gain the wake of the van, when they tack in ſucceſſion. See fig. 25.

44
To form the line from the order of retreat.

To form the line from the order of retreat: The leader of the wing, which is to form the head of the line, hauls the wind, and that wing follows in ſucceſſion; the other wing goes four points free together, on the ſame tack, and thus runs parallel to the wing which firſt began the evolution; and they haul up together when they arrive in the wake of the line. See fig. 26.

Chap. IV. *To change from the Line of Battle to the different Orders of Sailing.*

45
To change from the line of battle to the firſt order of ſailing.

To change from the line of battle to the firſt order of ſailing on the ſame tack: All the ſhips bear away together the number of points directed by the admiral, obſerving to keep themſelves in the line of bearing for the tack they are in. The ſternmoſt ſhip bears away firſt, and the reſt ſucceſſively as quickly as poſſible, to prevent being too near each other.

To change to the firſt order of ſailing in bearing for the line on the other tack: The leader bears away four points to leeward, and is followed in ſucceſſion by the reſt. When the ſternmoſt ſhip has bore away, the whole haul up, and they will be in bearing for the line on the other tack. See fig. 27.

46
To change to the ſecond order of ſailing.

To change from the line of battle to the ſecond order of ſailing: The whole fleet bears away together ten points; and ſo proportions the ſailing from the van to the rear of the line, that when the headmoſt ſhip, which firſt preſſes ſail, ſhall come abreaſt of the ſecond ſhip, the ſecond ſhip adapts her ſail to keep in this bearing; and ſo on in ſucceſſion, each obſerving to keep the ſhip that immediately preceded her in the evolution in a line with herſelf, perpendicular to the direction of the wind; and the whole fleet will now be running before the wind (ſee fig. 28.) But if it is intended that the fleet ſhall ſteer any other given courſe than that before the wind, the whole fleet may then alter together to the propoſed courſe.

47
To change to the third order of ſailing.

To change to the third order of ſailing from the line of battle: The whole fleet bears away together ten points; the headmoſt half of the fleet, including the centre ſhip, carry an equal degree of ſail, in order to preſerve their line of bearing; each ſhip of the remainder of the fleet carries leſs ſail in ſucceſſion, ſuch as will form and preſerve on the other line of bearing with reſpect to that upon which they were ranged before the evolution; and by this means the fleet will be formed in the third order of ſailing. See fig. 29.

Plate cccexcvi.

48
To change to the fifth order of ſailing on the ſame tack.

To change from the line of battle to the fifth order of ſailing on the ſame tack: In the treatiſe of *Naval Tactics*, publiſhed in the ſecond volume of *The Elements of Rigging and Seamanſhip*, there are various rules for performing this evolution, according as the different ſquadrons in the line of battle are intended to form the weather, the centre, and the lee columns, in the order of ſailing. We ſhall give two of them as examples.

To change from the Line of Battle to the Orders of Sailing.

49
The van forming the weather and the rear the lee column.

1. When it is intended to change from the line of battle to this order of ſailing, ſo as that the van ſhall form the weather, and the rear the lee column, and the fleet at the ſame time keep as much to windward as poſſible; the van and centre tack together, and run cloſe-hauled in bow and quarter-line; the rear moves on its former courſe under an eaſy ſail. When each ſhip of the centre is abreaſt of its correſpondent ſhip in the rear, the centre retacks: the van ſtands on until the centre and rear come up, and then retacks, and all the columns regulate their diſtances. See fig. 30.

50
The van forming the lee and the rear the weather column.

2. When it is intended that the van ſhall form the lee, and the rear the weather column; the van bears away together under an eaſy ſail, and goes at right angles with the line ahead: the centre at the ſame time goes away two points free, and each ſhip ſteers for that ſhip of the van reſpectively which is to be abreaſt of her when in column. The leader of the van muſt determine the diſtance, by not hauling up with his diviſion until his ſhip and the ſternmoſt ſhip of the centre-column, which is drawn up with him, are in a line at right angles with the wind: They then both ſtand on under an eaſy ſail, while the rear crowding ſail paſſes to the windward of both. See fig. 31.

51
To change to the fifth order of ſailing from the line of battle on the other tack.

To change from the line of battle to the fifth order of ſailing on the other tack: This evolution may be performed in as many ways as the former, according to the intended poſitions of the different columns; but in ſuch a Work as ours, it may be ſufficient to obſerve, that,

52
The van forming the weather and the rear the lee column.

1. When the van is meant to form the weather, and the rear the lee column: The van tacks in ſucceſſion; the leader of the centre tacks when the leader of the van is paſſing him exactly to windward, and his diviſion follows him; the rear manœuvres in the ſame manner with reſpect to the centre. See fig. 32.

53
The rear forming the weather and the van the lee column.

2. When the rear is to form the weather, and the van the lee column: The van tacks in ſucceſſion; and when about, either brings to, or ſhortens ſail, to allow the other columns time to form. The centre and rear then carry ſail, and tack in ſucceſſion. The centre tacks when its leader has the centre of the lee-column in a line at right angles with the wind, or when its centre paſſes aſtern of the lee-column. When the centre is about, it regulates its rate of ſailing by the lee-column, either by bringing to or making equal ſail; and thus both wait for the rear to paſs to windward. The rear tacks when its leader has the firſt ſhip of the lee-column in a line at right angles with the wind, or when its centre ſhip paſſes aſtern of the laſt ſhip of the centre-column. See fig. 33.

54
To change to the order of retreat.

To change from the line of battle to the order of retreat: The leader bears away four points; and all the fleet following cloſe hauled, they will come to file off in ſucceſſion at the ſame point in the van ſhip's wake, till the centre ſhip arrives at the angle where the evolution began. Then the order of retreat will be formed, and any courſe whatever may be ſteered, ſince the two wings will be equal and in order on the ſtarboard and larboard lines of bearing, forming conſequently between them an angle of 135 degrees. Fig. 34. repreſents the order of retreat formed from the line of battle, the whole fleet going four points free.

Chap. V. *To Manœuvre the Line of Battle.*

The method of forming the line of battle, when the ſhips are in no previous order, has already been explained. In this place it is intended to point out ſome of the various evolutions

Manœuvre the Line of Battle.

evolutions that are, or may be, performed by a fleet which is already formed in line of battle.

55 To form the line on the other tack by tacking in ſucceſſion.

The fleet being in line of battle, to form the line on the other tack, by tacking in ſucceſſion: The headmoſt ſhip of the fleet tacks firſt, having previouſly made more ſail, or the ſecond having ſhortened ſail, in order to increaſe the interval between them; for it often happens that one or two cables length are run over before the ſhip ahead has been able to fill her ſails on the other tack. When the firſt ſhip is about, either the ſecond makes more ſail, or the third ſhortens ſail; and then the ſecond tacks as ſoon as ſhe has gained the wake of the leader, the helm being put down at the inſtant ſhe opens the weather quarter of the firſt ſhip, which is already on the other tack. In like manner the third, fourth, &c. ſhips tack each at the inſtant it has gained the wake of the leader; and thoſe ſhips already about muſt preſerve their aſſigned diſtances, by ſhortening ſail, if neceſſary, until the whole fleet is on the other tack. If a ſhip miſſes ſtays, ſhe is immediately to fill again on the ſame tack, and make ſail with all poſſible expedition, taking care to keep as cloſe as poſſible to the wind, and not to fall off to leeward. By this means ſhe will get ahead and to windward of thoſe which follow her; and they will perform ſucceſſively their evolutions in the wake of the ſhips which are already on the other tack, only ſtanding on a little farther than they would have done if the ſhip ahead had not miſſed ſtays. The ſhip that miſſed ſtays will return ſooner to her ſtation, by making all poſſible ſail to windward of the line. See fig. 35.

56 Without tacking in ſucceſſion.

To form the line on the other tack without tacking in ſucceſſion: The whole fleet veers together: the rear ſhip hauls her wind on the other tack, and ſtands on, while all the others go two points free on the other tack, and haul up as they ſucceſſively gain the wake of the leading ſhip. Thus the rear of the line on the one tack becomes the van on the other tack. See fig. 36.

57 To veer in ſucceſſion.

The line to veer in ſucceſſion: The van ſhip of the line veers round, and ſteers four points free on the other tack; and when ſhe is clear of the rear ſhip of the line, ſhe hauls her wind; the reſt follow, and haul up in ſucceſſion. See fig. 37.

58 To tack and retack.

The line to tack and retack together: In tacking together, the ſternmoſt ſhip of the line puts in ſtays; then her ſecond ahead puts her helm down; and ſo on through the whole line, to prevent the ſhip ahead from falling on board the ſhips aſtern. The fleet will then be in bow and quarter line; from which, if tacking together, no ſhip muſt put in ſtays till the ſhip on her weather quarter is in the act of tacking.

59 To bear away together.

The line bear away together, preſerving their bearing for the line: The rear begins this evolution, the ſternmoſt ſhip bearing away the number of points propoſed; and ſo on as quickly as poſſible, to prevent falling on board of each other.

60 To turn to windward.

To turn to windward in line of battle: When the fleet has ſea-room, the moſt advantageous method of gaining to windward is, that all the ſhips of the fleet may go about together; as by this means the whole fleet will gain as much to windward as in the caſe of a ſingle ſhip. The fleet will be in line of battle on the one board, and in bow and quarter line on the other. This is alſo the moſt proper method to get to windward on a coaſt when the wind is parallel to the land: but if the fleet is turning to windward in a ſtrait or between two ſhores, the fleet ſhould tack in ſucceſſion; for if all the ſhips tacked together, the van would be ſoon in with the land on one ſide, and ſoon after the fleet had retacked the rear would be in with the land on the other ſide: hence this would occaſion a number of ſhort boards. In paſſing through a ſtrait, other circumſtances are alſo to be attended to, as tides, &c.

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61 To interchange the van and centre ſquadrons.

To interchange the van and centre ſquadrons: The van bears away a little, and brings to; the centre paſſes on to windward, edging a little, to get ahead of the former van on the ſame line; the rear, coming on under an eaſy ſail, edges away likewiſe, to obtain the wake of the new centre ſquadron. See fig. 38.

62 Van and rear ſquadrons.

To interchange the van and rear ſquadrons: The van and centre ſquadrons bear away a little, and then bring to, the van obſerving to bear away a little more to the leeward than the centre. The rear ſtands on to gain the head of the line; and when abreaſt of the former van, the centre fills, and both ſtanding on, form ahead of the new rear, by edging down until they are in a line with it. See fig. 39.

63 Centre and rear ſquadrons.

To interchange the centre and rear ſquadrons: The van ſtands on under an eaſy ſail, while the centre bears away a little and brings to, and the rear at the ſame time carries a preſs of ſail to paſs the centre to windward and get into the wake of the van. The van and centre then edge away to gain the line with the new rear ſquadron, which then fills. See fig. 40.

64 The van to paſs to the rear.

The van to paſs and form the rear: The van ſquadron edges away a little and brings to; the other two ſquadrons, crowding ſail, ſtand on till they get ahead of the new rear, and then edge away a little to form in the line; after which the rear fills.

65 The rear to paſs to the van.

The rear to paſs and form the van: The van and centre bear away a little and bring to; the rear makes ſail, paſſes ahead of both, and then edges away to form on the ſame line. Theſe two manœuvres are ſo ſimple as not to ſtand in need of illuſtration by figures.

CHAP. VI. *To Manœuvre a Fleet formed in the Fifth Order of Sailing.*

66 To manœuvre the fifth order of ſailing.

THIS order of ſailing is very advantageous for a numerous fleet, as it keeps the ſhips cloſer together, and therefore more connected with each other than either of the three firſt orders. The method of forming this order is ſhown in Chap. II.: and the method of manœuvring in it, which with very little alteration is alſo applicable to the fourth order, is to be the ſubject of this chapter.

67 To tack in ſucceſſion.

To tack the columns in ſucceſſion: The ſhips of the lee-column having more diſtance to run before they can recover their poſition, muſt go about firſt in ſucceſſion. When the centre leader finds himſelf abreaſt of the leader to leeward of him, or at right angles with the cloſe-hauled line on the other tack, upon which the lee leader is now moving, he tacks, and is followed in ſucceſſion by his diviſion. The weather-column paying the ſame regard to the centre column, manœuvres in the ſame manner (ſee fig. 41.) In this evolution the weather-column ſtill continues to windward; and ſhould the columns have cloſed too much, or be too far aſunder, either of which may happen from the inequality in the rate of ſailing of the different ſhips, the order may be recovered either by the lee or windward column bearing away, ſo as to make an angle equal to that propoſed, as two points, between any column, and a line joining the leader of that column and the ſternmoſt ſhip of the next column.

If this evolution is to be performed in the night, the weather-column muſt tack firſt. In order to prevent the riſk of one column paſſing through the van of the other columns, the next column muſt not tack till its leader is ſenſible that many ſhips of the column immediately to windward are about. When about, the leaders make little ſail, while their followers make ſucceſſively a little more, in order to form their reſpective columns. The columns which are

Manœuvre a Fleet in the Fifth Order of Sailing.

pletely about ſhould either bring to and wait for the next, or ſhould juſt keep ſteerage way; thus the former weather-column ſhould wait for the centre, and both ſhould then wait for the former lee-column. In this evolution the weather and lee-columns will be interchanged. As ſome riſk may attend the execution of this at night, it is moſt adviſable to tack the columns together, and ſail in bow and quarter line; becauſe ſhould it become neceſſary to retack, or ſhould the wind change before the completion of this evolution, much confuſion might enſue. By tacking together this will be avoided.

68 To tack together.

To tack the columns together: the ſternmoſt ſhips of the three columns put in ſtays together; and when they are obſerved to be ſo, their ſeconds ahead immediately put their helm down, and ſo on through the whole fleet. Each column will then be in bow and quarter line. See fig. 42.

69 To veer in ſucceſſion.

To veer the columns in ſucceſſion: The leader of the lee-column veers round, and ſteers four points free upon the other tack, followed by the ſhips of that diviſion; and of which, when he is clear of the ſternmoſt ſhips, he hauls up. The centre and weather columns perform ſucceſſively the ſame evolution, obſerving to continue ſtanding on till they ſucceſſively bring the point at which the lee-column began to veer to bear in a right line to leeward of them. They likewiſe ſucceſſively ſpring their luffs when the point at which the lee-column hauled its wind bears right to leeward (fig. 43.) Each column having the ſame diſtance to run, if the evolution be well executed, the leaders of the windward columns will find themſelves, when they ſpring their luffs, exactly abreaſt of the leader of the lee-column, and ſo will all the other ſhips. But the making or ſhortening ſail will at all events rectify the inequality of ſailing.

70 To turn to windward.

To turn to windward in the fifth order of ſailing: Let the ſhips of the fleet be ſo arranged, that the leaders, and alſo the correſponding ſhips of the columns, may be in the direction of the wind; as by this means the fleet will gain more to windward, and at the ſame time be leſs liable to diſorder. Now the van ſhips of the columns tack at the ſame inſtant, and are followed in ſucceſſion each by the remaining ſhips of the diviſion, when they reach the wake of their leaders, or the ſame point when they went about; hence there will always be three ſhips in ſtays at the ſame time until the whole fleet has got on the other tack. The fleet then ſtands on any aſſigned diſtance, and then retacks in the ſame manner as before. See fig. 44.

Plate cccxcvii.

71 To interchange the weather and centre columns.

To interchange the weather and centre columns: The weather and lee-columns lie to, or only keep ſteerage way. The centre column tacks together; and forming a bow and quarter line, goes cloſe hauled to gain the wake of the weather-column; it then retacks together, and ſtands on, while the weather-column bears away to its new ſtation in the centre, and the lee-column fills. See fig. 45.

72 The weather and lee-columns.

To interchange the weather and lee-columns: The centre column brings to; the lee-column ſtands on under a preſs of ſail; and when its ſternmoſt ſhip can paſs to windward of the van of the centre column, which will be when the centre ſhip of the lee-column is in a line perpendicular to the direction of the wind with the van of the centre column, the lee column then tacks together, and ſtands on cloſe-hauled till it comes in a line with the centre column, when it goes large two points to get into the ſtation which the weather-column left; and then veers together, hauling the wind for the other tack. At the beginning of the evolution, the weather column bears away together under little ſail, and goes large ſix points on the other tack, ſo as to get into the wake of the centre column; it then hauls to the former tack, going two points large, till it ranges abreaſt of the centre column, when it brings to, and waits for the new weather column. See fig. 46.

73 The centre and lee-columns.

To interchange the centre and lee-columns: The centre and weather columns bring to, or keep ſteerage way, as is moſt convenient; the lee-column tacks together, and preſſes ſail to gain the wake of the centre column; which, when they have effected, they retack together and ſtand on; the centre-column then edges away under an eaſy ſail, ſteering, if it lay to, eight points from the wind, and if it kept ſteerage way only two points, until it comes into the ſtation of the lee column, where it hauls to the wind; while the weather-column fills and ſtands on: and the order is re-eſtabliſhed by ſhortening or making ſail, according to circumſtances.

74 The weather column to paſs to leeward.

The weather-column to paſs to leeward: The weather-column ſtands on under very little ſail, while the centre and lee-columns tack together, and carry a preſs of ſail till they reach the wake of the weather-column, when they retack, and crowd ſail till they come up with the weather-column; and when they have gained the wake of the weather-column, it bears away two points, to gain its ſtation to leeward, and then hauls to the wind or brings to till the new weather and centre columns come up. See fig. 47.

75 The lee-column to paſs to windward.

The lee-column to paſs to windward: The weather and centre columns bring to, while the lee column carries ſail and tacks in ſucceſſion as ſoon as the leading ſhip can weather the headmoſt ſhip of the weather-column; and when arrived upon the line on which the weather-column is formed, it retacks in ſucceſſion, forms on the ſame line, and either brings to or ſtands on under very little ſail. If it brings to, the other two columns bear away together two points, to put themſelves abreaſt of the column now to windward; but if the new weather-column ſtood on under an eaſy ſail, they may bear away only one point to gain their proper ſtations. See fig. 48.

76 Method of keeping a ſhip in its proper ſtation by means of the naval ſquare.

As it is of the utmoſt importance that each ſhip be in her reſpective ſtation, both to preſerve order, and that the various evolutions may be more readily performed, the officer of the watch will therefore be ever anxious to preſerve the ſtation of his ſhip. This he may do by his quadrant; but the more ready method for this purpoſe is by means of the NAVAL SQUARE, which is conſtructed as follows:

77 Its conſtruction.

Upon ſome convenient place at the middle of the quarter-deck, deſcribe the ſquare ABCD (fig. 49.), of which the ſides AD and BC are parallel to the keel; through the centre line G draw the line EF parallel to AD or BC, and draw the diagonals AC and BD; biſect the angles EGD, EGC by the ſtraight lines GH, GI, and the naval ſquare will be conſtructed. Now ſince the angles FGD, FGC are equal to four points, being each half a right angle; therefore the angles EGD, EGC are each equal to 12 points, and conſequently the angles EGH, EGI are each equal to ſix points. Hence, if a ſhip is running cloſe-hauled on the ſtarboard tack, in the direction FE, the direction of the wind will be IG, and her cloſe-hauled courſe on the other tack will be GC: But if ſhe be running in the ſame direction FE upon the larboard tack, her cloſe-hauled courſe on the ſtarboard tack will be in the direction GD.

78 And application.

In order now to apply the naval ſquare to the keeping of ſhips in their reſpective ſtations, let the fleet be formed in the fifth order of ſailing cloſe-hauled, the correſponding ſhips of the columns coinciding with the direction of the wind, in order to turn to windward with greater facility. The correſponding ſhips in the column muſt be kept in the direction of GH, or GI, according to the direction of the wind and the tack they are upon, while all the ſhips of the

To reſtore the Order of Battle upon Shifts of the Wind.

the ſame column muſt be in the direction of EF. See fig. 50.

Again, let the fleet be in three columns in one of the lines of bearing, the ſhip being cloſe-hauled on the other tack. The ſhips of each column will be in the direction of one of the diagonals, while the correſponding ſhips of the other columns will be in the direction of the other diagonal (fig. 51.) It will alſo be the ſame if the columns are in one line of bearing, and going four points large on the ſame tack. The application of the naval ſquare in other caſes will be obvious.

Chap. VII. *To reſtore or reform the Order of Battle upon Shifts of the Wind.*

79 To reſtore the order of battle upon ſhifts of the wind on the ſame tack, the wind coming forward leſs than ſix points.

1. Let it be intended to reſtore the order of battle on the ſame tack, the wind coming forward, and ſhifting ahead leſs than ſix points. In this caſe, the whole fleet is to bring to except the leader; who, in order that the ſame diſtances between the ſhips may be preſerved when the line is reformed, ſteers a courſe *a b* (fig. 52.) ſuch as to be at right angles to the middle point between the former and preſent direction of the wind: hence the courſe he muſt ſteer will be known by adding half the number of points the wind has ſhifted to eight points, and applying this ſum to the former cloſe-hauled courſe. As ſoon as the leader has arrived at the new cloſe-hauled line with reſpect to the ſecond ſhip ahead, that ſhip immediately fills, and bears away the ſame number of points as the leader; and when both theſe have reached the cloſe hauled line with reſpect to the third ſhip, ſhe alſo fills, and bears away. In like manner the remaining part of the fleet bear away in ſucceſſion; and when they have got into the cloſe-hauled line *b c* with the ſternmoſt ſhip, they all haul their wind at the ſame inſtant, and the ſternmoſt ſhip fills and ſtands on cloſe-hauled.

A very expeditious method of performing this evolution is as follows: The whole fleet having fallen off as ſoon as the wind ſhifted the ſame number of points which it changed, the leader bears away eight points from the middle point between the former and preſent directions of the wind; or, if the wind has ſhifted near ſix points, in this caſe the leader muſt bear away eight points from the new direction of the wind; but then the fleet will be cloſer than before, and the leader hauls his wind as ſoon as the ſternmoſt ſhip bears on the cloſe-hauled line from him: The ſecond ſhip bears away when ſhe has reached the wake of the leader, and alſo hauls her wind when ſhe has again gained his wake. In like manner the third, fourth, &c. ſhips bear away, and alſo haul their wind in ſucceſſion, until the ſternmoſt and the whole line is formed again. See fig. 53.

80 Four points.

If the wind ſhifts exactly four points ahead, the whole fleet is to veer round till the heads of all the ſhips are directed to the point exactly oppoſite to their former courſe; and the rear ſhip, which has now become the van, is to run four points large upon her new tack, and the reſt of the fleet to follow her in ſucceſſion; and when the laſt ſhip, which was the former leader, is got into the wake of the headmoſt in the line, the whole fleet is to veer together, and the order will be reformed on the former tack.

81 Eight points.

If the wind ſhifts eight points forward, the ſhips are to veer round altogether till their heads are on the point of the compaſs oppoſite to their former courſe; then the rear ſhip, having become the van, is to haul cloſe by the wind on the ſame board; all the other ſhips are to haul up in ſucceſſion, and range in the wake of the leading ſhip; and when the laſt ſhip is in her ſtation, the order will be reformed on the ſame tack.

82 Twelve points.

If the wind changes 12 points exactly, the fleet muſt veer round together, and haul their wind in ſucceſſion on the firſt tack.

83 To reform the order of battle on the other tack, the wind coming forward leſs than ſix points.

2. The wind coming forward, and the order of battle to be reformed on the other tack.

84 Between ſix and twelve points.

85 Twelve points.

If the wind ſhifts ahead leſs than ſix points, all the ſhips of the fleet are to veer round, till their heads come to the oppoſite point of the compaſs with reſpect to their former courſe; and then the rear ſhip, which is now become the van, is to haul cloſe by the wind on that tack, and the other ſhips follow her in ſucceſſion. From hence the fleet might paſs to the line of battle on the former tack by veering in ſucceſſion. If the wind comes ahead more than ſix points, but leſs than twelve, the fleet is to manœuvre in the ſame manner as before. If the wind comes ahead exactly twelve points, the tack is to be changed.

86 The wind coming aft and the order of battle to be reformed on the ſame tack.

3. When the wind ſhifts aft, and the order of battle to be reformed on the ſame tack.

If the wind has ſhifted leſs than two points, the leader hauls his wind, the fleet ſtands on as before, and each ſhip hauls her wind in ſucceſſion as ſhe gains the wake of the leader. If it is intended to change the tack, the whole fleet tack together, and the ſternmoſt ſhip, which now becomes the leader, hauls up, and the reſt bear down and haul up in ſucceſſion.

87 On the other tack.

88 The wind changing ſixteen points.

If the wind changes ſixteen points, all the ſhips brace about for the other tack immediately, by which means the fleet will be going four points large; then the ſhips tacking or veering inſtantly together, the order of battle will be reſtored or formed again on the ſame tack as they were before the wind changed.

Chap. VIII. *Of the Battle.*

The Battle.

89 Of the line of battle.

90 Its advantages by being cloſe.

In a naval engagement, the preſent mode, as has already been obſerved, is to draw up the fleet in a ſtraight line upon one of the cloſe-hauled lines under an eaſy ſail. The frigates, fire-ſhips, tranſports, &c. are placed at proper diſtances on the other ſide, with reſpect to the enemy (b). The diſtance between two adjacent ſhips in the line is uſually about a cable's length; but the admiral increaſes or diminiſhes this interval according to circumſtances. The nearer, however, the ſhips are to each other, the ſtronger is the line, and the more difficult to be broken or forced by the enemy; but ſtill there muſt be a ſufficient interval left, ſo that if a ſhip receive conſiderable damage, ſhe may be got out of the line without becoming foul or falling aboard of the ſhip next aſtern, which would be the means of putting the whole line in confuſion.

91 And compoſed of large ſhips though fewer in number.

The ſtrength of a fleet depends alſo more on the largeneſs of the ſhips, and the weight of the metal, than in their number. The fewer the number of ſhips in a fleet, the more diſtinctly will the ſignals be perceived and anſwered by thoſe near the extremities of the line; the better alſo will the order

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(b) Several able officers have been of opinion, that when fleets are ranged in order of battle, inſtead of being cloſe-hauled, they ſhould have the wind two points free, or upon the beam. Some of the reaſons alleged in ſupport of this opinion are, that the ſhips can more eaſily keep their ſtations; and if any ſhip ſhould happen to fall to leeward, ſhe may eaſily regain her ſtation, which would be almoſt impoſſible were the fleet cloſe-hauled.

der of battle be kept, and the fleet more eaſily manœuvred. A large ſhip is not ſo ſoon diſabled as a ſmall one ; and in the caſe of a three decker, although the upper deck ſhould happen to be confuſed with the wreck of broken maſts, yards, &c. and hence it being ſcarcely poſſible to work the guns on that deck, yet if the weather be not tempeſtuous, the guns on the other two decks may be worked. If boarding ſhould be deemed practicable, it is evident that the large ſhip, upon account of the height of her ſide, as well as for other reaſons, will have greatly the advantage over one of a leſs ſize. Large ſhips are alſo for the moſt part more able to encounter a ſtorm than ſmall ones ; and in a gale of wind large ſhips have commonly the advantage in point of ſailing. Hence it is obvious, that a fleet compoſed of large ſhips may have greatly the advantage over a fleet conſiſting of leſs ſhips, though much more numerous.

As in a naval engagement the two fleets are drawn up cloſe-hauled, on two lines parallel to each other, one of theſe fleets is therefore to the windward of the other. The windward fleet has ſeveral advantages not poſſeſſed by the fleet to leeward, and the leeward fleet has alſo advantages over the weather fleet. The advantages and diſadvantages of each of theſe fleets are as follow :

92 Advantages of the fleet to windward.

The fleet to windward may approach the leeward fleet at pleaſure, and can therefore determine the time of commencement of the action. If the weather fleet is more numerous, it may ſend down a detachment of ſhips on the rear of the leeward fleet, and thereby put it into confuſion. If any of the ſhips of the fleet to leeward ſhould be diſabled, the fleet to windward may with great eaſe ſend down their fire-ſhips upon them, or ſend a detachment after any part that gives way. The weather fleet may board if the admiral thinks proper ; and it is ſcarcely incommoded with the ſmoke, which is carried off by the wind to the fleet to leeward.

93 Diſadvantages of the fleet to windward.

The diſadvantages of the fleet to windward are, an inability to quit the fight when once engaged, without being obliged to paſs through the enemy's line, which is extremely dangerous ; becauſe the ſhips being already very much injured before they are obliged to fly, they muſt expect to be ſtill more ſo ; and as they have it no longer in their power to form the order of retreat, this manœuvre is abſolutely a deſperate one. If the fleet to windward tack altogether, in order to get off, the line to leeward may do the ſame, after having raked the weather ſhips in ſtays, and follow them on the other tack, with the advantage of having gained the wind of the centre and rear diviſions of the flying line. If it blows freſh, it is ſeldom that weather ſhips have their lower deck guns ſufficiently elevated ; whence it reſults, that the ſhip being a little inclined on the lee ſide, the guns often run out again at their ports after being fired, which very much retards the ſervice of the artillery, ſince the guns are obliged to be bowſed in again every time for loading ; and oftentimes they can make no uſe at all of their lower tier. Again, ſuch of the ſhips as are ſo diſabled as to be obliged to quit the line, cannot eaſily do it, becauſe in veering, for want of being able to tack, they fall between the two lines, where they are raked ahead, and by that means completely put in diſorder : but ſhould they be fortunate enough to be able to finiſh their evolution, it is ſtill very difficult for them, diſabled as they are, to get to windward of their line, and very often they fall foul of the next ſhips aſtern of them, which have it ſcarcely in their power to prevent the accident on account of the fire and ſmoke, eſpecially if the line is much contracted ; and ſhould theſe perceive it, and try to avoid being run foul of by falling back on their next ſhip aſtern, and ſo on thus ſucceſſively, it might happen, that from one to the other a great part of the fleet being obliged to manœuvre, their fire would leſſen, and very often ceaſe, by their covering each other ; when, if the enemy take the advantage of this critical moment, the diſorder increaſes, and all is loſt. But theſe inconveniencies may be partly prevented by having the diſabled ſhips quickly towed out of the line by the boats of the fleet, which for that purpoſe ſhould always be hoiſted out from each ſhip before the engagement begins. Otherwiſe, if the ſhips in the weather line, not being too cloſe, have the neceſſary ſpace to obſerve what paſſes ahead of them, and to manœuvre, they ought to range themſelves to leeward of the diſabled ſhip, in order to cover her, and approach nearer to the enemy ; all the other ſhips bearing up alſo together to preſerve the line.

94 Advantages of the fleet to leeward,

The ſhips in the line to leeward have the advantage of ſerving with facility and effect their lower deck guns in all weathers proper for fleets to come to action : they can quit the engagement at pleaſure : their diſabled ſhips can without difficulty quit their ſtations when neceſſity requires it : they can form the order of retreat with more readineſs, or continue the action as long as convenient : in ſhort, the lee line of battle, if ſuperior in number, can alſo double the enemy, by making ſome of the ſhips in the van or rear to tack, and put one of the extremities of the enemy's line between two fires ; and if they are formed in time, they may cannonade the enemy while bearing down to the attack.

95 And its diſadvantages.

The diſadvantages of the fleet to leeward are, its being very much annoyed by the ſmoke, and a continued ſhower of fire from the wads falling on board, repelled by the wind, which if not attended to may be productive of dreadful conſequences. The ſhips of the line to leeward cannot attempt to board thoſe of the other whatever may be their inclination for it ; they can hardly do more than accept the battle, without being able to determine either time or diſtance : it is even with great difficulty that they can avoid being boarded, or prevent their line from being broken, if the weather ſhips are bent upon doing it ; and their fire-ſhips are very ſeldom of uſe.

96 No general rule for preferring the one before the other.

A general rule for the adoption of either the weather or lee gage cannot be laid down. Sometimes the one is preferable, and ſometimes the other ; and very often the commander in chief has it not in his power to make an option.

Having proceeded ſo far with reſpect to the line of battle, it may not be improper to introduce in this place an account of a naval engagement, with the conduct to be obſerved previous to, and during the time of, its continuance.

97 The action not to begin before the ſignal made for that purpoſe.

The engagement will not begin till the admiral makes the ſignal, unleſs an action is inſenſibly brought on by ſome unavoidable circumſtance in the line, or poſition of the van or rear of both fleets in forming or approaching each other. The admiral in ſuch caſe will make the proper ſignal for the van or rear, by the diſtinguiſhing flag of either of theſe diviſions, which will undoubtedly regulate the neceſſary manœuvres of the reſt of the fleet throughout the whole line.

98 Precautions to be obſerved during an engagement.

During the time of an engagement the greateſt ſilence is to be obſerved in each ſhip ; no one muſt quit his poſt upon pain of death ; and ſhould any one happen to refuſe obeying an officer, he ſhall be put to death on the ſpot ; the ſame alſo ſhall be done to any one who ſhall hide himſelf, or feign to be wounded. The wounded muſt be carried or conducted to the ſurgeon by thoſe who have been appointed by the captain for that purpoſe. Should any one diſcover an advantage to be taken, he ſhall inform the officer who ſtands neareſt him. No kind of rigging whatever is to be touched without an order. Should any dangerous ſhot be received at the water line of the ſhip, ſuch of the caulkers, or carpenters, or any other perſon who perceives it, ſhall inform in private the captain with it, without ſaying a word of the ſame to any one elſe upon pain of death, unleſs it be a ſuperior officer; the ſame precaution ſhall alſo be obſerved about any part of the ſhip catching fire.

99
The fleet to carry little ſail.

Whilſt the fleets are engaged, the admiral carries but little ſail: in this, however, he muſt conduct himſelf by the motions of the enemy, the ſhips always obſerving to keep cloſe in the line; and if any ſhip happen to get out of the line, the ſhip which immediately follows is to pay no regard to her, but endeavour to keep her ſtation in the line.

100
No captain to quit his poſt in the line,

A captain muſt not quit his poſt in the line upon any pretence whatever, unleſs his ſhip ſhould be ſo greatly damaged as to render her incapable of continuing the action. The little ſail a fleet is under at ſuch a time may in general give the ſhips, though damaged in their rigging, &c. time enough to repair their defects, without cauſing an unneceſſary interruption in the line, by withdrawing out of action when their ſervice might perhaps be of the utmoſt importance to the reſt of the fleet.

101
Nor make an attack without order from the admiral.

A captain, through too impetuous a deſire of diſtinguiſhing himſelf, ought never to break the order of the line, however inviting the advantage of an attack might then appear to him to ſecure ſucceſs: he muſt wait with patience the ſignal of the admiral or commanding officer of his diviſion, becauſe it is always more eſſential to preſerve and ſupport a cloſe line in action, as it conſtitutes the principal ſtrength of a fleet in general, than to attend to a particular attack between two ſhips which commonly decides but little with regard to the whole, however glorious in appearance, unleſs with a view at the ſame time of taking or deſtroying a flag-ſhip of the enemy's, and where ſucceſs alone, even then, can juſtify the attempt.

102
The admiral to be ſupported by his ſeconds,

The two immediate ſeconds to the admiral ought to direct part of their fire againſt the enemy's flag-ſhip, or any other that may attack their admiral; ſo that their chief attention ſhould be employed more in his defence than in that of their own proper ſhip, as they muſt ſacrifice every other conſideration to the honour of their flag.

The ſame attention muſt likewiſe be paid to any other ſhip that may find herſelf engaged with one of the enemy's flag-ſhips; the next to her ahead and aſtern ſhould ſerve in that reſpect as ſeconds, by dividing part of their fire againſt ſuch flag-officer, in order to make him ſtrike the ſooner.

If any flag-officer ſtand in need of being aſſiſted, he will of courſe make a ſignal for the corps de reſerve; or if there ſhould be none, he will ſignify the ſame to his diviſion; on which his two ſeconds, with thoſe neareſt him, will cloſe in to cover him, and continue the action. The frigates of his ſquadron will likewiſe be ready to give him the neceſſary aſſiſtance; and if he ſhould ſtill continue the attack, he will in a particular manner be ſupported by his whole diviſion.

103
And the ſhips mutually to protect each other.

Thoſe ſhips which happen to be moſt expoſed to danger will naturally make the ordinary ſignals upon the occaſion if they ſhould receive any hurt or damage, in order to be ſupported by ſuch of the line as are neareſt to them.

104
The body of reſerve
105
Formed in a line with the frigates.

When a fleet is ſo far ſuperior in number as to be able to extend itſelf both ahead and aſtern conſiderably beyond the enemy's line, the admiral generally forms the exceſs into a body of reſerve, drawn up in a line on the other ſide of the fleet with reſpect to the enemy. If the body of reſerve is to windward, the ſhips compoſing it are to be drawn up in a line with the frigates neareſt abreaſt of the centre; but if to leeward, a little ahead of them; being careful at the ſame time to keep within reach of obſerving diſtinctly all the ſignals and motions of the fleet, and to be ready to replace ſuch of the ſhips as may happen to be diſmaſted or driven out of the line, where all intervals muſt be properly ſtrengthened, and carefully filled up again without loſs of time. The body of reſerve is uſually formed at the ſame time with the line, to prevent any irregularity that may happen on leaving any intervals or openings; yet the admiral may draw ſhips out of the line to form a body of reſerve, according to the time and circumſtances of his ſituation.

106
The oldeſt captain except the commander to relieve the firſt diſabled ſhip.

The eldeſt captain, after the ſenior officer who commands the body of reſerve, ought to relieve the firſt, or cloſe that part of the line which the diſabled ſhip has been obliged to quit; and ſo on ſucceſſively of the reſt.

107
The whole body of reſerve not to be detached unleſs in caſe of emergency.

The commanding officer of the body of reſerve will not be detached with the whole corps, unleſs on ſome preſſing occaſion, to fortify the line, where ſuch reinforcement is abſolutely neceſſary. If to defend one of the flag-officers of the three ſquadrons, he will be followed by the next ſenior officer of the reſerve who was not before detached, in order to place themſelves as ſeconds, the firſt ahead and the other aſtern of the flag they are to ſupport, without any diminution of the honour of his own proper ſeconds at the ſame time, as they are only called in through neceſſity on that emergency, being not engaged before, and conſequently better able to aſſiſt and ſupport the admiral; their duty being likewiſe to exert their utmoſt efforts in attacking, or, if poſſible, in boarding, the enemy's flag-ſhip, to force him to yield, except they are particularly ordered off to ſome other quarter or part of the line.

108
The admiral may order the whole body to reinforce either of the ſquadrons.

The admiral will ſometimes order the whole body of reſerve to reinforce one of the three ſquadrons of the fleet, as he may ſee occaſion; which, when he does, the body muſt make all the ſail it can, that each ſhip may place herſelf ſucceſſively, the firſt in the firſt interval, the ſecond in the ſecond interval, and ſo on throughout. If a part only of the body of reſerve is wanted, the proper ſignal will be made accordingly.

109
The body of reſerve to rejoin the line.

When the admiral has no further occaſion for the body of reſerve, he will make the proper ſignal for the ſhips compoſing it to reſume their reſpective poſts in the line, and theſe ſhips will repeat the ſignals.

110
In caſe a captain ſhould think boarding practicable.

If any captain in the fleet think he can board with ſucceſs one of the enemy's ſhips, he will ſignify the ſame to the admiral by hoiſting the boarding flag, together with his particular pendant to be more painly diſtinguiſhed: the admiral in return will make the proper ſignal of approbation, or otherwiſe if he diſapprove of the attempt, by letting fly that ſhip's particular pendant that ſhe may obſerve the ſignal the better. Before the captain make the ſignal, he ought to conſider well the ill conſequences that might attend ſuch an enterpriſe if he ſhould fail of ſucceſs; for the breaking of the order or diſpoſition of the line, by quitting his poſt, may be of much greater diſadvantage to the whole, than any advantage ariſing from his victory, except that over a flag-ſhip.

111
The fire-ſhips to prepare when the ſignal is made to engage.

When the admiral makes the ſignal for his fleet to prepare for action, the fire-ſhips will at the ſame time get ready their grappling-irons, fire-engines, &c. for boarding, and will likewiſe diſpoſe all their combuſtibles into their proper channels of communication, &c. as ſoon as poſſible after the action begins: all which, when ready, they will take care to make known by ſignal to the particular diviſion or ſquadron they belong to, and they of courſe will repeat the ſame to the admirals.

112
To be out of the reach of the enemy's guns.

The fire-ſhips muſt be particularly careful in placing themſelves, out of the reach of the enemy's guns, which they may do abreaſt and under ſhelter of their own ſhips in the line, and not in the openings between the ſhips, unleſs to prevent any of the enemy's ſhips that ſhould attempt to force through their line, when they muſt in ſuch caſes uſe their utmoſt efforts to prevent them. They ought always to be very attentive to the admiral's ſignals, as well as thoſe of the commanding officer of the particular ſquadron they belong to, that they may loſe no time when the ſignal is made for them to act, which they muſt quickly anſwer by a ſignal in return.

113
The fire-ſhip in her way to the enemy to be aſſiſted by the ſhip ahead of which ſhe paſſes.

Although no ſhip in the line ſhould be particularly appointed to lead down or protect the fire-ſhips, beſides the frigates already ordered for that particular purpoſe; yet the ſhip ahead of which the fire-ſhip paſſes in her way to the enemy, whatever diviſion ſhe may belong to, is to eſcort her, and muſt aſſiſt her with a boat well manned and armed, as well as any other ſuccour ſhe may ſtand in need of: The two next ſhips to her muſt likewiſe give her all neceſſary aſſiſtance. The captain of a fire-ſhip is to conſider, in ſhort, that he is anſwerable for the event, in proportion as he expects to be honourably rewarded if he ſucceed in ſo daring and hazardous an enterpriſe.

114
Particular deſcription of a naval engagement between two ſhips.

Since a general engagement of fleets or ſquadrons of men of war is nothing elſe than a variety of particular actions of ſingle ſhips with each other, in a line of battle, it may not be improper to begin by deſcribing the latter, and then proceed to repreſent the uſual manner of conducting the former.

115
Divided into preparation, action, and repair.

The whole economy of a naval engagement may be arranged under the following heads; namely, the *preparation*, the *action*, and the *repair* or *refitting* for the purpoſes of navigation.

116
The preparation.

The *preparation* is begun by iſſuing the orders to clear the ſhip for action, which is repeated by the boatſwain and his mates at all the hatchways or ſtaircaſes leading to the different batteries. As the management of the artillery, in a veſſel of war, requires a conſiderable number of men, it is evident that the officers and ſailors muſt be reſtrained to a narrow ſpace in their uſual habitations, in order to preſerve the internal regularity of the ſhip. Hence the hammocs, or hanging-beds, of the latter are crowded together as cloſe as poſſible between the decks, each of them being limited to the breadth of 14 inches. They are hung parallel to each other, in rows ſtretching from one ſide of the ſhip to the other, nearly throughout her whole length, ſo as to admit of no paſſage but by ſtooping under them. As the cannon therefore cannot be worked while the hammocs are ſuſpended in this ſituation, it becomes neceſſary to remove them as quickly as poſſible. By this circumſtance a double advantage is obtained: the batteries of cannon are immediately cleared of an encumbrance, and the hammocs are converted into a ſort of parapet, to prevent the execution of ſmall-ſhot on the quarter-deck, tops, and forecaſtle. At the ſummons of the boatſwain, *Up all hammocs!* every ſailor repairs to his own, and, having ſtowed his bedding properly, he cords it up firmly with a laſhing or line provided for that purpoſe. He then carries it to the quarter-deck, poop, or forecaſtle, or wherever it may be neceſſary. As each ſide of the quarter-deck and poop is furniſhed with a double net-work, ſupported by iron cranes fixed immediately above the gunnel or top of the ſhip's ſide, the hammocs thus corded are firmly ſtowed by the quarter-maſter between the two parts of the netting, ſo as to form an excellent barrier. The tops, waiſte, and forecaſtle, are then fenced in the ſame manner.

Whilſt theſe offices are performed below, the boatſwain and his mates are employed in ſecuring the ſailyards, to prevent them from tumbling down when the ſhip is cannonaded, as ſhe might thereby be diſabled, and rendered incapable of attack, retreat, or purſuit. The yards are now likewiſe ſecured by ſtrong chains or ropes, additional to thoſe by which they are uſually ſuſpended. The boatſwain alſo provides the neceſſary materials to repair the rigging, wherever it may be damaged by the ſhot of the enemy, and to ſupply whatever parts of it may be entirely deſtroyed. The carpenter and his mates, in the meanwhile, prepare ſhot-plugs and mauls, to cloſe up any dangerous breaches that may be made near the ſurface of the water; and provide the iron-work neceſſary to refit the chain-pumps, in caſe their machinery ſhould be wounded in the engagement. The gunner with his mates and quarter-gunners is buſied in examining the cannon of the different batteries, to ſee that their charges are thoroughly dry and fit for execution; to have every thing ready for furniſhing the great guns and ſmall arms with powder as ſoon as the action begins; and to keep a ſufficient number of cartridges continually filled, to ſupply the place of thoſe expended in battle. The maſter and his mates are attentive to have the ſails properly trimmed, according to the ſituation of the ſhip; and to reduce or multiply them, as occaſion requires, with all poſſible expedition. The lieutenants viſit the different decks, to ſee that they are effectually cleared of all encumbrance, ſo that nothing may retard the execution of the artillery; and to enjoin the other officers to diligence and alertneſs, in making the neceſſary diſpoſitions for the expected engagement, ſo that every thing may be in readineſs at a moment's warning.

When the hoſtile ſhips have approached each other to a competent nearneſs, the drums beat to arms: The boatſwain and his mates pipe, *All hands to quarters!* at every hatchway: All the perſons appointed to manage the great guns immediately repair to their reſpective ſtations: The crows, handſpikes, rammers, ſponges, powder-horns, matches, and train tackles, are placed in order by the ſide of every cannon: The hatches are immediately laid, to prevent any one from deſerting his poſt by eſcaping into the lower apartments: The marines are drawn up in rank and file on the quarter-deck, poop, and forecaſtle: The laſhings of the great guns are caſt looſe, and the tompions withdrawn: The whole artillery, above and below, is run out at the ports, and levelled to the point blank range, ready for firing.

117
The action, and

The neceſſary preparations being completed, and the officers and crew ready at their reſpective ſtations to obey the order, the commencement of the action is determined by the mutual diſtance and ſituation of the adverſe ſhips, or by the ſignal from the commander in chief of the fleet or ſquadron. The cannon being levelled in parallel rows projecting from the ſhip's ſide, the moſt natural order of battle is evidently to range the ſhips abreaſt of each other, eſpecially if the engagement is general. The moſt convenient diſtance is properly within the point blank range of a muſket, ſo that all the artillery may do effectual execution.

The combat uſually begins by a vigorous cannonade, accompanied with the whole efforts of the ſwivel-guns and the ſmall-arms. The method of firing in platoons, or volleys of cannon at once, appears inconvenient in the ſea-ſervice, and perhaps ſhould never be attempted unleſs in the battering of a fortification. The ſides and decks of the ſhip, although ſufficiently ſtrong for all the purpoſes of war, would be too much ſhaken by ſo violent an exploſion and recoil. The general rule obſerved on this occaſion throughout the ſhip, is to load, fire, and ſpunge the guns with all poſſible expedition, yet without confuſion or precipitation. The captain of each gun is particularly enjoined to fire only when the piece is properly directed to its object, that the ſhot may not be fruitleſsly expended. The lieutenants, who command the different batteries, traverſe the deck to ſee that the battle is proſecuted with vivacity; and to exhort the men to their duty. The midſhipmen ſecond theſe injunctions, and give the neceſſary aſſiſtance, wherever it may be required, at the guns committed to their charge. The gunner ſhould be particularly attentive that all the artillery is ſufficiently ſupplied with powder, and that the cartridges are carefully conveyed along the decks in covered boxes. The havock produced by a continuation of this mutual aſſault may be readily conjectured by the reader's imagination: battering, penetrating, and ſplintering the ſides and decks; ſhattering or diſmounting the cannon; mangling and deſtroying the rigging; cutting aſunder or carrying away the maſts and yards; piercing and tearing the ſails ſo as to render them uſeleſs; and wounding, diſabling, or killing the ſhip's company! The comparative vigour and reſolution of the aſſailants to effect theſe pernicious conſequences in each other, generally determine their ſucceſs or defeat: we ſay generally, becauſe the fate of the combat may ſometimes be decided by an unforeſeen incident, equally fortunate for the one and fatal to the other. The defeated ſhip having acknowledged the victory by ſtriking her colours, is immediately taken poſſeſſion of by the conqueror, who ſecures her officers and crew as priſoners in his own ſhip; and inveſts his principal officer with the command of the prize until a captain is appointed by the commander in chief.

118 Repair. The engagement being concluded, they begin to repair: the cannon are ſecured by their breechings and tackles with all convenient expedition. Whatever ſails have been rendered unſerviceable and unbent; and the wounded maſts and yards ſtruck upon deck, and fiſhed or replaced by others. The ſtanding rigging is knotted, and the running-rigging ſpliced wherever neceſſary. Proper ſails are bent in the room of thoſe which have been diſplaced as uſeleſs. The carpenter and his mates are employed in repairing the breaches made in the ſhip's hull, by ſhot-plugs, pieces of plank, and ſheet-lead. The gunner and his aſſiſtants are buſied in repleniſhing the allotted number of charged cartridges, to ſupply the place of thoſe which have been expended, and in refitting whatever furniture of the cannon may have been damaged by the action.

Such is the uſual proceſs and conſequence of an engagement between two ſhips of war, which may be conſidered as an epitome of a general battle between fleets or ſquadrons. The latter, however, involves a greater variety of incidents, and neceſſarily requires more comprehenſive ſkill and judgement in the commanding officer. A ſhort account of which alſo we ſhall next proceed to lay before our readers.

119 Deſcription of an engagement between two fleets. When the admiral or commander in chief of a naval armament has diſcovered an enemy's fleet, his principal concern is uſually to approach it, and endeavour to come to action as ſoon as poſſible. Every inferior conſideration muſt be ſacrificed to this important object, and every rule of action ſhould tend to haſten and prepare for ſo material an event. The ſtate of the wind, and the ſituation of his adverſary, will in ſome meaſure dictate the conduct neceſſary to be purſued with regard to the diſpoſition of his ſhips on this occaſion. To facilitate the execution of the admiral's orders, the whole fleet is ranged into three ſquadrons, each of which is claſſed into three diviſions, under the command of different officers. Before the action begins, the adverſe fleets are drawn up in two lines, as formerly deſcribed. As ſoon as the admiral diſplays the ſignal for the line of battle, the ſeveral diviſions ſeparate from the columns, in which they were diſpoſed in the uſual order of ſailing, and every ſhip crowds ſail to get into its ſtation in the wake of the next ahead; and a proper diſtance from each other is regularly obſerved from the van to the rear. The admiral, however, will occaſionally contract to extend his line, ſo as to conform to the length of that of his adverſary, whoſe neglect or inferior ſkill on this occaſion he will naturally convert to his own advantage, as well as to prevent his own line from being doubled; a circumſtance which might throw his van and rear into confuſion.

When the adverſe fleets approach each other, the courſes are commonly hauled up in the brails, and the topgallant-ſails and ſtay-ſails furled. The movement of each ſhip is chiefly regulated by the main and fore-top ſails and the jib; the mizen top ſail being reſerved to haſten or retard the courſe of the ſhip; and, in fine by filling or backing, hoiſting or lowering it, to determine her velocity.

The ſignal for a general engagement is uſually diſplayed when the oppoſite fleets are ſufficiently within the range of point blank ſhot, ſo that they may level the artillery with certainty of execution, which is near enough for a line of battle. The action is begun and carried on throughout the fleet in the manner we have already deſcribed between ſingle ſhips. The various exigencies of the combat call forth the ſkill and reſources of the admiral to keep his line as complete as poſſible when it has been unequally attacked; by ordering ſhips from thoſe in reſerve to ſupply the place of others which have ſuffered greatly by the action; by directing his fire-ſhips at a convenient time to fall aboard the enemy; by detaching ſhips from one part of the line or wing which is ſtronger to another which is greatly preſſed by ſuperior force, and requires aſſiſtance. His vigilance is ever neceſſary to review the ſituation of the enemy from van to rear; every motion of whom he ſhould, if poſſible, anticipate and fruſtrate. He ſhould ſeize the favourable moments of occaſion, which are rapid in their progreſs, and never return. Far from being diſconcerted by any unforeſeen incident he ſhould endeavour, if poſſible, to make it ſubſervient to his deſign. His experience and reflection will naturally furniſh him with every method of intelligence to diſcover the ſtate of his different ſquadrons and diviſions. Signals of inquiry and anſwers, of requeſt and aſſent, of command and obedience, will be diſplayed and repeated on this occaſion. Tenders and boats will alſo continually be detached between the admiral and the commanders of the ſeveral ſquadrons or diviſions.

As the danger preſſes on him he ought to be fortified by reſolution and preſence of mind; becauſe the whole fleet is committed to his charge, and the conduct of his officers may in a great degree be influenced by his intrepidity, and perſerverance. In ſhort his renown or infamy may depend on the fate of the day.

CHAP. IX. *Manœuvres performed by adverſe Fleets when in ſight of each other.*

120 To diſpute the wind with the enemy. To diſpute the weather-gage with the enemy.—When the enemy is to windward, and it is wiſhed to gain the weather-gage of him, the fleet to leeward ſhould avoid extending itſelf the length of the enemy's line, in order to oblige them to edge down upon theirs, if they intend to attack them; which will be a mean, if they ſtill perſiſt in doing ſo, of loſing the advantage of the wind.

It is impoſſible for a fleet to leeward to gain to windward ſo long as the enemy keep their wind, unleſs a change happens in their favour: therefore all that a fleet to leeward can do, muſt be to wait with patience for ſuch a change which they will undoubtedly avail themſelves of, as well as any miſtake or inadvertency the enemy may commit in the mean time. And as long as the fleet to leeward does not extend its line the length of the enemy's, it will be impoſſible for the latter to bring them to action without running the hazard, by bearing down, of loſing the advantage of the wind, which both fleets will be ſo deſirous of preſerving.

Manœuvres performed by adverſe Fleets when in ſight of each other.

Hence, that an admiral may benefit by the ſhifts of the wind that frequently happen, he muſt in a manner force them; which will not appear ſo extraordinary to officers of any experience, who know what winds reign moſt on the coaſt, or off the head-lands, where they may expect an enemy; and though an admiral may be ſometimes out in his conjecture, he alſo as often ſucceeds ſo happily as to gain the advantage of his enemy. The diſpoſition of projecting head-lands, and the ſetting of tides or currents, alſo contribute greatly towards gaining the wind of the enemy.

Again, the fleet to windward ought to keep that to leeward as much as poſſible always abreaſt of it; becauſe, by doing ſo, they will preſerve the advantage they have, unleſs the wind changes much againſt them. They ſhould force them likewiſe to keep their wind, unleſs they think it more prudent not to engage; but when that is the caſe, they ſhould keep entirely out of ſight.

The following obſervations, with reſpect to the ſhifting of the wind, are given by M. Bourdé de Villehuet: 1. If the weather fleet be in order of battle, and the wind draw ahead, the lee fleet, if they be ahead and in order of battle, ought to box off on the ſame tack as before, in order to tack in ſucceſſion in the wake of one another, to reſtore the order of battle; drawing at the ſame time a great deal to windward. This manœuvre may even be the means of weathering the enemy, if the wind ſhould ſhift much; for they have no other method to regain the order of battle, without loſing much ground: though they will always loſe a great deal with reſpect to the poſition of the enemy to leeward.

Elements of Rigging and Seamanſhip, vol. ii. p. 382.

2. If the lee fleet be aſtern, and the wind ſhifts aft while they are on the contrary tack with the enemy in order of ſailing on one line, the lee fleet ought to tack or veer altogether, and at the ſame inſtant; becauſe this ſhift of wind will be ahead for all the ſhips in reſpect to their tacks then on board, and aſtern in reſpect to the order of battle. When the van ſhip is full on the other tack, as well as all the reſt in their former order of battle, ſhe ſhall haul by the wind, while the reſt of the fleet run large on their firſt line of battle as many points as the wind has ſhifted aft, to get into her wake ſucceſſively, and reſtore the order of battle while approaching the enemy; by which they gain the wind of him, or elſe double him if the ſhift has been great; for the only means they have of reſtoring the line of battle is by the van ſhip hauling by the wind, and the reſt coming into her wake in ſucceſſion. If the ſhift of the wind was four points, the fleet to leeward would be obliged ſtill to perform the ſame manœuvre, that they might go about, after a certain time, ſucceſſively to windward of the enemy, who could only in the mean time have tacked all together, to bring their fleet ſuddenly in a line of battle on the other board.

If, when the wind ſhifts aft, the lee fleet is aſtern in order of battle, and the enemy be on the other tack in the order of ſailing, the leading ſhip muſt haul cloſe to the wind immediately, while the other veſſels will, in ſucceſſion, bear away as many points as the wind has ſhifted, in order to perform the ſame manœuvre and reſtore the line of battle. By obſerving this mode of manœuvring, you will approach the enemy, and gain as much to windward of him as poſſible, or get even the weather-gage of him entirely, if the wind has ſhifted conſiderably. The rear ſhip of the fleet to leeward may immediately keep cloſe to this new wind on the ſame board, while all the reſt of the fleet, after having tacked together and at the ſame time, will come and place themſelves cloſe by the wind in her wake, where they are again to tack ſucceſſively, in order to follow their rear ſhip, which is now become the leader, and which may break the enemy's line, or at leaſt gain the wind of him. But, to be able to go through this evolution, you muſt have nothing to fear from the enemy; for the fleet will be obliged to go about twice before the order of battle can be reſtored. The weather fleet ought to keep their wind as cloſe as poſſible, holding the enemy always exactly to leeward of them, by keeping on the ſame tack as he; and if the wind ſhifts a little, and becomes favourable to the enemy which is to leeward, the weather ſhips are then to keep exactly their wind, without caring for the preſervation of the line, unleſs the two fleets be very near one another.

To force the enemy to action.

121 To force the enemy to action when he is to windward.

1. When the enemy has the weather-gage.—When two adverſe fleets are in ſight of each other, an engagement is almoſt unavoidable: For ſince it may be preſumed that the faſteſt ſailing ſhips of the one fleet will ſail faſter than the ſloweſt ſailing veſſels of the other fleet, hence the fleet that is in purſuit will gain upon the other. The lee fleet, which is wiſhing to bring on an engagement, muſt therefore keep always on the ſame tack with the weather fleet; and taking care to keep them ſo exactly abreaſt as to prevent the leaſt danger of loſing ſight of them, and hence be ready to take the advantage of the firſt favourable ſhift of wind to make the attack. Night is certainly the time when an alteration of the courſe may be beſt attempted. But the lee fleet is to have frigates on the look-out; which, by ſignals, will continually give notice of the manœuvre and courſe of the retreating fleet to windward; which, by theſe means, is always expoſed to be purſued without being able to get off unſeen, and muſt ſooner or later be compelled to come to action, unleſs they can get into ſome port, or a gale of wind ſhould come to reſcue them by diſperſing both fleets, and thus furniſh the means of retreating in a ſtorm.

Ibid. p. 384.

122 When he is to leeward.

2. When the enemy is to leeward.—If the lee fleet keep cloſe to the wind in the order of battle, the fleet to windward is to ſtand on in the ſame manner till it is abreaſt of the enemy, ſhip to ſhip, when they are all together, and at the ſame time, to bear away, and ſteer exactly ſo as to bring their reſpective opponents, in the adverſe line, on the ſame point of the compaſs with them; obſerving the principles of chaſing, which are to be obſerved by every chaſer to windward. Thus the fleets will be near enough to begin the action, in preſenting the bow of each ſhip to her opponent in the order of ſailing, which will be eaſily changed for the line of battle, by all the ſhips hauling cloſe to the wind together, in the moment which precedes the beginning of the action.

Ibid. and Manœuverer, p. 276.

If the fleet to leeward be inclined to engage, it might bring to, to prevent loſing time; as, by this manœuvre, leſs time will be requiſite for the weather fleet to join them: then they will fill as ſoon as the action begins, becauſe it is more favourable to a lee line to be advancing ahead; ſince, if a ſhip be diſabled in the weather line (which is obliged to follow with the topſails full), ſhe will infallibly drop, and run foul of the next veſſel aſtern of her, covered with fire and ſmoke, which may be productive of great diſorder.

As the lee fleet fills and ſtands on cloſe by the wind, it is neceſſary that the weather-line ſhould be abreaſt and parallel to the other before they bear away to come within the requiſite diſtance for action, in order that the van ſhip of the weather fleet ſhould always keep to windward of the leading ſhip of the lee line, and be guarded againſt ſuch a ſhift of wind as might come ahead: which would not be the caſe if they were aſtern of the van ſhip in the lee fleet; which, as well as the reſt of the line, would be able then to double them to windward, by tacking in ſucceſſion.

Another reaſon for the weather line being right abreaſt of the enemy to leeward, and for every ſhip ſteering on the ſame point in approaching her opponent in the leeward line of

Manœuvres performed by adverſe Fleets when in ſight of each other.

of battle, is, that the fleets may be placed exactly parallel to each other; for, as the weather line muſt not be aſtern, becauſe of the riſk of the wind coming more forward, neither muſt they be ahead of the line to leeward, in caſe the wind ſhould come aft; for then the lee fleet, keeping cloſe by the wind in the wake of their leading ſhip, might, by this ſhift, be as far to windward as the oppoſing fleet, or even get the weather gage of them. But if the weather fleet keep exactly abreaſt of the other, they will always be in a ſituation to preſerve their advantage without expoſing themſelves. It is, notwithſtanding, that thoſe ſhips keeping more away than the line to leeward will find themſelves, when come within gun-ſhot, in a very diſagreeable ſituation with reſpect to the enemy's ſhips, which will have it then in their power to rake them as they bear down. This may occaſion much diſorder among the ſhips of the weather line, which, for that moment, have it not in their power to fire their whole broadſide at the enemy, who has the advantage of beginning the action.

If the lee fleet bear away four points to move their order of battle on the other tack and avoid the action, filing off in ſucceſſion in the wake of the van ſhip, the weather line, by bearing away altogether eight points, cannot fail, as both fleets are ſuppoſed to ſail equally, to paſs through the middle of their line, and force them to fight with diſadvantage, if their extent be double the diſtance between the two fleets. If the extent of the fleet be leſs than the above limitation, then the weather fleet will divide the lee fleet more unequally; and if the diſtance between the fleets be conſiderable, the weather fleet will not be able to break through the line.

If the lee fleet bear away four points all together, being of equal extent with the fleet to windward, and their diſtance from each other equal to half the length of one of the lines; ſhould the weather fleet bear away at the ſame time eight points, they will approach very near the ſternmoſt of the retreating fleet; but they will not have it in their power to cut off any part of that fleet, even with an equality of ſailing: ſo that the only advantage gained by this manœuvre will be an ability of attacking the rear, and bringing it to action.

If the van ſhip and the reſt of the weather fleet had a ſufficient velocity to keep the centre ſhip of the lee line on the ſame point of bearing; in that caſe the leading ſhip may break through the enemy's line about the middle ſhip of the centre diviſion: for, ſuppoſing the fleets in order of battle, on the ſtarboard tack, ſteering eaſt, with the wind at ſouth-ſouth-eaſt, being at two leagues diſtance from each other, both the lines being four leagues in extent; then the lee line bearing away all together four points, will run north-eaſt, while the fleet to windward, bearing away all together eight points, will ſteer north; the van ſhip of which will keep the centre diviſion of the lee line on the point of bearing north-weſt. As ſhe is ſuppoſed to be able to continue in this poſition, it follows, that the van of the weather line muſt cloſe the centre of the flying line to leeward, after having run four leagues. The time and diſtance neceſſary to cut off a retreating fleet may always be known according to the laſt ſuppoſition. Should the lee fleet get upon the other tack and run large, ſtill preſerving the order of battle, they will be ſtill ſooner cloſed and forced to action by the weather fleet who have only to keep away from eight to nine points on the ſame tack, to run right before the wind.

The weather fleet can always force the lee one to action, whatever movements they make; for, if they run with the wind right aft in order of battle, they cannot, ſuppoſing an equality of ſailing, avoid being cloſed or broken nearly about the centre by the weather line, which has only to ſteer two points on each tack nearer the wind than the retreating fleet. So that the rear of the weather fleet having bore away no more than eight points, will be found at the end of a certain time to have approached extremely near the centre of the retreating fleet; and, in a ſhort time more, will be able to bring their rear to action. The weather fleet have yet another advantage; becauſe, as their ſhips have the wind on the quarter, they ſail with greater celerity than thoſe of the lee fleet, which run before the wind. The lee fleet being abſolutely determined to fly, has therefore no other expedient left to prolong time but to combat in the order of retreat right before the wind, or on the ſame courſe as the purſuing fleet; for other advantages are not to be relied on, if purſued by a victorious foe.

Manœuvres performed by adverſe Fleets when in ſight of each other.

If from all that has been ſaid, it reſults that it is not poſſible for a fleet of equal force to avoid an action, how then muſt it be with one much inferior? The more numerous has nothing to do but to form a detachment of ſuperior ſailors, which will gain upon the lee fleet and begin the action, while ſome others approach to finiſh it. Whence we may conclude, that when in preſence of too powerful an enemy, it will never be poſſible to avoid an action if he is determined to come to one.

To avoid coming to Action.

123
To avoid an action, the enemy being to windward.

1. When the enemy is to windward.—The lee fleet, which is wiſhing as much as poſſible to avoid an engagement, ought to form the order of retreat to fly from the enemy if they are in view of him, and run on the ſame tack as their chaſer. But if he is yet out of ſight and they have intelligence of his approach by their frigates which are looking out, they may run large from the hoſtile fleet, without confining themſelves to keep the wind exactly aft, unleſs they be in the order of retreat. There are, however, circumſtances when the lee fleet may run with the wind aft, without aſſuming the order of retreat; as, for example, when they wiſh to gain time, or are reſolved to engage the enemy, if they ſtill continue to purſue them. But except on ſuch extraordinary occaſions, a fleet ſhould not fly before the enemy without being in the order of retreat, as the rear is then in the beſt ſituation to extricate themſelves in caſe of accident.

124
The enemy being to leeward.

2. When the enemy is to leeward.—The weather fleet can ſcarcely ever be forced to engage; becauſe it can always continue on that tack which increaſes its diſtance from the enemy, by ſtanding on one tack, while the enemy continues upon the other. If the wind was to remain on the ſame point of the compaſs for any conſiderable ſpace of time, it would be very eaſy for the fleet to windward to keep in ſight of the enemy, without being under any apprehenſions of being forced to come to action; but the inconſtancy of the wind obliges the moſt experienced admiral to avoid meeting the enemy when he thinks it improper to engage him.

To double the Enemy, or to bring a Part of his Fleet between two Fires.

125
To double the enemy, when he has the weather-gage.

Elements of Rigging and Seamanſhip, vol. ii. p. 386.

1. When the enemy has the weather-gage.—The fleet which attempts to double an enemy ought always to be ſuperior to him in number of ſhips. The lee fleet ought to endeavour to range exactly abreaſt of, and parallel to, the weather fleet, ſo that the van or rear may extend beyond their line in order to over-reach them, by tacking in ſucceſſion to double to windward their van or rear, and bring them between two fires. Provided this manœuvre be properly executed, it will be impoſſible for the ſhips in the weather line, thus preſſed, to continue long in their ports; for there is no veſſel cloſely attacked by two others of equal force which can long reſiſt being overcome, ſince it is always in the power of one of them to get into ſuch a poſi-

tion as to be able, without much danger on her ſide, to deſtroy the enemy in a very ſhort time. But whether the moſt advantageous evolution is to double the van or the rear, is neceſſary to be conſidered ; for there is ſo conſiderable an advantage attending each of theſe evolutions, that either of them may in a very little time determine the fate of the battle.

As, in the preſent caſe, the enemy is ſuppoſed to be to windward, either their van or rear may be doubled ; but the van may with the greateſt facility, becauſe, if they are engaged by the ſhips abreaſt of them, thoſe which are advanced ahead will be able, by making all ſail, to get on the perpendicular to the direction of the wind with the van of the enemy, and tack in ſucceſſion to gain the wind of them on the other board, thus keeping them to leeward ; and when they are come ſufficiently to windward, they are again to go about, in order to keep the two headmoſt ſhips of the enemy's line continually under their fire. If there be two or three ſhips to tack in ſucceſſion and gain the wind of the enemy, they may edge down on the van of the weather line at pleaſure, keeping themſelves a little to windward of it ; and as that van is already engaged by the other ſhips abreaſt on the other ſide, ſhe muſt neceſſarily be ſoon diſabled. If they bear away, they muſt drop upon the line with which they are engaged to leeward, while the ſhips to windward ſtill continue to cannonade them. If they attempt going about, in order to attack more cloſely the ſhips to windward, they will be raked, while in ſtays, by their opponents to leeward and to windward, who enfilading them with whole broadſides, which they cannot return, muſt abſolutely complete their diſorder. If they make ſail, in order to fruſtrate the deſign of the ſhips inclined to double, thoſe with which they are engaged abreaſt to leeward have only to perform the ſame manœuvre, and keep them under their fire ; while the others, after having haraſſed them as much as poſſible, will do their beſt to perform the ſame manœuvre on the ſucceeding ſhips.

The captains deſtined to double the enemy ought to be men of known ability, as well as of approved courage. They ſhould not be ordered upon that ſervice but in weather fit for ſailing at the rate of three knots an hour at leaſt ; and, for the greater promptitude and certainty of ſucceſs, none but the beſt going ſhips are to be employed.

If any of the ſhips in the van of the weather-line happen to be diſabled in their maſts or yards, as will moſt probably be the caſe after having been between two fires, they will drop aſtern and run foul of the next which follows, and theſe again of their ſubſequent comrades ; at laſt, diſorder will become prevalent, by ſhips running foul of each other, or manœuvring to avoid the ſame accident : ſo that the order of battle will be broken ; while, on the other hand, the line to leeward is preſerved with all the advantage poſſible. The ſhips which have gained the wind of the enemy will, by continuing their manœuvre, augment the confuſion ; engaging, however, no more than they like ; and if, by chance or misfortune, they ſhould be crippled, it will not certainly be an eaſy matter for them to extricate themſelves. But as they may, on the other tack, drop aſtern to windward of the enemy's line, or veer again like him, they muſt extricate themſelves as well as they can, and always advantageouſly enough if, by doubling the van, they are able to throw it into diſorder.

If the rear of the lee fleet be extended beyond the ſternmoſt ſhip of the weather line, they will be obliged, if they want to double the rear of the enemy to windward, to make ſail and tack in ſucceſſion ; in which manœuvre the headmoſt ſhip of thoſe deſtined for this ſervice is to go about firſt ; then, continuing to keep up a briſk cannonade as they come to the wind, they will go and heave about again a little to windward of the rear of the enemy, in order to bring their ſtern ſhips between two fires : and ſhould they have the good fortune to oblige them to bear away, they muſt go on ſucceſſively from one ſhip to another, as long as they find they ſucceed in forcing them to give way. Should diſorder take place in the rear of the weather fleet, it will not be near ſo prejudicial to the enemy as if it had happened in the van ; on the contrary, it may turn out to be of ſome advantage to them. But the veſſels combating to windward can eaſily withdraw from the fight, by backing aſtern when they find themſelves too hard preſſed.

126 To double the enemy when he is to leeward.

2. When an enemy is to leeward.—The ſhips of the weather-line having extended their van beyond that of the lee-line, are to veer, in order to bring the headmoſt ſhips of the enemy's line between two fires. But, let them do as they will, there never can reſult ſo much advantage from this manœuvre as when doubling a fleet to windward, becauſe the diſabled ſhips can always veer with facility. True it is, they cannot fail becoming at the ſame time the prey of the enemy ; for both thoſe which have doubled them, and thoſe with which they are engaged abreaſt in the weather-line, will always have it in their power jointly to preſs as cloſe as they think proper.

Ibid. p. 388.

If the ſhips which have doubled the van of the lee fleet, with which they are engaged, be diſabled, they will be obliged, as they cannot make ſail, to paſs along the lee-line ; and they cannot eſcape being totally deſtroyed if they do not bear away before the wind, to get out of gun-ſhot ; during which manœuvre they cannot avoid being ſtill in a very diſagreeable ſituation.

Should the ſternmoſt ſhips of the weather fleet be diſabled in doubling the enemy's rear, they have only, if they want to extricate themſelves, to drop aſtern, and let the two fleets advance ahead ; and after having refitted themſelves, they will reaſſume their ports.

To avoid being doubled.

127 To avoid being doubled, the enemy being to windward.

1. The enemy being to windward.—For this purpoſe, it has been propoſed to extend the line, by leaving a greater interval between the ſhips towards the centre than in the van or rear ; but in this caſe the line runs the riſk of being divided, unleſs prevented by a corps de reſerve, conſiſting of a few ſhips of the line and fire-ſhips. It has alſo been propoſed as a general rule, that the flag-officers of the lee fleet ſhould oppoſe themſelves to thoſe of the enemy ; by which means ſeveral of the enemy's ſhips will be rendered uſeleſs in the intervals. This method has, however, its inconveniencies ; as ſometimes the van and rear of each diviſion may be expoſed to the fire of two ſhips at the ſame time : nor is the laſt diviſion out of danger of being doubled. In order to remedy theſe defects, the larger ſhips ought to be placed in the van and rear of each diviſion ; and the whole fleet muſt regulate its ſailing in ſuch a manner that the rear of the enemy may not be aſtern of the rear of the laſt diviſion.

Other methods have been propoſed to avoid being doubled ; as, that each ſquadron of the lee fleet ſhould attack its correſponding ſquadron in the weather fleet ; each diviſion of the lee fleet, however, extending its line far enough to prevent the enemy from leaving any ſhips aſtern of it, but rather ahead. It has alſo been propoſed, that the lee fleet ſhould extend its line as long as the enemy's line. This method will be advantageous for the lee fleet, provided it is compoſed of ſhips of ſuperior force, though fewer in number, than the enemy. In other caſes, it is probably the worſt method that can be followed by the lee fleet, as it gives the enemy's fleet all the advantage it can deſire of exerting its whole force upon the inferior line.

128 The enemy being to leeward.

2. When the enemy is to leeward.—The weather fleet is to keep aſtern of the enemy, ſo that the van of the weather fleet may be oppoſed to and attack the enemy's centre :

hence the enemy's van will become uſeleſs for ſome time; and if it ſhould attempt to tack and double upon the weather fleet, much time will be loſt in performing that evolution; and it alſo runs the riſk of being ſeparated by the calm which generally happens in the courſe of a ſea-engagement in conſequence of the continual diſcharge of cannon. A conſiderable interval might alſo be left between the centre and van, provided the neceſſary precautions be taken to prevent the van from being cut off.

To force the enemy's line.

129 To force the enemy's line. This is a manœuvre which the lee fleet may execute to gain the advantage of the wind. It is performed by the van ſhip, if within gun-ſhot, tacking when ſhe and the centre ſhip of the weather line are on a perpendicular to the direction of the wind; then all the lee fleet tack in ſucceſſion, and thus may paſs through the enemy's line, or perhaps a little more towards the enemy's van, and go about again in ſucceſſion to windward of him. But as he will not be long, without doubt, before he performs the ſame manœuvre, he will thus be able to regain the wind, if he be not forced to give way before his evolution is finiſhed. The enemy to windward may even cauſe his van ſhip to tack, as well as the reſt of the van ſquadron to follow in ſucceſſion, as ſoon as the leading ſhip of the lee fleet ſhall have paſſed through his line and be ready to go about; by which means he will bring them between two fires. This manœuvre, well executed, might perhaps give no little trouble to the ſhip attempting to force the line. Ibid. p. 389.

This evolution may be performed with advantage, if, by ſome accident or fault in the manœuvring, the centre diviſion of the weather-line be ſeparated from their van or rear. For example, when the centre diviſion to windward is encumbered with diſabled ſhips, then the ſhips of the centre diviſion of the fleet to leeward, having all ſails ſet, are to tack in ſucceſſion, and force with promptitude through the weather fleet, leaving their own van diviſion to engage that of the enemy on the other tack.

To prevent the line being forced.

130 To prevent the line being forced. When the ſhips of the fleet go about in ſucceſſion, in order to force the weather line, the whole line to windward is to tack together, and at the ſame time to get upon the ſame board as the lee fleet; then that fleet will neither be able to traverſe nor join them. To perform this evolution with advantage, it will be requiſite to permit ſome of the van ſhips of the lee fleet to paſs to windward; then the weather fleet muſt go all about rapidly, in order to put and keep them between two fires: thus may theſe ſhips be deſtroyed without their own fleet being able to give them any effectual aſſiſtance.

It is eaſy to perceive, from what has been ſaid, that there is little occaſion to fear being traverſed, as ſuch a manœuvre may turn out to be more prejudicial than advantageous to thoſe who perform it. Neverthelefs, it may and ought to be put in practice when the weather fleet leave ſuch vacancies between their diviſions as to allow ſome ſhips of the lee fleet to be inactive. In this caſe, the ſhips which are without opponents abreaſt of them are made to tack, with all ſails ſet, in ſucceſſion, and paſs through theſe intervals in the weather line, in order to double the centre diviſion, or any other part of it, and bring it between two fires.

CHAP. X. *Of Chaſing.*

131 Chaſing in the caſe of ſingle ſhips. 1. IN the caſe of ſingle ſhips.—It is ſcarcely neceſſary to obſerve, that the ſhip which gives chaſe is uſually called the *chaſer*, and that which is purſued is called the *chaſe*. Unleſs the chaſer be the faſteſt ſailing veſſel of the two, it is generally ſuppoſed that ſhe will ſeldom or never come up with the chaſe: but we have heard experienced officers ſay, that a chaſing ſhip, ſailing equally faſt, in other circumſtances, will gain on her chaſe; becauſe ſhe has an object to ſteer by, whereas the chaſe cannot ſteer ſo nicely by the compaſs. In what follows, however, we ſhall ſuppoſe the chaſer to be the faſteſt ſailer.

132 The chaſe being to windward. When the chaſe is to windward, it is evident that as ſoon as ſhe perceives a ſtrange ſhip which ſhe takes for an enemy, ſhe will haul her wind, in order to prolong the chaſe, as otherwiſe her retreat would be ſoon cut off. The chaſer then ſtands on alſo nearly cloſe-hauled until he has the chaſe on his beam; he then tacks, and ſtands on cloſe hauled until the chaſe is again on his beam, and then retacks. In this manner he continues tacking every time he brings the chaſe perpendicular to his courſe on either board; and by manœuvring in this manner, it is very certain that the chaſer will, by the ſuperiority only of his ſailing, join the other in the ſhorteſt time. For ſince the chaſer tacks always as ſoon as the chaſe is perpendicular to his courſe, ſhe is then at the ſhorteſt diſtance poſſible on that board; and ſince the chaſer is ſuppoſed to be the faſteſt ſailer, theſe ſhorteſt diſtances will decreaſe every time the chaſer tacks. It is therefore of advantage to the chaſe to keep conſtantly on the ſame courſe, without loſing her time in going about; as tacking cannot be ſo favourable to her as to her adverſary, whoſe ſailing is ſuperior. If the chaſer ſhould ſo little underſtand his profeſſion as to ſtand on a long way, and tack in the wake of the chaſe, the beſt thing ſhe can do is to heave in ſtays, and paſs to windward of him on the other tack, unleſs ſhe would have a ſuperiority in going large; for if the chaſer perſiſts in tacking in the wake of the other ſhip, it is an unqueſtionable fact that the chaſe will be very much prolonged.

133 The chaſe being to leeward. The chaſe being to leeward, the chaſer is to ſteer that courſe by which he thinks he will gain moſt upon her. If, after having run a ſhort time, the chaſe is found to draw more aft, the chaſer is then to bear away a little more; but if the chaſe draws ahead, the purſuer is to haul up a little, and by this means the courſe may be ſo regulated that the chaſe may always bear on the ſame point of the compaſs, and then the chaſer will get up with the chaſe in the ſhorteſt time poſſible; for were any other courſe ſteered than that which keeps the chaſe always on the ſame point, the chaſer would then be either too far ahead, or too far aſtern; and hence the chaſe would be prolonged.

The chaſe ought to run upon that courſe which will carry her directly from the chaſer; and, in general, to conſult which is her beſt trim with reſpect to the wind, that ſhe may move with the greateſt rapidity poſſible from the ſhip which purſues her; for ſome veſſels have more advantage in going large than others, ſome with the wind right aſt, and others again are to be found that ſail beſt cloſe-hauled; ſo that attention ſhould be paid by the officer to the known qualities of his ſhip, in order to take the moſt advantageous direction capable to effect a retreat.

134 Curve of purſuit. Another method has alſo been propoſed for chaſing a ſhip to leeward, that is, by conſtantly ſteering directly for the chaſe: In this caſe, the tract the purſuer deſcribes through the water is called the line or *curve of purſuit*. In order to illuſtrate this, let A (fig. 54.) repreſent the purſuer, and B the chaſe directly to leeward of it, and running with leſs velocity than the purſuer, in the direction BC, perpendicular to that of the wind. Now, to conſtruct this curve, let Bb be the diſtance run by the chaſe in any ſhort interval of time; join Ab, and make $A1$ equal to the diſtance run by the purſuer in the ſame time. Again, make bc, cd, de, ef, &c.

Of Chaſing.

&c. each equal to B*b*; join 1*c*, and make 12 equal to A1; join 2*d*, and make 23 equal to A1; in like manner proceed until the two diſtances carried forward meet as at C, and a curve deſcribed through the points A, 1, 2, 3, &c. will repreſent nearly the curve of purſuit; and the leſs the interval A1 is taken, the more accurate will the curve be formed. In this particular caſe the length of the diſtance BC may be found as follows, provided the diſtance AB and the proportional velocities of the two ſhips be known.

Let the velocity of the chaſe be expreſſed by a fraction, that of the chaſer being unity. Multiply the given diſtance AB by this fraction, and divide the product by the complement of the ſquare of the ſame fraction, and the quotient will be the diſtance run by the chaſe E. Let AB, the diſtance of the chaſe directly to the leeward of the purſuer, be 12 miles, and the velocity of the chaſe three fourths of that of the chaſer; the diſtance to be run by the chaſe before ſhe is overtaken is required?

Now $\frac{12\times\frac{3}{4}}{1-\overline{\frac{3}{4}}|^{2}}=\frac{9}{\frac{7}{16}}=9\times\frac{16}{7}=20\frac{4}{7}$ miles; and ſince the velocity of the purſuer to that of the chaſe is as 4 to 3: hence the diſtance run by the chaſer will be $=20\frac{2}{7}\times\frac{4}{3}=27\frac{3}{7}$ miles.

As the purſuer alters his courſe at every point, and ſince it is preſumed, his ſhip will ſail better with the wind in one direction, with reſpect to her courſe, than in an another, her velocity will therefore be different at different points of the courſe. Thus ſuppoſe her to ſail faſter when the wind is upon the quarter, her velocity will conſtantly increaſe until ſhe has attained a certain point, and then it will decreaſe: hence in real practice this curve will not be preciſely the ſame as above, and of courſe the meaſure of BC will differ a little from the preceding determination. The inveſtigation of the foregoing rule is in Simpſon's Fluxions, p. 516.; and the application of the curve of purſuit in Sir George Pococke's engagement in the Eaſt Indies in the year 1758, is given in Clerk's Eſſay on Naval Tactics, p. 160. It muſt be confeſſed, however, that Mr Simpſon's inveſtigation, though a pretty ſpecimen of mathematical inveſtigation, proceeds on certain phyſical aſſumptions, which are by no means ſanctioned by experience. See what has been ſaid of theſe aſſumptions and principles in the articles RESISTANCE *of Fluids*, and SEAMANSHIP.

Hitherto we have conſidered chaſing in the caſe of ſingl ſhips only; the ſame rules are alſo applicable to fleets: we ſhall, however, ſubjoin the following remarks with reſpect to chaſing as practiſed by fleets.

If the whole fleet is to give chaſe, the admiral will make the proper ſignal; and then each ſhip will inſtantly make all the ſail poſſible. If the retreating fleet is not much inferior to the other, a few of the faſteſt ſailing veſſels only are to be detached from the victorious fleet, in order to pick up any ſtragglers or thoſe ſhips which may have fallen aſtern; and the remaining part of the fleet will keep in the ſame line or order of ſailing as the retreating fleet, ſo that they may, if poſſible, force them to action. But if the retreating fleet is much inferior, the admiral of the ſuperior fleet will make the ſignal for a general chaſe; and then each ſhip will immediately crowd all the ſail poſſible after the retreating fleet; or, if the chaſe be ſtill leſs numerous, the admiral will detach one of the ſquadrons of his fleet, by hoiſting the proper ſignal for that purpoſe, and he will follow with the remainder of the fleet. The ſquadron that chaſes, or the cruiſers detached from the fleet, ſhould be very careful not to engage too far in the chaſe for fear of being overpowered; but at the ſame time to endeavour to ſatisfy themſelves as much as may be in their power with regard to the object of their chaſe. They muſt pay great attention to the admiral's ſignals at all times; and in order to prevent ſeparation, they ſhould collect themſelves before night, eſpecially if there be any appearance of thick or foggy weather coming on, and endeavour to join the fleet again. The ſhips are diligently to obſerve when the admiral makes the ſignal to give over chaſe; that each regarding the admiral's ſhip as a fixed point, is to work back or make ſail into her ſtation, to form the order or line again as expeditiouſly as the nature of the caſe and the diſtance will permit.

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When a fleet is obliged to run from an enemy who is in ſight, it is uſual to draw up the ſhips in that form or order, called the *order of retreat*, which has been already deſcribed; and the admiral, when hard purſued, without any probability of eſcaping, ought, if practicable, to run his ſhips aſhore, rather than ſuffer them to be taken afloat, and thereby transfer additional ſtrength to the enemy. In ſhort, nothing ſhould be neglected that may contribute to the preſervation of his fleet, or prevent any part of it from falling into the hands of the conqueror.

PART II. NEW SYSTEM OF NAVAL TACTICS.

We have now laid before our readers as comprehenſive a view as the limits preſcribed to ſuch articles will permit of the various evolutions uſually practiſed by fleets in naval war. Though we have tranſcribed liberally from the moſt approved writers on the ſubject, we doubt not but the ſcientific officer will perceive that we have compiled aukwardly and unſkilfully: but we are not ſeamen ourſelves; and the generoſity of able officers will pardon the blunders into which mere literary landſman could hardly avoid falling. The young ſeaman, who has the noble ambition to excel in his profeſſion, will conſult the authors whom we have mentioned in our introduction, in whoſe works he will find our deficiencies amply ſupplied; but that the preſent article may be as complete as *we* can make it, a view muſt be given of the ſyſtem of tactics propoſed by the Viſcount de Grenier and Mr Clerk; becauſe, whether theſe ſyſtems ſhall ever be adopted or not, they are the offspring of ingenuity, and as ſuch merit attention.

CHAP. I. *View of De Grenier's Tactics.*

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Of all the orders, that of battle is the moſt important in naval tactics; but the order of battle which was firſt formed in the laſt century by the Duke of York, and has been continued in uſe to the preſent day, the Viſcount de Grenier thinks extremely defective. Various cauſes may conſpire to render the taſk of breaking it not difficult. Its great extent muſt make it no eaſy matter for the admiral to judge what orders are proper to be iſſued to the ſhips ſtationed in its extremities; whilſt his ſignals, however diſtinctly made, are liable to be miſtaken by the commanders of thoſe ſhips. The extremities of a long line are neceſſarily defenceleſs, eſpecially if it be to leeward; becauſe, after it is formed, the enemy may throw himſelf with a ſuperior number on its van or rear, and put that ſquadron to flight before aſſiſtance can be ſent to it from the other ſquadrons. Theſe defects the Viſcount de Grenier thinks may be remedied by never

View of De Greni- r's Tactics.

138 Remedied y the Viſ- ount de Grenier.

never preſenting to the enemy any part of a fleet without its being flanked; ſo that were the commander of the adverſe fleet to attack thoſe parts which hitherto have been reckoned weakeſt, he might find himſelf defeated when he looked for conqueſt. With this view he propoſes a new order of battle; in which the fleet, compoſed of three diviſions, inſtead of being drawn up in one line as uſual, ſhall be ranged on the three ſides of a regular lozenge, formed by the interſecting of the two cloſe-hauled lines. It is obvious that one of the diviſions of a fleet ranged in this manner will always be formed in the order of battle; whilſt the two others, reſting upon the firſt ſhip ahead and the laſt aſtern of that diviſion, will be formed on the cloſe-hauled line oppoſite, and will ſtand on chequerwiſe on the ſame tack with the ſhips which are in the line of battle, ſerving to cover the headmoſt and ſternmoſt of thoſe ſhips, and thereby prevent the enemy from penetrating the line or doubling the rear.

139 Object of De Greni- r's tactics.

Our author thinks it a great miſtake, though very generally fallen into, that the weather gage is of any advantage to a fleet equal in force to its enemy and willing to engage. To him the great art of war at ſea appears to conſiſt in drawing or keeping to *windward a part of the adverſe fleet*, and collecting all one's forces againſt that part; and it is chiefly to effect this purpoſe that he propoſes his new ſyſtem of tactics. The reader, who would underſtand his principles, muſt never loſe ſight of this evident truth, that each ſhip of a fleet neceſſarily occupies at all times the centre of an horizon; which the author divides into two unequal parts, calling the greater the *direct and graduated ſpace*, and the leſs the *indirect, croſſed, and ungraduated ſpace*. The reaſon of theſe appellations is, that on the greater ſegment of the horizontal circle there are twenty different points, which may be marked by degrees from one of the cloſe-hauled lines to the other, and to which a ſhip may ſail from the centre by ſo many direct courſes without tacking; whereas to the other twelve points, including that from which the wind blows, ſhe cannot arrive but by ſteering croſs courſes, which muſt neceſſarily delay her progreſs.

140 rinciples his ſy- em.

Suppoſe now a fleet to leeward, ſo diſpoſed as that only a part of it can fight with another equally numerous, and ranged to windward in a ſingle line; and let the lee fleet be ranged on the three ſides of a lozenge *a b*, *c d*, *e f* (fig. 55.). The ſquadron *a b*, which is moſt to windward, being drawn up in line of battle, cannot be fought but by an equal number AB of the weather fleet AB, CD, F. All the reſt of that fleet therefore muſt remain inactive, unleſs the ſhips which are not engaged ſhould try to paſs to leeward of the fleet, *a b*, *c d*, *e f*. But ſhould the ſhips of the weather fleet, which are placed between B and F, bear away as they appear in the figure between C *i* and F *i*, it is evident that the ſhips between A and B, which are fighting to windward, cannot bear away with them. Suppoſe now that, after the ſhips between C *i* and F *i* have paſſed to leeward, the ſquadrons *c d*, *e f*, which are ranged according to the new ſyſtem, and have not yet been engaged, ſhould come to windward and join with their friends *a b* againſt that ſquadron of the enemy AB which is ſtill to windward and engaged; it ſeems almoſt inevitable but that the ſquadron AB muſt be deſtroyed by ſo great a ſuperiority, before it could receive any aſſiſtance from the ſhips to leeward between C *i* and F *i*. No doubt thoſe ſhips would endeavour to ſuccour their friends; but with reſpect to them, the ſquadron AB muſt be conſidered as placed in that part of the horizon which our author calls *croſſed and indirect*, and to which they would not be able to repair but by ſteering alternately the two cloſe hauled lines; and aſſiſtance brought by ſo tedious a courſe would come too late to be of eſſential ſervice. It is from this apparently well ſupported concluſion that the viſcount de Grenier deduces the propriety of his propoſed orders of ſailing and order of battle.

141 Firſt order of ſailing.

Of orders of ſailing, he thinks, there can be no occaſion for more than three; one, when a fleet is to paſs a ſtrait; another, when it ſteers in an open ſea, either looking for the enemy or trying to avoid him; and the third, when it has an extenſive cruiſe to perform, in which the ſhips ſhould be ſo diſpoſed as not to be ſurpriſed or cut off by the enemy. His firſt order of ſailing differs not from that in common uſe. It is and muſt be obſerved (ſays he) in any narrow road, whatever may be the occaſion of its narrowneſs, whether rocks or ſands.

142 Second order.

Plate CCCCXCVIII.

In the ſecond order of ſailing, when the fleet is looking for the enemy or trying to avoid him, the columns *a b*, *c d*, *e f*, are to be formed on three ſides of a regular lozenge, and ranged on the two cloſe-hauled lines. The ſhips of the two diviſions *c d*, *e f*, ſometimes to windward (as in fig. 56.), and ſometimes to leeward (as in fig. 57.), of the third diviſion *a b*, are to be formed on two parallels of one of the cloſe-hauled lines in the wakes of their reſpective headmoſt ſhips; and the third diviſion *a b* is to be ranged ahead or aſtern of the two others on the other cloſe-hauled line, and nevertheleſs to ſteer chequerwiſe the ſame courſe as the two diviſions *c d* and *e f*. When *a b* is to windward of *c d* and *e f* (fig. 57.), the viſcount calls that the *primitive* windward order of ſailing; and when to leeward (fig. 56.), the fleet is in the *leeward primitive* order of ſailing. The poſition of the three diviſions in the windward primitive order of ſailing is the ſame for the order of battle natural; for the order of retreat; and for the order of circumvallation, when the object is to ſeparate from the hoſtile fleet a part of its ſhips in order to engage the remainder with more advantage. The poſition of the three diviſions in the leeward primitive order of ſail is alſo the ſame for the order of battle inverted; for the order of chaſing; and for the order of convoy; ſo that in no poſſible caſe, when looking for the enemy or wiſhing to avoid him, need the admiral perplex himſelf with more than theſe two poſitions on the one or the other tack, whatever movements he may wiſh the fleet to make.

143 Third order.

In the third order of ſailing, the diviſions *c d* and *e f* inſtead of bearing on the headmoſt and ſternmoſt ſhips of the diviſion *a b*, may be very conveniently placed at conſiderable diſtances from that diviſion, without the ſmalleſt danger of being ſurpriſed by the enemy, provided the ſhips of each of the diviſions keep always their reſpective poſitions in the two lines of bearing. For if we ſuppoſe the three diviſions to be in ſuch poſitions that *a b* and *e f* are at the diſtance of ſix leagues from each other (fig. 58), and that the two diviſions *c d* and *e f* reſt on the extremities of the baſe of the triangle STV, while the centre ſhip of the diviſion *a b* reſts on its ſummit T; none of the diviſions could be cut off by an enemy, however formidable, ſeen from its centre ſhip at the diſtance of ſix leagues. For if, upon the proper ſignal being thrown out, the diviſion *a b* ſhould ſteer from T towards X, on the courſe oppoſite to the cloſe-hauled line it ſteered before, and the two diviſions *c d* and *e f* ſteer from V and S towards X likewiſe; it is plain that each of theſe three diviſions would have only three leagues to run in order to join the other two in the windward primitive order of ſailing, which is the ſame with the order of battle natural; whilſt the enemy, which was firſt perveived at the diſtance of ſix leagues, muſt neceſſarily run nine before he could come up with the neareſt of theſe ſquadrons. And if frigates were placed ahead, and in the intervals between the diviſions, at the points *y y y* to windward and leeward of the fleet, the enemy might be ſeen at a ſtill greater diſtance, and the danger of ſurpriſe be ſtill ſo much leſs.

144 Order of battle. We have ſaid, that the poſition of the three diviſions in the primitive orders of ſailing is the ſame with our author's propoſed order of battle; but there is this difference between them, that in the order of battle only the ſhips of one of the three diviſions ſtand in the wakes one of another, and that thoſe of the two other diviſions are ranged on two parallel lines, and ſteer chequerwiſe. So that if it be wanted to change a fleet from the windward primitive order of ſailing to this new order of battle on the other tack, the movement will be infinitely quicker than thoſe which, in former known tactics, are commonly preſcribed, to paſs from all the orders of ſailing either in one line, or on the obtuſe angle of chaſing or retreating, or in three or ſix diviſions, to the uſual order of battle. For it will be ſufficient for the ſhips of the three diviſions, ranged in the windward primitive order of ſailing, to heave in ſtays all together, and get on the other tack in the oppoſite line of bearing, and they will inſtantly find themſelves in this new propoſed order of battle (fig. 59.); and ſhould the fleet be in the leeward primitive order of ſailing, it would be ſufficient for the ſhips of the three diviſions all together to haul their wind on the ſame tack as they ſteer, and they would find themſelves in order of battle (fig. 60.)

145 Natural and inverted. When the two columns *c d*, *e f*, are to leeward of the third diviſion *a b*, ranged in order of battle, our author calls *that* the order of battle *natural;* and when *c d* and *e f* are to windward of *a b*, the fleet is in the order of battle *inverted*. The former of theſe orders is calculated for a fleet combating to leeward, and the latter for a fleet which muſt combat to windward.

146 Advantages of theſe orders of ſailing and of battle. That we may form ſome notion of the advantages which our author expects from drawing up a fleet for battle in the form of a lozenge, let us ſuppoſe the line AB, CD, EF, (fig. 61,) to repreſent the fleet of an enemy to windward in the ordinary order of battle on the cloſe-hauled line of bearing, and on the ſtarboard tack. Then the leeward line *a b* will repreſent one of the diviſions, in order of battle on the ſtarboard tack, of the fleet ranged according to the new natural order, which the enemy wiſhes to attack, and to which he believes himſelf ſuperior, becauſe that diviſion offers a front much inferior to his own. The two lines *c d*, *e f*, will repreſent the two other diviſions ſtanding on chequerwiſe on the ſame tack as the line of battle, and formed on the oppoſite cloſe-hauled line. On this ſuppoſition, if the diviſions AB, EF, of the hoſtile fleet, which have it not in their power to attack the ſhips of the line *a b*, wiſh to fall on the headmoſt ſhip *a* or the ſternmoſt *b* of that line, they will be obliged to bear away in order to attack the two ſhips *a* and *b*. To prevent this, each of the diviſions *c d*, *e f*, of the fleet ranged according to the new order, ſhould make the following evolutions, according to their reſpective ſituations and to the manœuvres of the enemy.

147 Evolutions to be performed when engaging, and 1ſt, The ſhips of the diviſion *a b* are to ſlacken as much as poſſible their headway, and form a very cloſe line, till the enemy makes a movement to attack the headmoſt or ſternmoſt ſhip of that diviſion.

2dly, The ſhips of the diviſion *c d* are to make ſail till they come under the ſecond or third ſhip of the rear of the line of battle *a b*, when they will take the ſame ſail as the ſhips of that diviſion, to preſerve that poſition until the hoſtile ſhips make their evolution to attack the rear ſhips of that diviſion. In this ſituation the ſhips of the diviſion *c d* will be able to obſerve the manœuvres of the enemy, in order to change tack and form themſelves in order of battle on the oppoſite board as ſoon as the hoſtile ſhips ſhall have, after their bearing away, run over a certain ſpace: becauſe the ſhips of the diviſion *c d*, ſteering afterwards cloſe-hauled in the wake of the ſternmoſt ſhip of the diviſion, *a b*, will be able to cover the rear ſhips of that diviſion, and get the weather gage of the hoſtile diviſions which are bearing away; rake their ſhips; run alongſide of them; double their rear-guard, and put it between two fires, if thoſe hoſtile ſhips are following in the wake of each other (c); divide it if they bear away chequerwiſe, or gain to windward, and put between two fires the enemy's diviſion CD, while it is engaged with the diviſion *a b*.

3dly, The ſhips of the diviſion *e f* may abandon their poſt and run chequerwiſe under a preſs of ſail, in the ſame courſe and in the ſame order they were formed, as ſoon as they perceive that the enemy falls ahead of the diviſion *a b*; in order that if the diviſion AB of that enemy makes any manœuvre to bear away and fall on the diviſion *e f*, or on the van of the diviſion *a b*, they may, by going about, ſteer in order of battle cloſe-hauled on the oppoſite line of bearing, and cover the headmoſt ſhip of the diviſion *a b*, double the hoſtile diviſion CD ahead, or divide the other hoſtile diviſion AB, which is running chequerwiſe on the oppoſite tack.

148 When the enemy is in a ſingle line not well formed. The two diviſions *c d*, *e f*, might again manœuvre another way, in caſe the ſhips of the enemy were ranged in one ſingle line not well formed; or ſhould be in diſorder and leave too great a diſtance between them while they are engaged very cloſe with the diviſion *a b* (fig. 62.)

1ſt, By putting about the ſhips of the diviſion *e f*, and likewiſe the ſhip *a* headmoſt of the diviſion *a b*. 2dly, By making at the ſame time the ſhips of the diviſion *c d* tack, and likewiſe the ſhip *b* of the diviſion *a b*, to keep by the wind on the oppoſite cloſe-hauled line. 3dly, By making all the ſhips of the diviſion *a b* (which ſtood between the headmoſt *a* and the ſternmoſt *b*) bear away four points at the ſame time, and making them alſo take the ſame tack as the ſhips of the other two diviſions when they are on the beam of the ſternmoſt ſhips of thoſe two diviſions; becauſe, in that poſition, the ſhips of the two diviſions *c d*, *e f*, getting to windward on two parallels in order of battle, in the wake of the two headmoſt *a* and *b*, might put between two fires a part of the enemy's ſhips, which then would be obliged to take the ſame tack as theſe two diviſions, becauſe the ſhips of the diviſion *a b* (which are on the ſame tack as thoſe two diviſions) might prevent the ſhips of the enemy ſteering the courſe oppoſite to that tack.

From this ſuccinct expoſition it may be obſerved, that, in the firſt ſuppoſition, the way of thus diſpoſing the forces of a fleet is ſo much the more ſuitable to the defence of the headmoſt and ſternmoſt ſhips of a line of battle, as the ſhips of the diviſion *c d*, being covered by that line of battle, are able to manœuvre without any one ſhip of that diviſion being expoſed to the fire of the enemy; that the diviſion *e f*, the headmoſt ſhip of which is *e*, always preſents the ſide to the enemy, without any one ſhip of that diviſion being expoſed to receive the fire of the enemy either ahead or aſtern, becauſe they are not to range in a line of battle unleſs the enemy runs large or before the wind; and that, in the ſecond ſuppoſition, the only ſhips which are liable to be raked aſtern, while they change tack, are the headmoſt and ſternmoſt of the diviſion in line of battle which cover the ſhips of the other two diviſions.

(c) If the hoſtile ſhips which are not engaged with any of thoſe of the diviſion *a b* bear away in ſucceſſion in the wake of their headmoſt, in order to paſs to leeward of the diviſion *a b*, and to put it between two fires; then the ſhips of the diviſion *e f* muſt neceſſarily take the weather-gage of them, ſince the headmoſt of that diviſion *e f* is by her very ſituation already to windward of the headmoſt of the adverſe ſhips which are bearing away, and ſhe has the opportunity to come as cloſe as poſſible to the ſternmoſt ſhip *b* of the line of battle *a b*.

149 How to know on what tack the fleet muſt be formed.

As it is of the utmoſt advantage to know, at firſt ſight of the enemy, whether it be to windward or leeward of the fleet ranged lozenge-like, on what tack, and on what ſide the fleet muſt be formed, in order to defend itſelf or attack the enemy with advantage, it is to be obſerved, that in both the windward and leeward primitive orders of ſailing the direction of the wind always traverſes both the weathermoſt and leewardmoſt ſhips of the fleet (figs. 57. and 56.); that this leewardmoſt ſhip is always placed in the centre of an horizon, which is to be conſidered as the horizon of the whole fleet; and that it is from that ſhip you are to judge, by means of the rules which are known and practiſed in ſuch caſes, whether the lozenge-like fleet be to windward or to leeward of that of the enemy.

If you want to know, at ſight of the enemy, ſeen either to windward or to leeward, on what ſide the line of battle is to be formed in order to be able to ſend one of the diviſions on that ſide of the lozenge where there is none, it is the poſition of the enemy, with reſpect to the direction of the wind, which is to determine it; becauſe, if the enemy is to windward of the fleet ranged in the windward primitive order of ſailing, and if it bears down on that fleet, with the wind large or right aſt, it belongs to its weathermoſt ſhip to obſerve what follows. If that ſhip, by ſetting the enemy, finds him to ſtarboard of the direction of the wind, the diviſion which is ſtarboard of that direction of the wind is to take the ſtarboard tack, and range in order of battle before the enemy is arrived within gunſhot: if, on the contrary, the abovementioned ſhip finds the enemy to larboard, it belongs to the larboard diviſion to aſſume the order of battle, and to take that tack, before the enemy can come to action. The old rule for chooſing the proper tack is to be obſerved by a fleet in the leeward primitive order of ſailing; obſerving, that it is the buſineſs of that fleet's leewardmoſt ſhip to determine it; and the point of the horizon which is oppoſite to that whence the wind blows, is the point towards which the obſerver is to be turned to judge on what ſide, whether ſtarboard or larboard, the line of battle is to be formed; becauſe, in that poſition, the ſtarboard ſide muſt always be on his right hand and the larboard on his left.

By following this general rule, the line of battle will never be expoſed to be too much lengthened either to windward or to leeward, in order to oppoſe all the ſhips of the adverſe fleet formed in one ſingle line, nor even to be ſurpriſed in diſorder by that fleet while you are forming in orders of battle natural or inverted.

150 The orders of chaſing, retreat, and convoy.

Our author's orders of CHASING, of RETREAT, and of CONVOY, are very eaſily formed. We have already ſaid what they are; and the ſeaman, or even the landſman, who has any tolerable conception of his orders of SAILING and of BATTLE, will not ſtand in need of any farther deſcription of them. It muſt, however, be obſerved, that in the order of chaſing, the fleet in the lozenge-like poſition preſents the obtuſe angle of chaſing, as when ranged according to the ordinary tactics; with this difference, that, in order to form themſelves in order of battle, it is enough that, in this lozenge-like poſition, the ſhips of the ſecond diviſion ſhould all keep the wind on the ſame board they were ſtanding on, becauſe they would afterwards find themſelves in a line in the wake one of another; but, according to the uſual tactics, the ſhips have a long ſpace to run before they can execute the ſame evolution.

151 How the admiral's ſhip, the frigates, and tranſports, are to be placed.

We ſhall conclude this ſhort view of the Viſcount de Grenier's tactics, with his directions for the moſt advantageous placing of the admiral's ſhip, the frigates, and tranſports, belonging to a lozenge-like fleet, whether it be ranged in the order of ſailing or of battle, &c.

In the order of ſailing, the admiral A is to be placed ahead of the fleet, at a ſhort diſtance from the headmoſt of the ſecond diviſion, and in the direction of the wind with the headmoſt of the firſt diviſion (fig. 63.). Two of the frigates *ff* are to obſerve the ſame rule and the ſame poſition, with reſpect to the van ſhip of the third diviſion and the ſternmoſt of the firſt. In the order of battle, on the contrary, the admiral is to be in the centre of the lozenge, and two of the frigates on the fourth ſide of the lozenge. (fig. 64). As for the tranſports and ſtore-ſhips, when there are any, their ſtation is to be in one line on the ſide oppoſite to that of the enemy, when ranged in order of battle; and, if in order of ſailing or convoy, they may occupy the ſpace circumſcribed by the lozenge. In any other circumſtances theſe ſhips are to occupy the different ſtations appointed for them, that they may diſtinguiſh the ſignals and execute the commands of the admiral. Laſtly, when the fleet ſhall paſs from the order of battle to any other order whatever, or from any order to the order of battle, the admiral's ſhip is to bring to, and not to take any of the poſitions abovementioned till after the complete execution of the movement.

CHAP. II. *View of Mr Clerk's Tactics.*

WHETHER the Viſcount de Grenier's order of battle and of ſailing would be attended with all the advantages which he hopes from them, experienced ſeamen alone can judge; but we are now to introduce to our readers part of a ſyſtem which has met with very great approbation from ſome of the ableſt officers in the Britiſh navy, and which to us appears to be founded on principles ſelf-evident. Mr Clerk, in the introduction to his Eſſay, informs us, that upon conſidering the great ſuperiority diſplayed in the three laſt wars by the Britiſh ſeamen over their enemies, when engaged in ſingle ſhips, and comparing it with the very little that, previous to Lord Rodney's glorious action, they had atchieved when engaged in fleets drawn up in line of battle, he was led to conclude, that there muſt be ſomething wrong in the mode of making the attack. He turned his thoughts to the ſubject, and in 1790 publiſhed part of a large work, comprehending, 1. *A Theory of Attack from Windward*; 2. *A Theory of attack from Leeward*; and, 3. *An Hiſtorical Sketch of Naval Tactics*. We think it not much to the honour of his countrymen, that he has not yet had encouragement to publiſh more than the firſt part; but in hopes of exciting curioſity, we ſhall lay before our readers a diſtinct view of that part, beginning, as he begins, with

OBSERVATIONS OF THE PRESENT METHOD OF BRINGING SHIPS TO ACTION.

152 Diſadvantages of bearing down directly on the enemy.

It has often, if not generally, been the practice, in the caſe of ſingle ſhips, as well as in that of fleets, for the weather ſhip or fleet, when it is wiſhed to bring the other to action, to ſteer directly down upon that ſhip or fleet, without reflecting that, by doing ſo, it gives the enemy an opportunity of completely diſabling it, before it can attain its wiſhed for ſtation. For each ſhip in the lee line can uſe all the guns upon one ſide; whereas the ſhips in the weather-line, bearing directly down, have it only in their power to uſe their bow-chaces. This method of attack appears, therefore, to be the worſt poſſible for the weather-fleet, and the moſt advantageous for the lee fleet. For ſuppoſe a ſingle ſhip of 80 guns to windward at B (fig. 65.), diſcovering an enemy's ſhip of equal force to leeward at F, to bear directly down upon her endwiſe, the receiving ſhip F, by lying to as in fig. 66. would preſent a broadſide of 40 heavy guns bearing upon B during a courſe of two miles, in which every ſhot might take effect; while B, in this poſition, would have it in her power to bring only the two light guns of her forecaſtle or bow-chaſe to bear on F; a diſadvantage greatly exceeding twenty to one. Beſides, the receiving ſhip F, by lying broadſide to, will have all her maſts and rigging more open, and conſequently will allow ſhot to paſs with leſs effect than the ſhip B, which, coming endwiſe, is liable to be raked by every ſhot from ſtem to ſtern. The conſequence of which muſt be, that B would be diſabled in her rigging, &c. long before ſhe could arrive at a proper poſition for annoying F; and when ſhe had attained that poſition, F, by being entire in her rigging, would have it in her power to fight in any poſition, or to make off at pleaſure.

153 Proper method of attack.

The method then is, B having the wind, ſhould run down aſtern as *per* dotted line, and getting into the courſe, or near the wake of F, or a poſition that will bring her parallel to the courſe of F, at a proper diſtance, ſhe ſhould then run up cloſe along ſide of F, upon equal terms, as in fig. 67; or otherwiſe, on ſhooting ahead, ſhe may veer, and run down on the weather-bow of F, as in fig. 68. till ſhe ſhall force F to bear away to leeward, keeping cloſe by F on equal terms; but during the courſe, in both caſes, carefully watching that F may not have it in her power to bring her broadſide to bear upon B without retaliation.

154 Modes of attack by the Britiſh and French.

It having been often ſaid that the French have made it a rule to throw the whole effect of their ſhot more particularly into the rigging of their enemy, and that the Britiſh, on the other hand, have been as attentive to point the force of their fire againſt the hull of the ſhip; it may be proper here to ſtate the two caſes, and compare the effect.

Let us ſuppoſe a ſhip of 80 guns wiſhing to avoid the effects of a cloſe engagement, but at the ſame time lying to as at F (fig. 63.), intending to receive, with every advantage, an enemy B of equal force, coming down with an intention to fight her; and let us ſuppoſe that F, by aiming her fire at the rigging of B, ſhall have carried away any of the principal ſtays, eight or ten windward ſhrouds, or a foretopmaſt, or any other rigging, though of much leſs conſequence, but, at the ſame time, without having wounded a ſingle man of the ſhip B; and ſuppoſe a ſecond ſhip, conſort to F, receiving ſuch another ſhip as B, and by firing at her hull only, ſhall, without other damage, have killed 30 or 40 of her men: In this critical juncture, when F and her conſort are deſirous of avoiding a cloſe engagement, it is evident that the ſhip at B, which has loſt part of her rigging, is more completely diſabled from cloſing with them than the other ſhip, whoſe rigging is entire, though ſhe may have loſt 100 of her men.

155 No ſhip in the line of battle can be expoſed to the fire of many at once.

It has been often ſaid, that ſome particular ſhip has been expoſed in battle to the cannonade of three, four, or even five ſhips, all extended in the enemy's line, and all bearing upon her at one and the ſame time; but this can never have been the caſe, but when the ſhip ſo expoſed was at a very great diſtance. Let I, H, F, H, I, (fig. 70.) repreſent five ſhips extended in line of battle ahead at the diſtance of one cable's length, or 240 yards, from each other; let the length of each ſhip be 40 yards, ſo that the whole ſpace between head and head of any two adjacent ſhips is 280 yards; and let the perpendicular line FK, proceeding right out from the beam of the middle ſhip F, to the diſtance of ſix cable's length or 1440 yards, be divided into ſix equal parts: It is evident, from inſpection, that a ſhip ſtationed at the point E of the line FK, 720 yards diſtant, cannot for any length of time be expoſed to the fire of more than the centre ſhip F of the fleet I, H, F, H, I. For ſuppoſing the ſhips H, K, ahead and aſtern of F, to be able to bring their broadſides to bear on E (a ſuppoſition which, if the line be cloſe-hauled, cannot be made of the headmoſt of thoſe ſhips), it is evident, that by putting themſelves in poſitions proper for that purpoſe, the ſhips H, H, will not only diſorder their own line, but alſo leave, the one her head, and the other her ſtern, expoſed to a raking fire from their oppoſites B, B, in the enemy's line.

But if the opponent ſhip cannot well be expoſed to the fire of the two ſhips H, H, at the point E, ſhe muſt be ſtill leſs expoſed at the point C, 480 yards diſtant; and it will be almoſt impoſſible for the ſhips H, H, to touch her at the point G, 240 yards, or one cable's length, diſtant.

But one cable's length aſunder is too ſmall an allowance for accidents that may happen by the ſhips, I, H, F, H, I, extended in line of battle ahead. Therefore let us ſuppoſe the three ſhips, which are ſaid to be at once upon a ſingle opponent, to be ſtationed at I, F, I, at the diſtance of two cable's length or 480 yards from each other. Then it is evident that the opponent ſhip cannot now be more expoſed at the point K, at the diſtance of 1440 yards, than ſhe was, on the former ſuppoſition, at the point E, 720 yards diſtant; and if we ſuppoſe the line of battle to be formed at one and an half cable's length aſunder, ſhe muſt be at L, diſtant 1080 yards, before ſhe can be annoyed even to this degree by the three hoſtile ſhips at once. Hence we may fairly conclude, that if one ſhip has at any time been expoſed at once to the fire of five, four, or even three ſhips of the enemy's line, ſuch ſhip muſt have been at a very great diſtance, and in no great danger.

156 Principles neceſſary for bringing fleets to action.

Having finiſhed the above obſervations, our author proceeds to the principles neceſſary to be known for enabling us to judge of the different modes of bringing great fleets to action. For this purpoſe he ſuppoſes a fleet of 10, 20, or more ſhips, of 80 guns each, extended in line of battle, to leeward, and lying to at F (fig. 71.), with the intention of avoiding an attack; whilſt another fleet at B, of equal number and force of ſhips, alſo extended in line of battle three or four miles to windward, is deſirous of making an attack, and coming to cloſe action on equal terms with the fleet F. In this diſpoſition of the two fleets, ſhould that to windward run down headlong ſhip for ſhip on its opponent, as in figs. 66. and 69. it is evident, from what has been ſaid in the beginning of this chapter, that each individual ſhip of the weather-fleet might be completely diſabled before it could poſſibly come to cloſe action with the fleet to leeward. But let it be ſuppoſed that the commander of the weather fleet B, though his ſhips have been much diſabled in their rigging during their courſe *a a a* from windward (fig. 72.), has made them bring to at a great diſtance, from whence he can hurt F; is it to be expected that F, whoſe deſire has always been to avoid a cloſe engagement, and who has already diſabled the ſhips of B, will patiently lie ſtill, or wait until B ſhall have time to diſable him in his turn? No ſurely. While enveloped in his own ſmoke, as well as that of his enemy, he will bear away unhurt to a new ſtation G, and there remain out of the reach of B's cannon-ſhot, who muſt repair his rigging before he can attempt a ſecond attack.

Again, ſuppoſe that B, in place of going headlong and endwiſe down, were to run down in an angular courſe, or

View of Mr Clerk's Tactics.

laſking as it has been called; it is evident from fig. 73. that ſhould any ſhip in this angular line come to be crippled, her way being ſtopped, might of conſequence occaſion a confuſion among the ſhips next aſtern to her, ſome running to leeward and others to windward of the diſabled ſhip; and thus the time be loſt for affording the neceſſary ſupport to the ſhips ahead, and now ſo far ſeparated from their companions. Should it be ſaid, that a ſtoppage of one ſhip ahead will not neceſſarily produce a ſtoppage of every ſhip aſtern, becauſe they may go to leeward of the diſabled ſhip; we anſwer, that the ſhips ahead in the van A (fig. 74 n° 1.) may be now engaged, and of conſequence not having much headway, may be ſaid to be ſtationary; therefore every ſhip aſtern, if ſhe ſhall attempt to bear down, as at D, D, from being confined to a determined courſe, muſt be brought into the poſition of being raked when coming down before the wind, as in figs 76. and 69. and conſequently of being completely diſabled long before ſhe can get cloſe enough alongſide of the enemy.

Again, the headmoſt ſhips, or van of B, having attained their ſtation at A, that is, abreaſt of the van of F (fig. 74. n° 1.), and having begun the cannonade, may we not ſuppoſe that F, whoſe conduct or deſire has always been to ſave his ſhips, has inſtructed the commanders of thoſe in the van of his fleet to withdraw from danger as ſoon as they begin to feel the effects of a cannonade? and if ſo, may not thoſe ſhips, as ſoon as they have thrown in their fire upon the van of B, bear away in ſucceſſion as at H, followed indeed by the whole ſhips of F's fleet, which, having poured in their fire upon the van of B, may form a new line of battle two or three miles to leeward at II (fig. 74. n° 2.), and there be in readineſs to receive a ſecond attack, if B ſhall be ſo imprudent as to attempt it? And is it not farther evident, that if any one or more ſhips of the ſquadron of F ſhall be crippled, they will have it in their power to quit their ſtation, being covered with ſmoke, at any time, and to fall to leeward as at G, where they will be in ſafety?

Plate cccxcix.

In order to illuſtrate this ſtill farther, let B (fig. 75.) repreſent a fleet putting before the wind, each ſhip with an intent, when brought to at a determined diſtance at A, to take up her particular antagoniſt in the line of the enemy F to leeward; and, for argument's ſake, let F be ſuppoſed at reſt, without any motion ahead. There ſeems to be no difficulty in conceiving, that while the alternate ſhips of F's line, under cover of the ſmoke, withdraw from battle to GGG, the intermediate ſhips left behind them in the line will be ſufficient to amuſe even the whole of B's fleet, till the ſhips G ſhall form a new line HH as a ſupport from the leeward. In ſuch caſe B, after being diſabled, as he muſt be, and not having foreſeen the manœuvre, will neither be able to prevent the intermediate ſhips with which he is engaged from bearing away to join their friends, nor, were he able, would it be adviſable to follow them; for the ſame manœuvre with equal ſucceſs can again and again be repeated.

In order to ſhow the relative motion of both fleets, let F (fig. 76.) be a fleet conſiſting of twelve ſhips, drawn up in line of battle, at one cable's length or 120 fathoms aſunder; and let the length of each ſhip from the end of the jibboom to the ſtern be $36\frac{2}{3}$d fathoms; the whole fleet will then occupy a ſpace of two Engliſh miles; alſo, let its rate of ſailing be four knots an hour in the direction FG, ſo that in the ſpace of an hour it may have moved from F to G four miles diſtant from its former poſition.

Let B be the opponent fleet, conſiſting alſo of twelve ſhips, and four miles to windward; and let the point A be 440 yards, or one quarter of a mile, right to windward of the point G. Then if B, by bearing away in the direction BA, ſhall arrive at the point A at the ſame inſtant that F, the fleet to leeward, has arrived at the point G, the motion of the fleet B will have been at the rate of $5\frac{1}{2}$ miles nearly per hour; and the angle contained between the direction of its line of bearing and preſent courſe 43° 9′, or nearly 4 points. For in the right-angled triangle ABM are given BM = 4 miles, and AM = $3\frac{3}{4}$ miles. Now $\text{BM}=4\text{ m.} : \text{AM}=3\frac{3}{4}\text{m.} :: \text{R} : \text{tan. ABM}=43^\circ\ 9'$, and $\text{R} : \text{ſec. ABM. } 43^\circ\ 9' :: \text{BM}=4\text{m.} : \text{AB}=5.483\text{ m.}$

Again, if F, as in fig. 77. by carrying more ſail, ſhall move at the rate of ſix miles an hour, that is, from F to G; then B, having his courſe made thereby the more ſlanting, will have juſt ſo much the greater difficulty of keeping his ſhips in line abreaſt while coming down to the attack: For the leading ſhip meeting with no obſtruction in her courſe, will puſh on; whereas every accident of obſtruction accumulating, as it happens to each ſhip progreſſively, the rear, being affected in the greateſt degree, will for that reaſon be left the farther aſtern. But, from the very form of this ſlanting courſe, every ſhip aſtern will be apt to get into the wake of the ſhip ahead. Therefore the whole fleet of B, van and rear, will not arrive in the ſame time at the line AD, ſo as to be in a perfect line abreaſt, and parallel with the fleet to leeward; but will have aſſumed the laſking form, as repreſented at the points M, N, and O, in the different parts of the courſe. In this caſe, the diſtance run by the van of B, from B to A, is 7,075 miles, or 7 miles and 132 yards, and the angle contained between the line of bearing and the diſtance BA is 32° 0′.

And again, as in fig. 78. if the fleet to leeward ſhall lie up one point higher, as FG, then the rears of the two fleets will thereby be removed at a much greater diſtance, and the van A of conſequence muſt be ſooner up with the enemy's van, and evidently ſo much the farther from ſupport; while F, by bringing up his ſhips in ſucceſſion, will have it in his power to diſable the van of A, and will afterwards bear away, as at H, unhurt and at pleaſure; while B, at this time, by the ſuppoſition, being crippled, or having his rear D obſtructed, and at a diſtance, will be unable to prevent him. And in all the three caſes, it is evident that the fleet B, ſo ſoon as he ſhall approach within reach of gun-ſhot, muſt be expoſed to the fire of F's whole line; for he will be abreaſt of B continually in every part of his courſe. But the difficulty of bringing the rear of the windward fleet to action will ſtill be more increaſed, if the ſternmoſt ſhips of the fleet to leeward, in place of keeping their wind, ſhall bear away occaſionally as at ML. All which being admitted, the difficulty of bringing adverſe fleets to cloſe engagement may be accounted for, without being obliged to have recourſe to that ſuppoſed inferiority in point of ſailing, imputed to Britiſh ſhips, compared to thoſe of the French.

Hence it appears, that a fleet B to windward, by extending his line of battle, with a deſign to ſtop and attack a whole line of enemy's ſhips to leeward, muſt do it at a great diſadvantage, and without hope of ſucceſs; for the receiving fleet F to leeward unqueſtionably will have the four following advantages over him: 1. The ſuperiority of a fire above 20 to 1 over the fleet B, while coming down to attack. 2. That when the ſhips of B are brought to at their reſpective ſtation, if it blows hard, the ſhot from F, by the lying along of the ſhips, will be thrown up into the air, and will have an effect at a much greater diſtance; whereas, on the other hand, the ſhot from B, from the ſame cauſe, will be thrown into the water, and the effect loſt. 3. That F, will have the power of directing and applying at pleaſure the fire of his whole line againſt the van of B, who is now unable to prevent it, his ſhips being diſabled, ſeparated, and therefore unſupported. 4. That F will alſo have a greater facility of withdrawing from battle the whole or any one of the diſabled ſhips of his line.

If then, after a proper examination of the late (D) ſea-engagements or rencounters, it ſhall be found that the French admirals have never once ſhewn a willingneſs to riſk the making of the attack, but invariably have made choice of and earneſtly courted, a leeward poſition; if invariably, upon ſeeing the Britiſh fleet diſabled, they have made ſail, and demoliſhed the van in paſſing; if invariably, upon feeling the effect of the Britiſh fire, they have withdrawn at pleaſure either a part or the whole of their fleet, and have formed a new line of battle to leeward; if the French repeatedly have done this upon every occaſion:—and, on the other hand, if it ſhall be found that the Britiſh, from an irreſiſtible deſire of making the attack, as conſtantly and uniformly have courted the windward poſition; if, uniformly and repeatedly, they have had their ſhips ſo diſabled and ſeparated, by making the attack, that they have not once been able to bring them to cloſe with, to follow up, or even to detain one ſhip of the enemy for a moment—ſhall we not have reaſon to believe, that the French have adopted and put in execution ſome ſyſtem which, if the Britiſh have diſcovered, they have not yet profited by the diſcovery?

Our author therefore, inſtead of the uſual mode of attack, which, by being made principally on the van, ſeems to be the reſult of a groundleſs expectation of being able to *take*, *deſtroy*, or *diſable* the whole of the enemy's line, propoſes

A NEW MODE OF ATTACK FROM THE WINDWARD UPON THE REAR OF THE ENEMY.

157 Mr Clerk's mode of attack upon the rear of the enemy.

Suppoſe, ſays he, a fleet of ten, twenty, or more ſhips, extended in line of battle at F (fig. 79.), endeavouring to avoid a cloſe engagement, but at the ſame time keeping under an eaſy ſail, with the intention of receiving the uſual attack from another fleet of equal number, three or four miles to windward at B, ſailing in any form, but let it be in three lines or diviſions; it is required by what method ſhall B make the attack on F with advantage?

The improbability, or rather impoſſibility, of attacking and carrying the enemy's whole line of ſhips, having been demonſtrated by every action which has been fought at ſea, the next conſideration will be, how many ſhips may be attacked and carried with advantage? Let it be ſuppoſed that the three ſternmoſt ſhips only, and not exceeding the fourth, are poſſible to be *carried;* let a ſufficient ſtrength A be ſent down to force an attack upon theſe three ſhips, diſpoſed and ſupported according to the judgment of the admiral, while in the mean time he keeps to windward with the reſt of his fleet, formed into ſuch diviſions as may beſt enable him to attend to the motions of the enemy and the effect of his attack; being himſelf ſo far diſengaged from action, as to be able to make his obſervations, and give his orders, with ſome degree of tranquillity.

By placing the fleet B in ſuch diviſions as repreſented in the figure, when the attacking ſquadron comes up with the rear of the enemy, the whole will be ſo diſpoſed, and ſo connected together, as to be able to give the ſupport and attention that may be required to any ſhip, or any part of the fleet, and in preference to a long extended line of ſix or ſeven miles in length, where it muſt be impracticable to give the neceſſary ſupport to ſuch ſhips as may be diſabled. 158 Attack upon the enemy's three ſternmoſt ſhips more particularly conſidered. The ſhips of the fleet F may, in general, be better ſailers than the ſhips of the fleet B; but it is not conceivable but that the ſwifteſt ſhips of B muſt come up alongſide of the ſternmoſt and dulleſt ſailing ſhips of the enemy F; while, at the ſame time, F, by attempting to outſail B, muſt be thrown into the diſorder of a downright flight: Therefore, of courſe, it muſt be admitted, that if the enemy F continues going off in line of battle, and endeavouring to avoid a cloſe engagement, it will be impoſſible to prevent the fleet making the attack from getting into the poſition B A. But by this poſition, it is evident that the three ſhips at I of the fleet F will be in the power of the admiral of B; for, by keeping ſo many ſhips to windward, he will be enabled to ſend down freſh ſhips from time to time, either for the ſupport, or to ſupply the ſtation, of any of thoſe that may be diſabled in making the attack, while it may be imagined that the three ſhips in queſtion, by being diſabled, or being deprived of the wind now taken out of their ſails by the ſhips to windward, will be prevented from following their friends. Hence the enemy ahead muſt either abandon his three ſternmoſt ſhips, or he muſt double back to ſupport them; which muſt be done either by tacking or veering. But let it be firſt examined what is naturally to be done by tacking; and for the greater ſatisfaction, let every poſſible caſe that can happen be examined ſeparately.

159 The enemy's attempt to ſupport his three ſternmoſt ſhips by tacking his fleet.

Firſt, let us ſuppoſe that the enemy at F, fig. 80. has continued to protract his courſe in line of battle upon the ſame tack, and that the headmoſt ſhip H, with the three next aſtern of her, have tacked to windward, and that the whole remaining ſhips intend to tack the ſame way, but in ſucceſſion; is it not evident that F has then left his three ſternmoſt ſhips at I in the power of the ſhips at A; that he muſt alſo leave expoſed his fourth and fifth ſhip G to another attack from another diviſion of B at C, which will alſo be on equal terms as with his three ſternmoſt at I; and laſtly, if he proſecutes his intention of ſupporting his three ſhips, he will be obliged to begin a diſadvantageous attack upon the admiral, with the main body of the fleet lying ready to receive him? The conſequence of all which muſt be, that he will not only loſe his three ſternmoſt ſhips, but in all probability the fourth and fifth alſo, as at G; and will be forced to begin an attack, and cloſe and mix ſhip with ſhip on equal terms; a ſituation which he at all times, with the greateſt anxiety, hath avoided, and which B with equal anxiety has always courted.

Again, ſuppoſe that his three ſternmoſt ſhips have been attacked, and that he has ordered his fleet to tack all at one time, as in fig. 81. The conſequences will then be, that this movement, having required ſome time and ſome length of courſe, will have produced a conſiderable diſtance between his main body and his three ſhips; or, in other words, that theſe three ſhips have been deſerted; for it will not be in their power to tack with the reſt of their friends. He muſt alſo, in bringing his ſhips' heads round, expoſe the ſhips neareſt his enemy to be raked by a dreadful cannonade; beſides running the riſk of having his fleet thrown into a general diſorder, by many of his ſhips miſſing ſtays, veering, and running to leeward. Laſtly, upon a ſuppoſition that his ſhips have all tacked, and none of them miſſed ſtays, ſtill he

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(D) This was written during the American war, and before Lord Rodney's deciſive victory on the 12th of April 1782. That action, as well as the ſtill more brilliant one of Lord Howe on the 1ſt of June 1794, we have heard the author diſtinguiſh from thoſe battles which, with great propriety, he calls *ſea-rencounters*, and do ample juſtice to the ſcientific manœuvres of both the noble admirals.

he muſt of neceſſity begin the attack, mix his ſhips, and come to a cloſe engagement, as in the former caſe.

160 The enemy's attempt to ſupport his three ſternmoſt ſhips by veering his fleet.

Having ſhewn the conſequences of an attempt to ſuccour the three ſternmoſt ſhips by tacking, let us alſo examine what may be expected from an attempt to do it by veering the fleet. Suppoſe the two fleets in the ſame poſition as in fig. 79. that is, the main body of the enemy extended in line of battle to leeward, his three ſternmoſt ſhips entangled with the fleet B, whoſe admiral, with the main body, keeps to windward to obſerve, with a rigid attention, the motions of the enemy. At the ſame time ſuppoſe that the admiral F has ordered his ſternmoſt ſhip G to veer (fig. 82.), and afterwards the whole line; and that he is now running upon a contrary tack to leeward, as at H, wiſhing to ſupport or bring off his three ſhips. From inſpection, it will be evident that this attempt may be more dangerous than the attempt to windward; for it will expoſe a number of his ſhips to a raking fire while in the act of veering; and the ſquadron, by getting ſo far to leeward, will be unable to give the proper ſupport to the three ſhips. It will open a gap for the fleet of B (who will immediately veer alſo and follow him) to break in, as at A, and cut off the three ſhips without hope of recovery. And if F ſhall ſtill perſiſt in the endeavour to recover his three ſhips, he will be obliged to begin the attack under all the uſual diſadvantages.

Again, upon another ſuppoſition, that the headmoſt ſhip of the enemy H (fig. 83.), with the four or five next aſtern, have wore, and are running upon a contrary tack, wiſhing, as before, to ſupport or bring off the three ſhips, the reſt of the fleet intending to wear alſo, and follow in ſucceſſion; it is evident that this movement, being more unſeaman-like, will be worſe than the laſt: It will expoſe an additional number of ſhips, particularly the laſt two, as at G; and will at the ſame time make an opening for the main body of B's fleet to fall in and cut off the three ſhips, as in the former caſe.

Again, ſhould the enemy F veer and bear away with his whole ſhips at one and the ſame time, it is evident that this movement muſt have the conſequence of a downright flight, with the certainty of loſing the three ſhips.

From what has been ſaid, it will appear, that a fleet B, keeping connected in a body to windward, may come up with and entangle the three ſternmoſt ſhips of an enemy F, extended in line of battle and going off to leeward, and at the ſame time be able to overawe the remaining main body of their fleet; and that, having forced the poſition, the whole conſequences, as already deſcribed, muſt follow; that is, F muſt ſubmit to the loſs of three ſhips.

What has been hitherto ſaid proceeds upon a ſuppoſition that the fleet F has kept on his courſe till the fleet B has come up with his rear. Let it then be examined what other attempts the enemy F can make to avoid coming to cloſe engagement upon equal terms.

161 The enemy endeavouring to avoid the attack upon his rear by veering and paſſing on contrary tacks to leeward.

Suppoſe a fleet of ſhips of the enemy ſtanding on the larboard tack to leeward, and going off as before at F, and a fleet of ſhips in a collected ſtate or poſition to windward, as at B (fig. 79.); and ſuppoſe that the enemy F, perceiving the fleet B pointing an attack againſt his rear, in place of keeping on his courſe upon the ſame tack, ſhould veer, and endeavour to paſs on contrary tacks to leeward (for it will not be admitted that he can get to windward); what will then be the effect?

Is it not evident, that the headmoſt ſhips of F muſt be forced to leeward by the fleet B obſtructing his line of direction, or the line of his courſe; that they muſt be forced to begin an attack at any diſtance B may chooſe? that they may receive ſuch damage as will ſtop their way? that their way being ſtopped, will of courſe be an obſtruction to the next aſtern; or that theſe ſubſequent ſhips, to prevent this ſtop, muſt bear away to leeward of their crippled ſhips, as at G (fig. 84.), which will not only prevent theſe ſhips from damaging the headmoſt ſhips of B, but will give time and opportunity to B to bring down his windward ſhips to fall in either ahead or aſtern, that is, to the right or left of his headmoſt ſhips A, and oppoſe ſhip for ſhip of the enemy upon equal terms? But ſhould none of the headmoſt ſhips of the ſquadron F be crippled, that is, ſhould F paſs B without reach of cannon ſhot, which undoubtedly he will do if he can; ſtill, while bearing away, he may be forced to ſuffer a diſtant cannonade, ſhip with ſhip on equal terms, whether he veers and gets back upon his former tack, as at G in fig. 85. or continues to run before the wind, as at P in fig. 86. But if F perſiſts to paſs on a contrary tack to leeward, and without reach of cannon-ſhot, it is evident, whether he put right before the wind, or run off ſhip by ſhip as he beſt can, that B muſt at ſome time or other come up with his rear.

162 Effect produced by a change of wind during the action.

So far the attack has proceeded with the wind fixed in one and the ſame quarter. To make the propriety of it the more apparent, it will be neceſſary to inquire, What might be the effect produced by a change of wind, ſhould that take place during the action? For this purpoſe, let the opponent fleets be placed in ſome one of the preceding poſitions, repreſenting the attack upon the three ſternmoſt ſhips of the enemy, as in fig. 87.; in which the fleet deſirous of making the attack is repreſented in four diviſions, as at B, B, B, A, and F the fleet deſirous of avoiding the attack, at the hazard of abandoning his three ſternmoſt ſhips at G.

163 The wind ſhifting by degrees, and coming aft.

In the commencement of the attack, let us ſuppoſe the wind to be N. and the ſhips going two points free on the larboard tack, or ſtand E.; and ſoon after the commencement let the wind be ſuppoſed to veer round to the W.; then it is evident, by the diſpoſition of the two fleets, that the fleet F, by ſuch a change, will have acquired no advantage whatever; on the contrary, it will thereby be thrown juſt ſo much the farther to leeward.

164 The wind ſhifting by degrees round a-head.

Again, if the wind, by taking an oppoſite courſe, ſhall ſhift ahead and come round by the eaſtern quarter to L, the admiral of the fleet F will not have it in his power to avail himſelf of this circumſtance, provided the commander of B, continuing carefully to watch his motions, and feeling the impulſe of the veering wind, ſhall ſtretch his ſhips, as at OO, to the windward of the three ſhips at G, ſeparated from F's fleet, and at the ſame time to the leeward of the main body of that fleet. This will be apparent from figures 88. and 89. which exhibit the two fleets, after this manœuvre, both on the larboard and ſtarboard tack.

165 The wind continuing to veer round the compaſs.

Let the wind be ſuppoſed to veer round gradually from the E. towards the S. and from thence to the W. and then quite round the compaſs. Then F being ſuppoſed to have gained the wind, it will be in his power to maintain it, and make a circular courſe to windward of B; but as he can be attended all the while by the fleet B, who will cut him off to leeward, he never will be able to recover his three ſhips, ſuppoſed to be cut off. This is evident without the illuſtration of a figure.

166 The wind ſhifting inſtantly to the oppoſite points.

Laſtly, if the wind in changing ſhall in one inſtant ſhift in direct oppoſition to where it was when the attack began, that is, from north to ſouth; then and in that caſe, before it can be judged whether ſuch change ſhall be favourable for F or not, it will be neceſſary that the relative ſituation of the two fleets ſhould be determined, ſuch as it was when the change took place. For example, if the headmoſt ſhips of the fleet F, that is, if his van and centre ſhall have ſeparated at any conſiderable diſtance from his rear, and ſhall, in conſequence of this mode of attack, have advanced to a poſition as repreſented in fig. 90. it is evident that F, though by this change he ſhall have got to windward, will yet not be able to avail himſelf of this ſeeming advantage, the fleet B having it ſtill in their power to cut him off from his three ſhips.

On the other hand, if this inſtantaneous change of wind, in direct oppoſition, ſhall have taken place more early in the action, that is, when the poſitions of the two fleets ſhall be ſuch as repreſented in fig. 87. (the fleet B in the poſition of four diviſions B, B, B, and A, and the enemy in the poſitions F and G) ; then F, who before was to leeward, by this inſtantaneous change of wind from the north to the ſouth, having now got to windward of every diviſion of the fleet B, is it not evident that it may be practicable for him to carry aſſiſtance to his three ſhips at G in the rear, and perhaps even to cut off ſome of B's ſhips at A, if they do not with all convenient ſpeed bear away to put themſelves under the protection of their friends B to leeward? But whether F ſhall attempt to effect this manœuvre, by veering his ſhips in the line, or, what ſeems moſt eligible, by making his ſhips tack, as it is to be preſumed that his three ſhips, which have been ſome time engaged, muſt be conſiderably crippled, and not able to make ſufficient ſail; while endeavouring to bring them off, it will be difficult for him to prevent being drawn into a general and cloſe engagement, which, by the ſuppoſition, he has all along endeavoured to avoid.

CHAP. III. *Of Partial Breezes of Wind.*

IT often happens at ſea, that when two ſhips are in ſight of each other, one of them will be ſailing at a conſiderable rate, being favoured with a breeze of wind; while the other at the ſame time is lying becalmed, having no other motion than what ſhe receives from the tide or a current, if any, or from the ſwell of the ſea. As this may be the caſe with reſpect to two adverſe fleets when in ſight of each other, that fleet which has the advantage of the wind will evidently uſe every poſſible method to proſecute the advantage that may reſult from it. Thus if the fleet deſirous of making the attack be favoured with a breeze of wind, while the other fleet at the ſame time is lying becalmed, it is evident that the commander of this fleet will endeavour to get as near the opponent fleet as poſſible; whereas, if the fleet wiſhing to avoid an engagement be favoured with the wind, the other lying becalmed, then that fleet will avail themſelves of this opportunity of making their eſcape.

167 The fleet purſued being favoured with a partial breeze after the attack upon his three ſternmoſt ſhips is commenced

If the attack upon the three ſternmoſt ſhips ſhall have commenced before this partial breeze in favour of the fleet purſued has taken place; then the variety of poſitions in which the two fleets may be affected is ſo great, and the reſulting conſequences ſo numerous, that it would be an endleſs taſk to give a ſeparate deſcription of each. In the mean time, therefore, as it is imagined nothing in ſuch inveſtigation will be found that can materially affect the general iſſue; and ſince no breeze whatever can favour the fleet F, ſo as to enable it to ſail round and round the fleet B, which all the while is ſuppoſed to be lying becalmed, it will not be too much to ſay, that *this partial breeze in favour of the fleet F, taking place after the attack began, although it may facilitate the eſcape of his van and centre, will not avail him much in the recovery of the three ſhips in his rear*—perhaps not in any caſe as yet exhibited, excepting this one, where the the wind in one inſtant had changed in direct oppoſition.

168 Of little advantage.

Now let, as formerly, the attack be commenced before the partial breeze in favour of the fleet purſued has taken place, but that the wind has inſtantaneouſly ſhifted in direct oppoſition; then, even in this caſe, the ſame breeze which would favour F (fig. 87.) in the attempt to bring off his three ſhips, would at the ſame time favour the eſcape of the ſhips of B at A, as formerly deſcribed. That this partial breeze would require to be of conſiderable duration, otherwiſe F, in thus attempting to bring off his three ſhips, crippled as they will be, muſt hazard a general engagement, in like manner as already deſcribed.

169 The wind ſhifting inſtantaneouſly in direct oppoſition.

170 Of ſome other methods of attack.

Mr Clerk employs a ſection of his book to ſhow the propriety of his propoſed attack from windward, in places where the hoſtile fleets are liable to encounter winds blowing in contrary directions at the ſame inſtant; but as this is a caſe which does not ſurely often happen, we ſhall refer our readers to the work itſelf, and conclude this article with ſome other methods of attack, which have ſuggeſted as improvements of that which is commonly followed.

1ſt, It has been propoſed that the attack ſhould be made with the greater part bearing down before the wind upon the ſix ſternmoſt ſhips of the enemy. It is, however, evident, that ſhips by making the attack in this manner muſt be expoſed, without a poſſibility of return, to as many broadſides from each of theſe ſix ſhips as can be got ready during a courſe of two miles. Hence, as the ſhips making the attack will aſſuredly be diſabled before they can have it in their power to hurt the enemy, this mode of attack cannot be proper.

2d, It has alſo been imagined, that ſome part of the force choſen to make the attack ſhould be ſent to leeward as well as to windward of the three ſhips determined to be attacked. But the danger ſuppoſed, of ſhot paſſing over the enemy's ſhips, and ſtriking thoſe of friends, may be an objection to this mode.

3d, Others have been of opinion, that the headmoſt ſhip choſen to make the attack ſhould come cloſe up alongſide of the ſternmoſt of the enemy, and having delivered her fire, puſh along the line as far as poſſible, which may be ſuppoſed to be the ſixth ſhip of the enemy; and as it is evident that this firſt ſhip may have received ſix broadſides, that is, a broadſide from every one of the ſix ſhips of the enemy during her courſe in paſſing them, it has been thought poſſible that the other five ſhips, by following cloſe after her, may attain their ſtations, each abreaſt of her oppoſite, without having received a greater number of broadſides than they have had it in their power to return; and therefore that by this mode the number of ſhips to be attacked will be determined: For as many ſhips as the leading ſhip will be able to reach, as many will the attacking fleet be able to carry.

4th, Again, let it be ſuppoſed, as in the former caſe, that the fleet making the attack has been brought up to action in a collected manner, but ſubdivided only ſo far as the ſervice may require, and that the leeward diviſion ſhall be more particularly deſtined for the immediate attack, while, at the ſame time, the body of the fleet keeping to windward ſhall be ſuppoſed attentive to give the neceſſary ſupport where required; then let it be ſuppoſed, that the headmoſt ſhip making the attack having been ſoon crippled, ſhall not have been able to puſh farther than the third or fourth ſhip of the enemy's line—is it not eaſy to conceive, it is aſked, that ſome one or more of the ſhips to windward, attentive to ſupport and ſupply her place, may bear down on the fourth ſhip of the enemy, under cover of the ſmoke, throw in her fire, and puſh on to the fifth or ſixth ſhip, or perhaps farther; and that ſo far as this freſh ſhip, or a ſecond freſh ſhip, may be able to puſh, ſo many ſhips of the enemy may be expected to be carried? For whatever ſhips of the enemy

NAVAL-TACTICS. Plate CCCCXCIII.

Fig. 1.

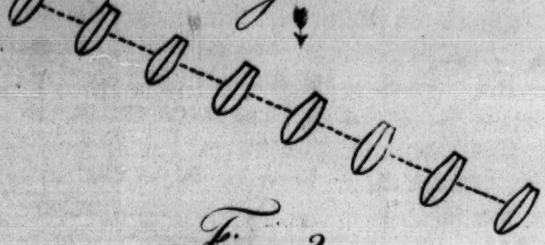


Fig. 2.

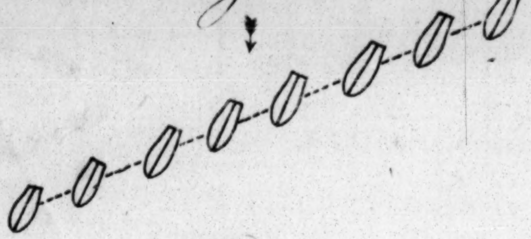
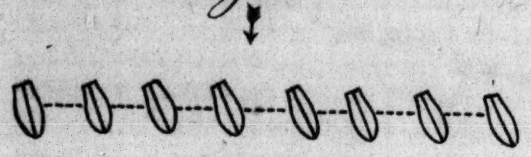


Fig. 3.



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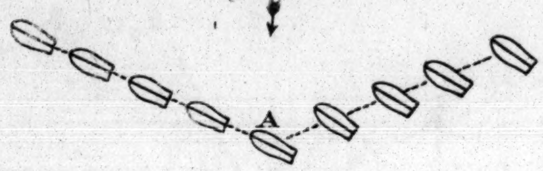

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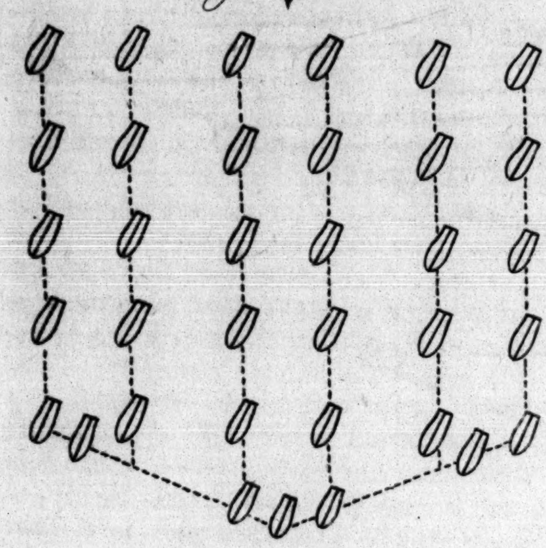


Fig. 6.

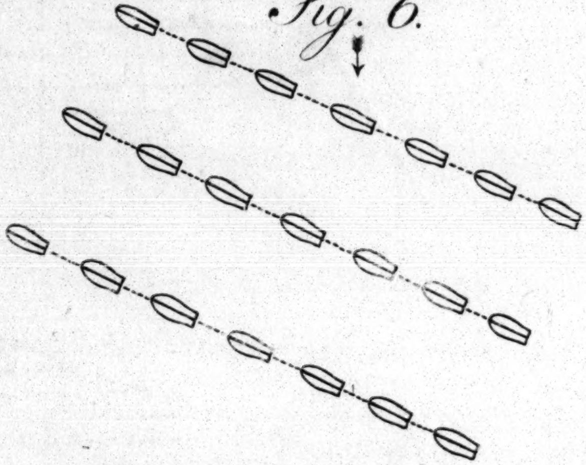


Fig. 7. Fig. 8. Fig. 10.

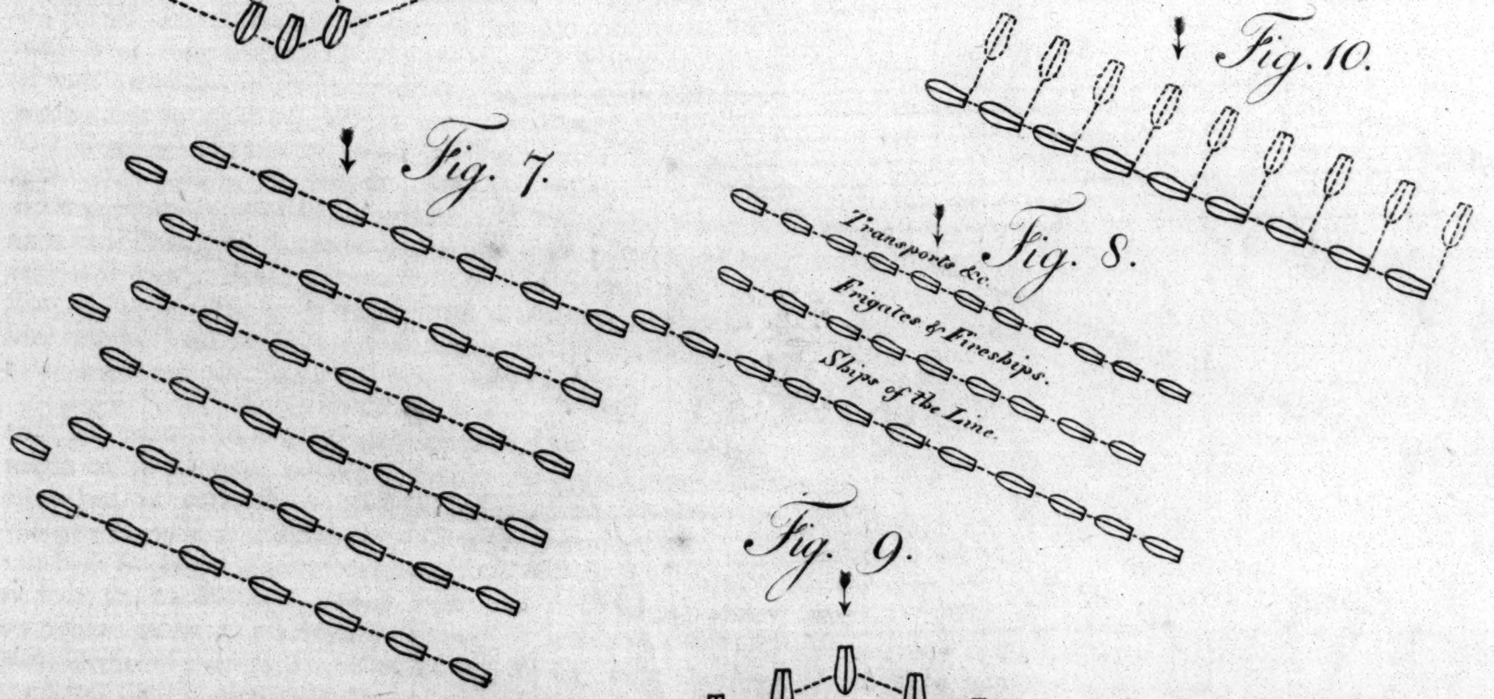
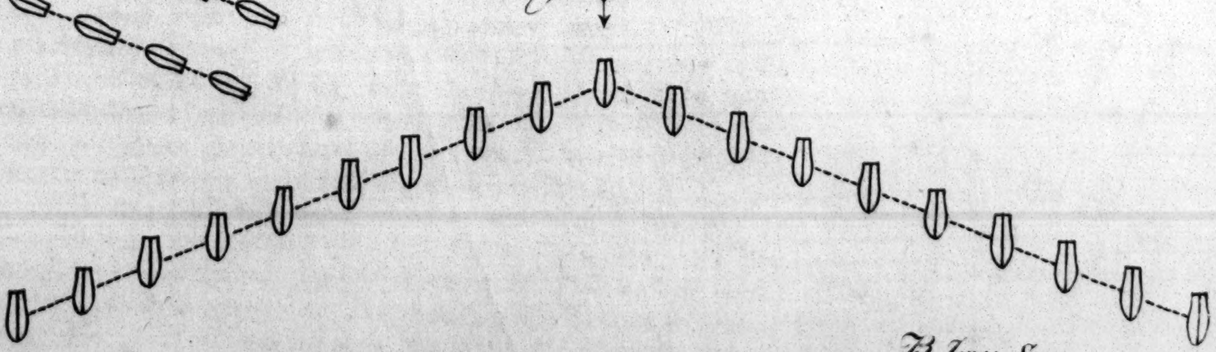

Transports &c.
Frigates & Fireships.
Ships of the Line.

Fig. 9.



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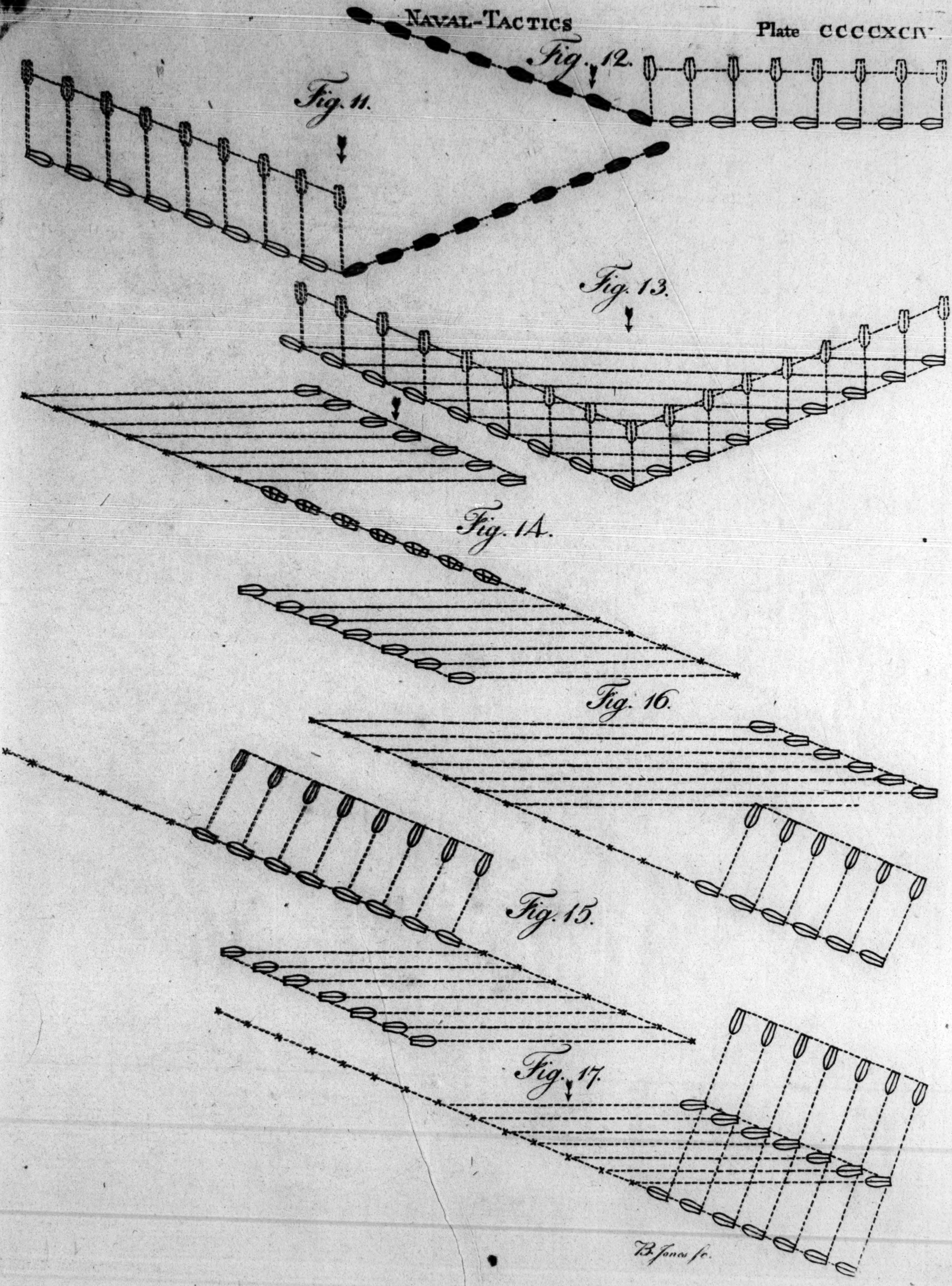
Fig. 11.
Fig. 12.
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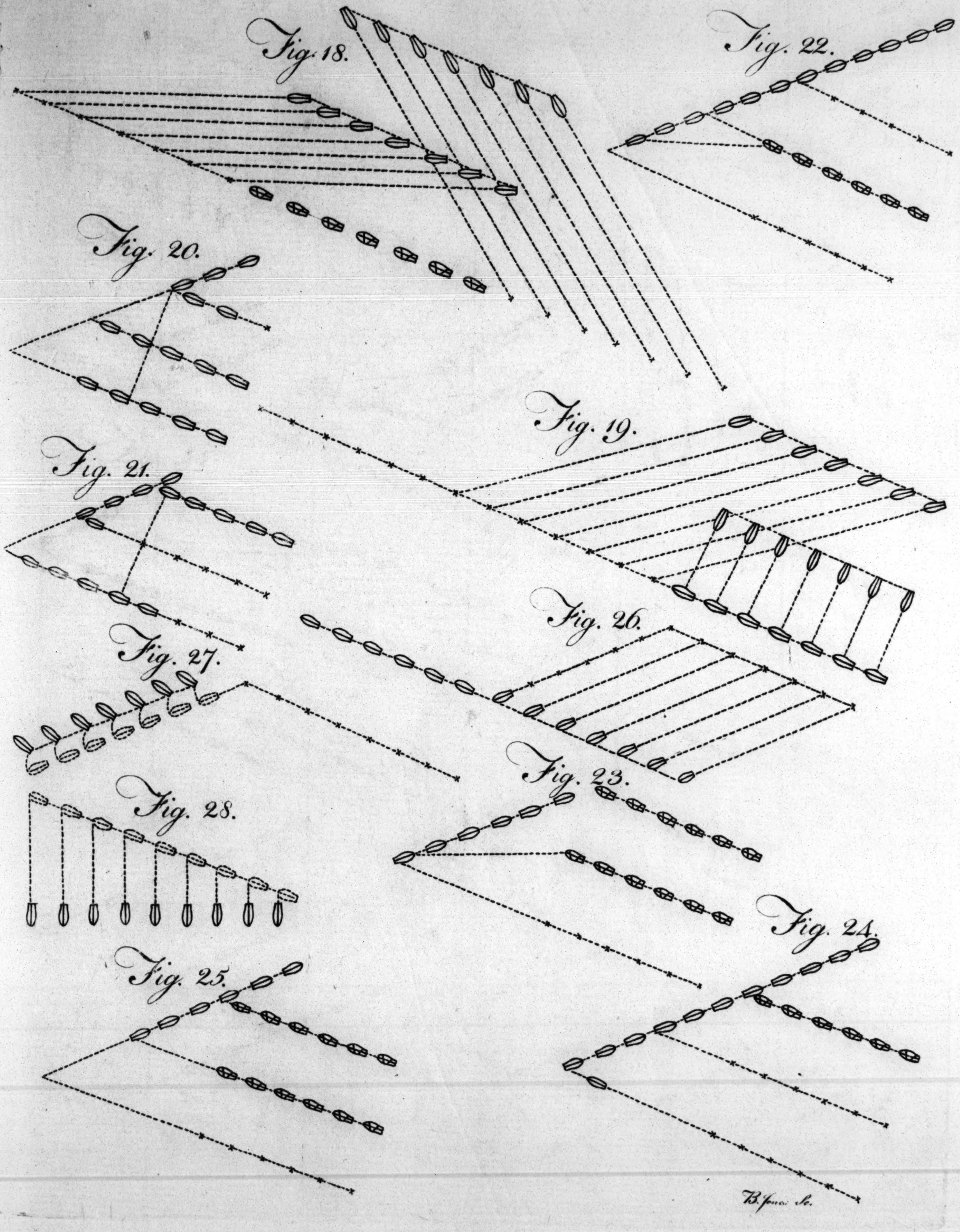
Fig. 18.
Fig. 22.
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Fig. 29.

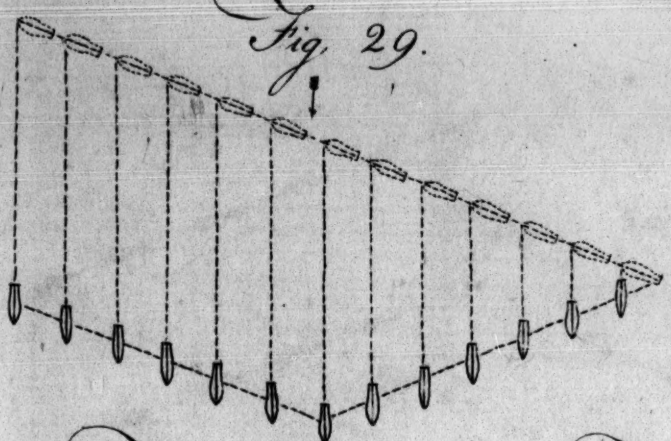
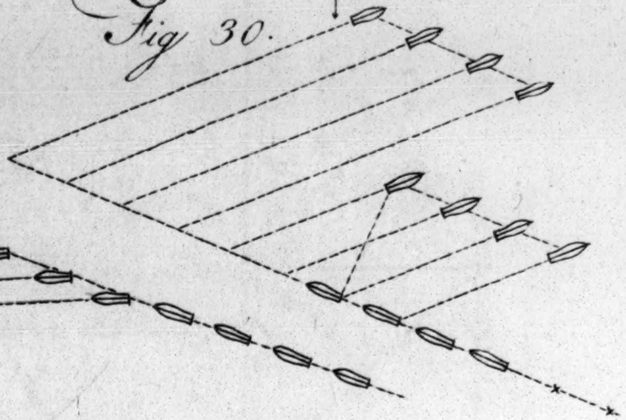


Fig. 30.



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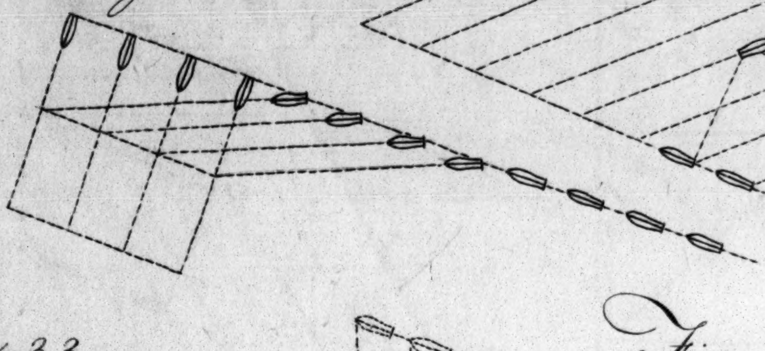

Fig. 32.

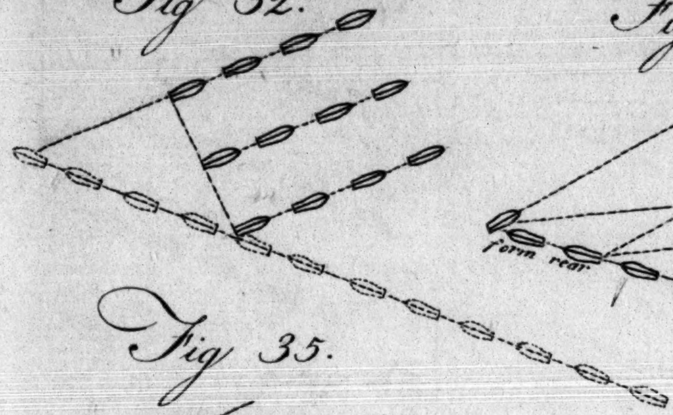

Fig. 33.

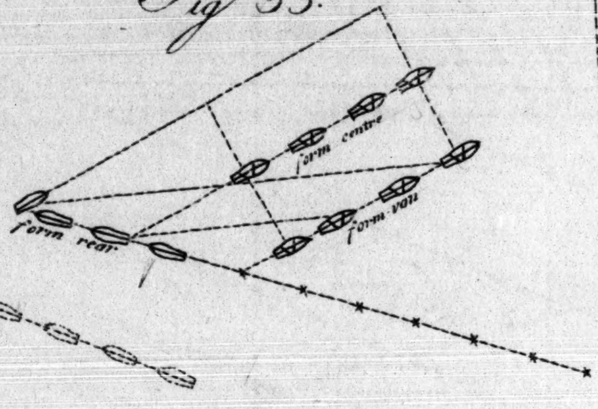
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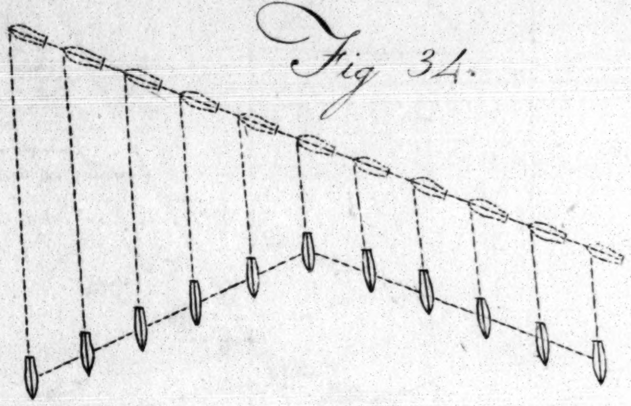
Fig. 34.



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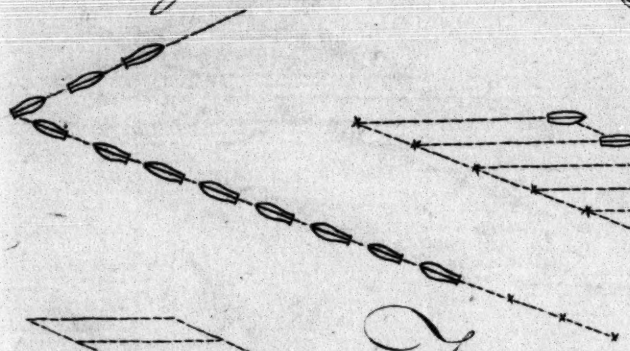


Fig. 36.

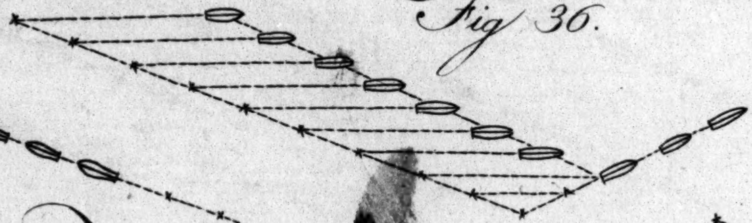


Fig. 37.

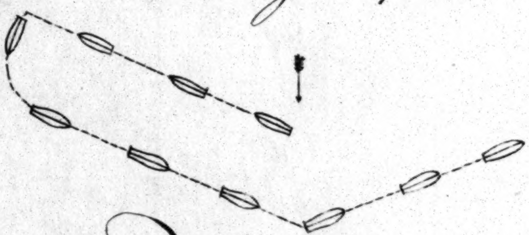


Fig. 38.

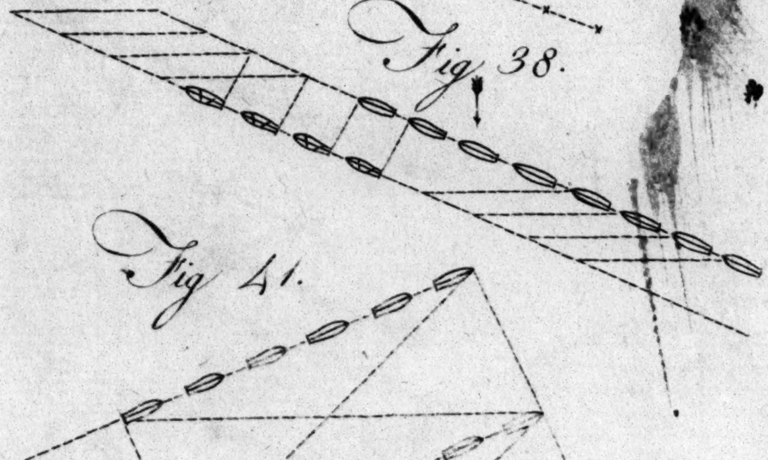


Fig. 39.

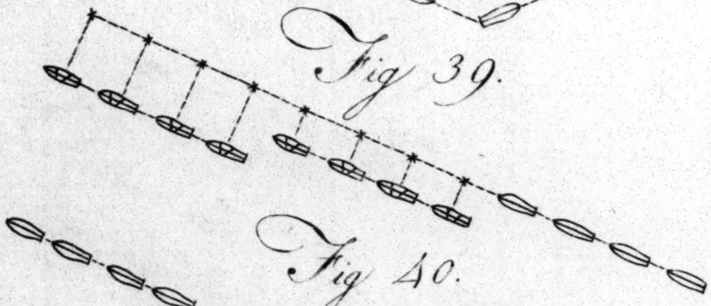


Fig. 40.

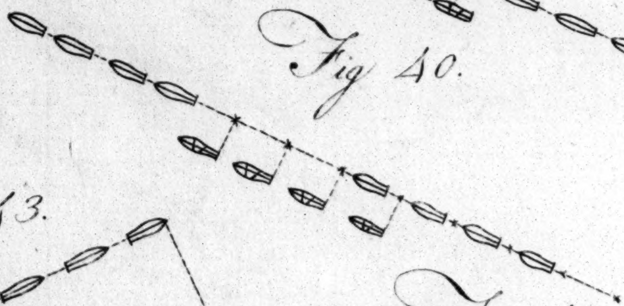


Fig. 41.

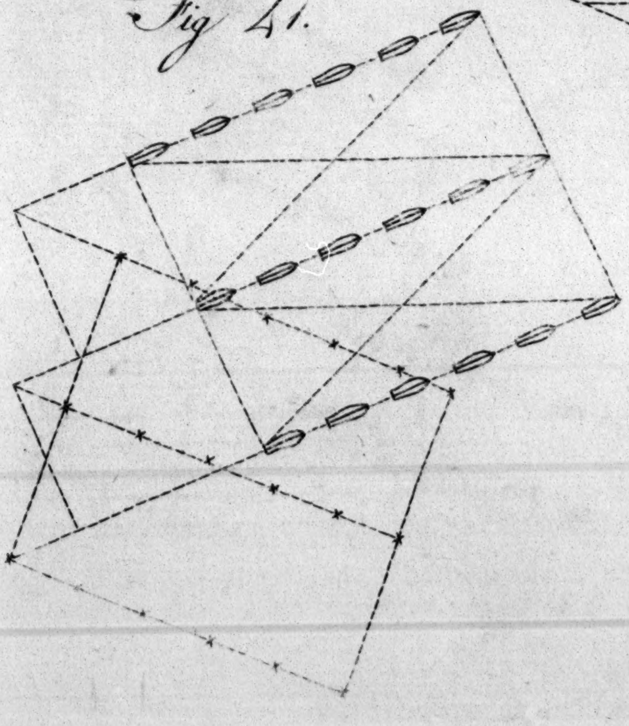
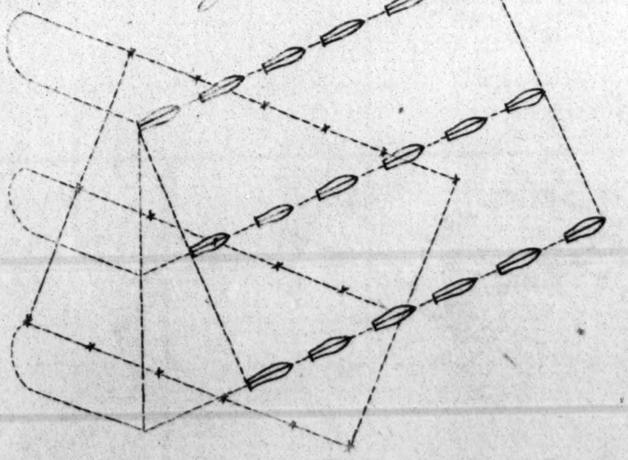


Fig. 43.



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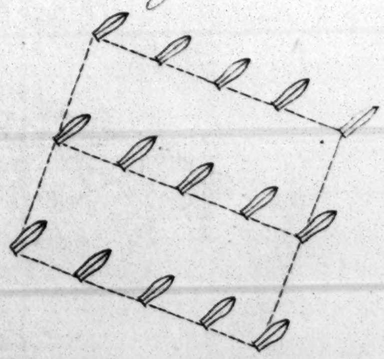

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Fig 44.

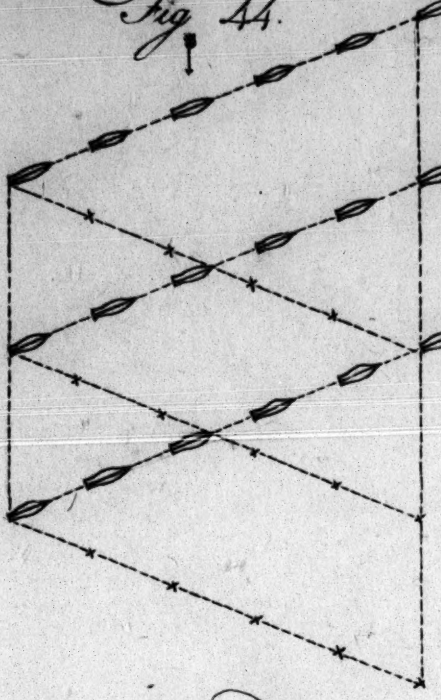


Fig 45.

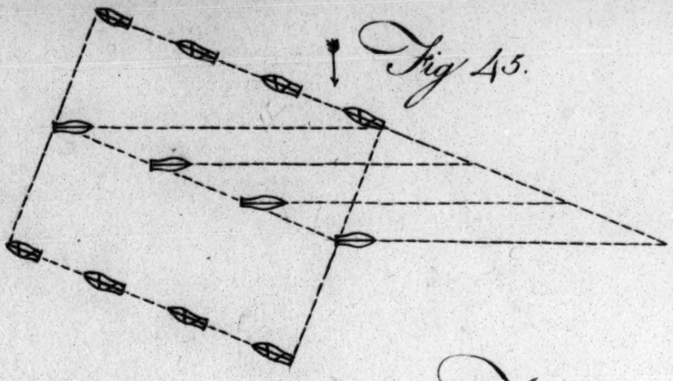


Fig 49.

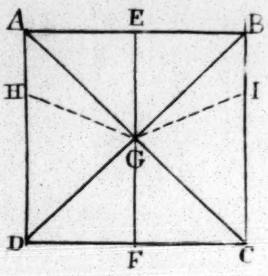


Fig 47.

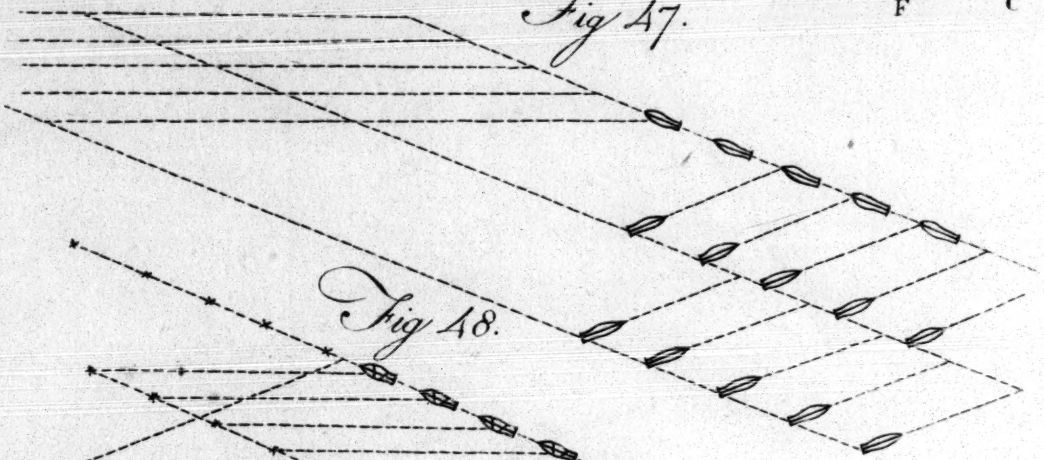


Fig 48.

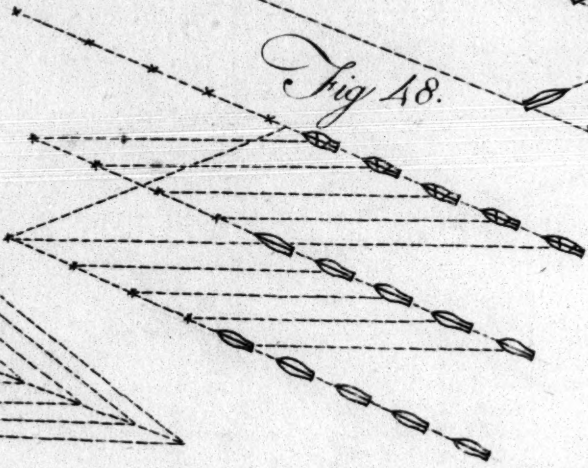


Fig 46.

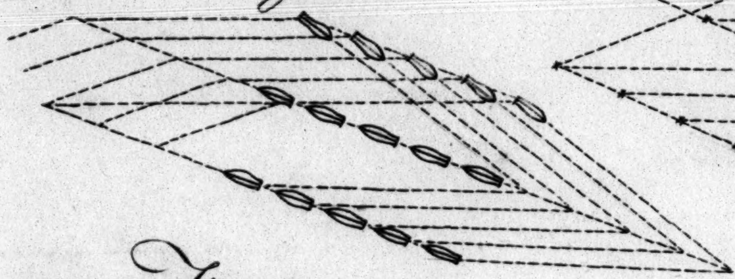


Fig 50.

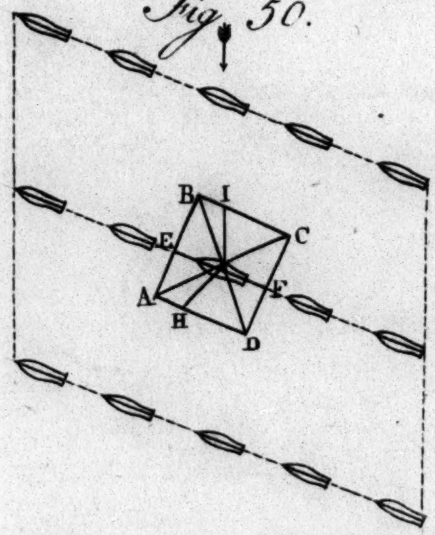


Fig 51.

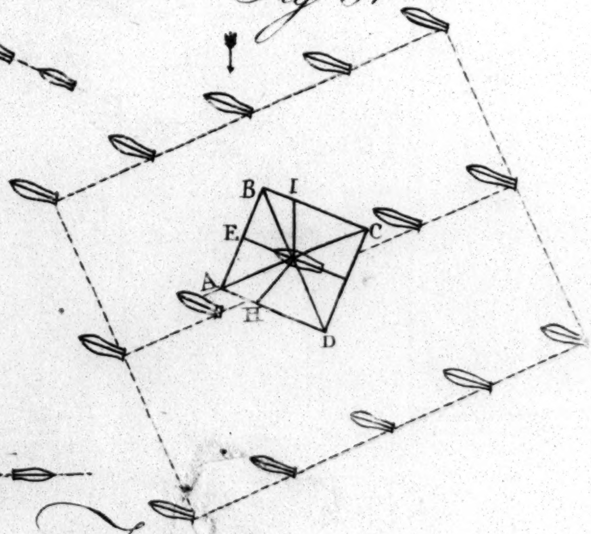


Fig 53.

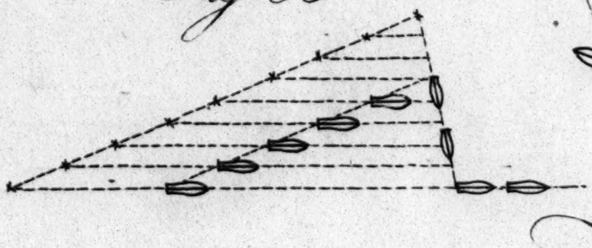


Fig 55.

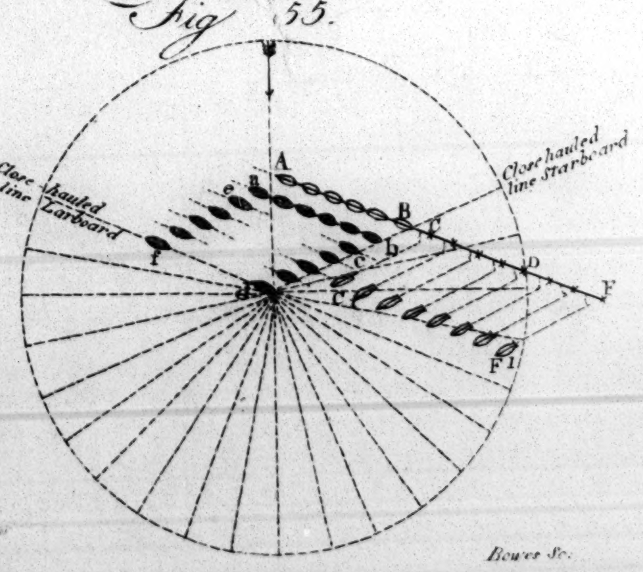

Close hauled line Larboard
Close hauled line Starboard
A
a
e
B
b
C
c
D
d
F
f
I
H
F 1

Fig 52.

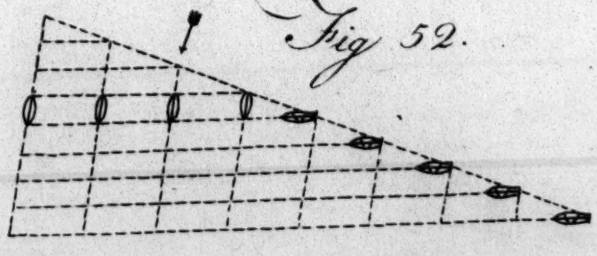
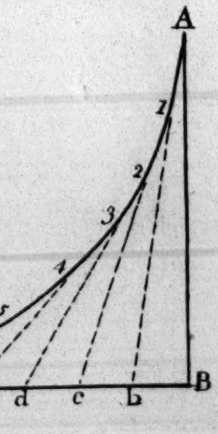


Fig 54.


A
1
2
3
4
5
C
f
e
d
c
b
B

Bower Sc.

BRITISH MUSEUM

Naval TACTICS.

Plate CCCCXCVIII.

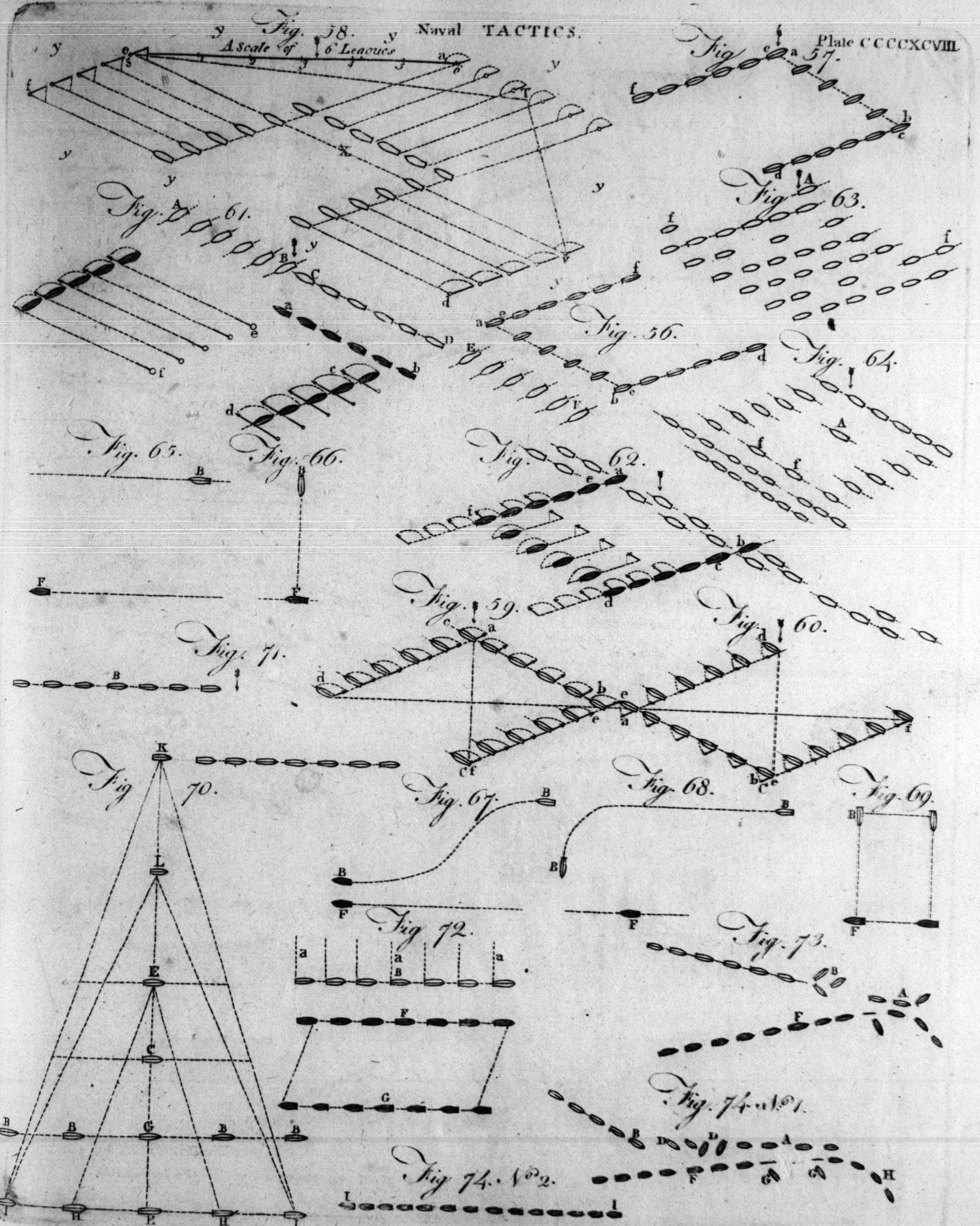


Fig. 58.
A Scale of 6 Leagues
1
2
3
4
5
6
a
e
f
g
y
x
Fig. 57.
a
b
c
d
f
Fig. 63.
A
f
Fig. 61.
A
B
y
c
d
e
f
a
b
n
Fig. 56.
a
e
f
E
b
d
Fig. 64.
A
f
Fig. 65.
B
F
Fig. 66.
B
F
Fig. 62.
a
b
c
d
e
f
Fig. 59.
a
b
c
d
e
f
Fig. 60.
a
b
c
d
e
f
Fig. 71.
B
Fig. 70.
K
L
E
C
G
B
I
H
F
Fig. 67.
B
F
Fig. 68.
B
F
Fig. 69.
B
F
Fig. 72.
a
B
F
G
Fig. 73.
B
A
F
Fig. 74. No. 1.
B
D
A
F
G
H
Fig. 74. No. 2.
I

[illegible] Sc.

BRITISH MUSEUM

Naval TACTICS. Plate CCCCXCIX.

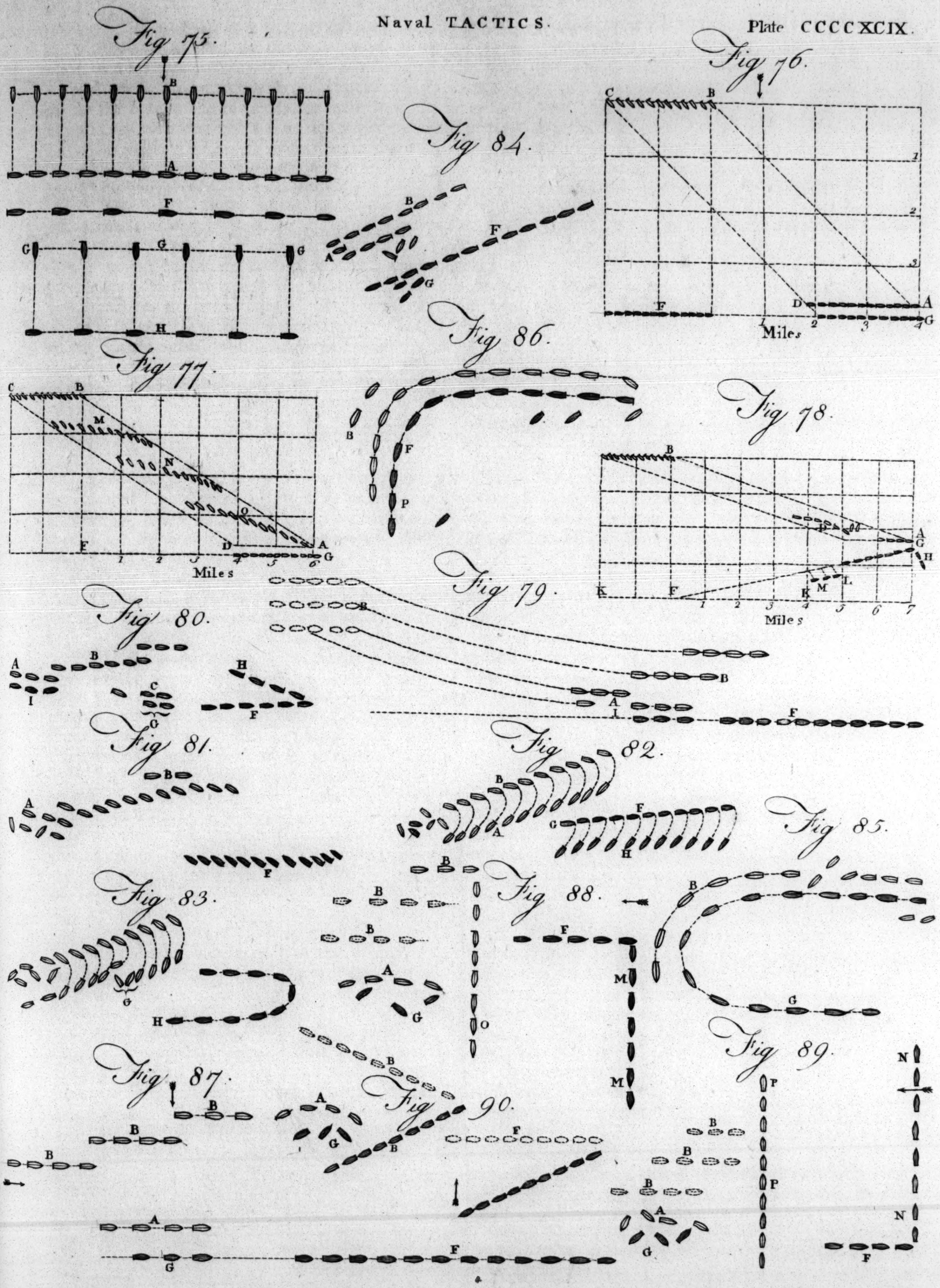


Fig 75.
B
A
F
G
G
G
H
Fig 84.
B
F
A
G
Fig 76.
C
B
1
2
3
D
A
F
G
1
2
3
4
Miles
Fig 86.
B
F
P
Fig 77.
C
B
M
N
O
D
A
F
G
1
2
3
4
5
6
Miles
Fig 78.
B
D
A
G
H
K
F
M
L
1
2
3
4
5
6
7
Miles
Fig 79.
B
B
A
L
F
Fig 80.
A
B
I
C
G
H
F
Fig 81.
B
A
F
Fig 82.
B
A
G
F
H
Fig 85.
B
G
Fig 83.
G
H
Fig 88.
B
B
B
F
A
G
M
O
M
Fig 89.
P
P
N
N
B
B
B
A
G
F
Fig 87.
B
B
B
A
G
F
Fig 90.
A
G
B
F

Bower Sc.

BRITISH MUSEUM

Partial Breezes of Wind.

can be got abreaſt of, at a proper diſtance, *may be diſabled, and therefore commanded*, by the numerous freſh ſhips kept to windward for this purpoſe.

In all theſe various methods of attack, the fleet making the attack is ſuppoſed to ſail faſter than the other, or at leaſt to come up with it; and that ſo ſoon as the ſhips are engaged, their velocity will conſequently be diminiſhed. That being premiſed, a more proper mode of attack than any of the preceding will perhaps be as follows:

5th, The firſt or headmoſt of the ſhips intended to make the attack is to range alongſide of the enemy, and preſerve that ſtation. The ſecond ſhip is to make all poſſible ſail to luff up and paſs the firſt ſhip, which is now ſuppoſed to be engaged, and get alongſide of the laſt but one of the enemy, which ſhe is to engage. In like manner, the third of the attacking ſhips is to get alongſide of the laſt but two of the enemy, whom ſhe is to engage; and if it be deemed expedient, the fourth, &c. ſhip may be engaged. It is, however, evident that this method can only be practiſed when the wind is briſk, and that a calm, in conſequence of a vigorous cannonade, may render the attack upon more than three or four of the enemy's ſhips impoſſible.

In all the different attacks upon the rear, it has by ſome been thought a great object, if practicable, to throw a raking fire into the rear of an enemy's line of battle, by ſhips detached for that purpoſe. For if ſhot, as has been ſaid, can take effect at a diſtance of two miles, from this poſition it will ſurely reach the ſixth ſhip, if the enemy's line ſhall be formed at two cable's length aſunder; and if formed at one cable's length aſunder, it may reach and may cripple the twelfth ſhip.

We have now given a curſory view of Naval Tactics in its preſent improved ſtate; and ſhall take leave of the ſubject, with earneſtly recommending to our nautical readers Mr Clerk's Eſſay, which, if allowance be made for the author's peculiarity of ſtyle, will ſurely meet the approbation of every officer who wiſhes to ſee the practice of naval war founded on principles of ſcience.

TADCASTER, a town in the Weſt Riding of Yorkſhire, noted for the great plenty of limeſtone dug up near it; and for being one of the firſt places in which a building was erected for Sunday ſchools. It is nine miles from York, and 188 from London.

TADMOR. See PALMYRA.

TADPOLE, a young frog before it has diſengaged itſelf from the membranes that envelope it in its firſt ſtage of life.

TÆNIA, in zoology; a genus of animals belonging to the claſs of *vermes*, and order of *inteſtina*. The body is long, depreſſed, and jointed like a chain, and contains a mouth and viſcera in each joint. According to Gmelin, there are 92 ſpecies; all which inhabit the inteſtines of various animals, particularly of quadrupeds.

Seven ſpecies of tænia are peculiar to man. 1. The *viſceralis*, which is incloſed in a veſicle, broad in the fore-part, and pointed in the hinder part, inhabits the liver, the placenta uterina, and the ſack which contains the ſuperfluous fluid of dropſical perſons. 2. The *celluloſæ*, which is incloſed in a cartilaginous veſicle, inhabits the cellular ſubſtance of the muſcles; is about an inch long, half an inch broad, and one-fourth of an inch thick, and is very tenacious of life. 3. The *dentata*, has a pointed head; the large joints are ſtreaked tranſverſely, and the ſmall joints are all dilated; the oſculum or opening in the middle of both margins is ſomewhat raiſed. It is narrow, 10 or 12 feet long, and broad in the fore-parts; its ovaria are not viſible to the naked eye; and the head underneath reſembles a heart in ſhape. It inhabits the inteſtines. 4. The *lata*, is white, with joints very ſhort and knotty in the middle; the oſculum is ſolitary. It is from 18 to 120 feet long; its joints are ſtreaked tranſverſely; its ovaria are diſpoſed like the petals of a roſe. 5. The *vulgaris*, or common tape-worm, has two lateral mouths in each joint; it attaches itſelf ſo firmly to the inteſtines, that it can ſcarcely be removed by the moſt violent medicines; it is ſlender, and has the appearance of being membranaceous; it is ſomewhat pellucid, from 10 to 16 feet long, and about four and an half lines broad at one end. 6. The *truttæ*, which chiefly inhabits the liver of the trout, but is alſo to be found in the inteſtines of the human ſpecies. 7. The *ſolium*, has a marginal mouth, one on each joint.

The ſtructure and phyſiology of the tænia is curious, and it may be amuſing as well as inſtructive to conſider it with more attention. As the tænia is often the occaſion of diſeaſe, we may be apt to conſider it not only as uſeleſs, but even as naturally hurtful; but it is impoſſible to ſuppoſe that the Benevolent Father of mankind created a ſpecies of animals ſolely for the purpoſe of producing diſeaſe. The creation of the tænia is rather a ſtriking inſtance of that rule which the Deity ſeems to have laid down to himſelf, to leave no place deſtitute of living creatures where they could multiply their ſpecies. He has therefore not only covered the earth with animals, but the ſurface of animals with other animals; and has even peopled ſuch of their internal parts as could ſupply nouriſhment without diſadvantage. Perhaps therefore a certain proportion of theſe animals is conducive to health, juſt as a certain proportion of different fluids is ſo, tho' an exceſſive increaſe always produces diſeaſe. For there is in almoſt every different ſpecies of quadrupeds a different ſpecies of tænia, which is a full proof that theſe worms have their ſtructure and ſituation determined with as much attention and ſkill as any ſpecies of animals whatever. It is alſo a very curious fact, that thoſe ſpecies of tænia which are peculiar to the human race are alſo peculiar to particular countries. Thus the vulgaris is moſt common in Sweden, the lata in Switzerland and Ruſſia, and the ſolium in Great Britain, Saxony, and Holland.

The tænia appears deſtined to feed upon ſuch juices of animals as are already animalized, and is therefore moſt commonly found in the alimentary canal, and in the upper part, where there is the greateſt abundance of chyle; for chyle ſeems to be the natural food of the tænia. As it is thus ſupported by food which is already digeſted, it is deſtitute of the complicated organs of digeſtion. The tænia ſolium which is moſt frequent in this country, it may be proper to deſcribe more particularly:

It is from 3 to 30 feet long, ſome ſay 60 feet. It is compoſed of a head, in which is a mouth adapted to drink up fluids, and an apparatus for giving the head a fixed ſituation. The body is compoſed of a great number of diſtinct pieces articulated together, each joint having an organ whereby it attaches itſelf to the neighbouring part of the inner coat of the inteſtine. The joints neareſt the head are always ſmall, and they become gradually enlarged as they are farther removed from it; but towards the tail a few of the laſt joints again become diminiſhed in ſize. The extremity of the body is terminated by a ſmall ſemicircular joint, which has no opening in it.

The head of this animal is compoſed of the ſame kind of materials as the other parts of its body; it has a rounded opening at its extremity, which is conſidered to be its mouth. See Plate DI. fig. 1, 2. This opening is continued by a ſhort duct into two canals; theſe canals paſs round every joint of the animal's body, and convey the aliment (fig. 3.). Surrounding the opening of the mouth are placed a number of projecting radii, which are of a fibrous texture, whoſe direction is longitudinal. Theſe radii appear to ſerve the purpoſe of tentacula for fixing the orifice of the mouth, as well as that of muſcles to expand the cavity of the mouth, from their being inſerted along the brim of that opening: (See fig. 1.) After the rounded extremity or head has been narrowed into the neck, as is repreſented in fig. 2. the lower part becomes flatted, and has two ſmall tubercles placed upon each flatted ſide; the tubercles are concave in the middle, and appear deſtined to ſerve the purpoſe of ſuckers for attaching the head more effectually. The internal ſtructure of the joints compoſing the body of this animal is partly vaſcular and partly cellular; the ſubſtance itſelf is white, and ſomewhat reſembles in its texture the coagulated lymph of the human blood. The alimentary canal paſſes along each ſide of the animal, ſending a croſs canal over the bottom of each joint, which connects the two lateral canals together. See fig. 3.

Mr Carliſle, who gives the beſt account of the ſtructure and economy of the tænia which we have ſeen, injected with a coloured ſize by a ſingle puſh, with a ſmall ſyringe thee feet in length of theſe canals, in the direction from the mouth downwards. He tried the injection the contrary way, but it ſeemed to be ſtopped by valves. The alimentary canal is impervious at the extreme joint, where it terminates without any opening analogous to an anus. Each joint has a vaſcular joint occupying the middle part, which is compoſed of a longitudinal canal, from which a great number of lateral canals branch off at right angles. Theſe canals contain a fluid like milk.

The tænia ſeems to be one of the ſimpleſt vaſcular animals in nature. The way in which it is nouriſhed is ſingular; the food being taken in by the mouth, paſſes into the alimentary canal, and is thus made to viſit in a general way the different parts of the animal. As it has no excretory ducts, it would appear that the whole of its alimentary fluid is fit for nouriſhment; the decayed parts probably diſſolve into a fluid which tranſudes through the ſkin, which is extremely porous.

This animal has nothing reſembling a brain or nerves, and ſeems to have no organs of ſenſe but that of touch. It is moſt probably propagated by ova, which may eaſily paſs along the circulating veſſels of other animals. We cannot otherwiſe explain the phenomena of worms being found in the eggs of fowls, and in the inteſtines of a fœtus before birth, except by ſuppoſing their ova to have paſſed through the circulating veſſels of the mother, and by this means been conveyed to the fœtus.

The chance of an ovum being placed in a ſituation where it will be hatched, and the young find convenient ſubſiſtence, muſt be very ſmall; hence the neceſſity for their being very prolific. If they had the ſame powers of being prolific which they now have, and their ova were afterwards very readily hatched, then the multiplication of theſe animals would be immenſe, and become a nuiſance to the other parts of the creation.

Another mode of increaſe allowed to tænia (if we may call it increaſe) is by an addition to the number of their joints. If we conſider the individual joints as diſtinct beings, it is ſo; and when we reflect upon the power of generation given to each joint, it makes this conjecture the more probable. We can hardly ſuppoſe that an ovum of a tænia, which at its full growth is 30 feet long, and compoſed of 400 joints, contained a young tænia compoſed of this number of pieces; but we have ſeen young tænia not half a foot long, and not poſſeſſed of 50 joints, which ſtill were entire worms. We have alſo many reaſons to believe, that when a part of this animal is broken off from the reſt, it is capable of forming a head for itſelf, and becomes an independent being. The ſimple conſtruction of the head makes its regeneration a much more eaſy operation than that of the tails and feet of lizards, which are compoſed of bones and complicated veſſels; but this laſt operation has been proved by the experiments of Spallanzani and many other naturaliſts.

When inteſtinal worms produce a diſeaſed ſtate of the animal's body which they inhabit, various remedies are adviſed for removing them; many of which are ineffectual, and others very injurious by the violence of their operation. Draſtic purges ſeem to operate upon tænia, partly by irritating the external ſurface of their bodies, ſo as to make them quit their holds, and partly by the violent contractions produced in the inteſtine, which may ſometimes divide the bodies of tænia, and even kill them by bruiſing. Mr Carliſle propoſes the trial of a ſimple remedy, which (*à priori*) promiſes to be ſucceſsful; namely, ſmall ſhocks of electricity paſſed frequently through the regions of the abdomen; the lives of the lower orders of animals ſeeming to be eaſily deſtroyed by ſuch ſhocks of electricity as do not injure the larger and more perfect animals.

Plate DI. fig. 1. ſhows the head of the tænia magnified; the mouth is in the middle of the circular plane, where the body becomes flatted and broad; there are two hollow tubercles repreſented by the two dark-ſhaded ſpots. Fig. 2. is the ſame head, of its natural bigneſs, and which belonged to a tænia 20 feet in length. Fig. 3. ſhows the alimentary canals, in a portion of the ſame tænia, of their natural bigneſs. The dark-ſhaded undulating lines are the alimentary canals, which are ſeen to their full extent in this portion of the worm. Fig. 4. ſhows the middle ſyſtem of veſſels, in two joints, which are repreſented by the dark-lines. Fig. 5. ſhows two joints, from one ſide of which a ſlip was torn down to ſhow the veſſels underneath, and alſo the direction of the fibres in the ſlip, which are accumulated into little faſciculi like muſcular fibres. Fig. 6. exhibits three joints, having the ducts leading from the lateral oſcula injected; the dark tranſverſe lines leading from each oſculum ſhow the ſize, direction, and extent of theſe ducts. Fig. 7. ſhows the edge of two joints turned forwards, and the appearance of the oſcula in this point of view. Fig. 8. repreſents the whole of theſe canals in their relative ſituations.

For a more complete account of the tænia, we muſt refer to Mr Carliſle's ingenious paper in the Linnæan Tranſactions.

TAFFETY or TAFFETA, in commerce, a fine ſmooth ſilken ſtuff, remarkably gloſſy. There are taffeties of all colours, ſome plain, and others ſtriped with gold, ſilver, &c. others chequered, others flowered, &c. according to the fancy of the workmen.

TAGARA, a city of ancient India, the metropolis of a large diſtrict called *Ariaca*, which comprehended the greateſt part of the Subah of Aurangabad, and the ſouthern part of Concan. Arrian ſays, that it was ſituated about ten days journey to the eaſtward of Pultanah; which, according to the rate of travelling in that country with loaded carts, might be about 100 Britiſh miles. This fixes its ſituation at Deoghir, a place of great antiquity, and famous through all India on account of the pagodas of Elouſa. It is now called *Doulet-abad*.

TAGETES, MARYGOLD, in botany: A genus of plants belonging to the claſs of *ſyngeneſia*, and order of *polygamia ſuperflua*; and in the natural ſyſtem ranging under the 49th order, *Compoſitæ*. The receptacle is naked; the pappus conſiſts of five erect awns or beards; the calyx is monophyllous, quinquedentate, and tubular; and there are four perſiſtent florets of the ray. There are three ſpecies, the *patula*, *erecta*, and *minuta*; of which the two firſt have been cultivated in the Britiſh gardens, at leaſt ſince the year 1596, for it is mentioned in Gerard's Herbal, which was publiſhed that year. They are both natives of Mexico.

The *erecta*, or African marygold, has a ſtem ſubdivided and ſpreading, and has formed itſelf into a great many varieties: 1. Pale yellow, or brimſtone colour, with ſingle, double, and fiſtulous flowers. 2. Deep yellow, with ſingle, double, and fiſtulous flowers. 3. Orange-coloured, with ſingle, double, and fiſtulous flowers. 4. Middling African, with orange-coloured flowers. 5. Sweet-ſcented African. Theſe are all very ſubject to vary; ſo that unleſs the ſeeds are very carefully ſaved from the fineſt flowers, they are apt to degenerate: nor ſhould the ſame ſeeds be too long ſown in the ſame garden, for the ſame reaſon; therefore, thoſe who are deſirous to have theſe flowers in perfection ſhould exchange their ſeeds with ſome perſon of integrity at a diſtance, where the ſoil is of a different nature, at leaſt every other year. If this is done, the varieties may be continued in perfection. This plant is ſo well known as to need no deſcription. It flowers from the beginning of July till the froſt puts a ſtop to it.

The *patula* has a ſimple erect ſtem, and the peduncles are ſcaly and multiflorous.

It has been long in the Britiſh gardens, where it is diſtinguiſhed from the firſt by the title of *French marygold*. Of this there are ſeveral varieties, ſome of which have much larger flowers than others, and their colour varies greatly: there are ſome which are beautifully variegated, and others quite plain; but as theſe are accidents ariſing from culture, ſo they do not merit farther diſtinction; for we have always found that ſeeds ſaved from the moſt beautiful flowers will degenerate, eſpecially if they are ſown in the ſame garden for two or three years together, without changing the ſeed.

Theſe plants have a ſtrong diſagreeable ſcent, eſpecially when handled; for which reaſon they are not ſo greatly eſteemed for planting near habitations: but the flowers of the ſweet-ſcented ſort being more agreeable, are generally preferred, eſpecially for planting in ſmall gardens.

TAGUS, the largeſt river of Spain; which, taking its riſe on the confines of Arragon, runs ſouth-weſt through the provinces of New Caſtile and Eſtremadura; and paſſing by the cities of Aranjuez, Toledo, and Alcantara, and then croſſing Portugal, forms the harbour of Liſbon, at which city it is about three miles over; and about eight or ten miles below this it falls into the Atlantic ocean.

TAHOEREWA, one of the Sandwich iſlands. It is ſmall, deſtitute of wood, and its ſoil ſandy and unfertile. It is ſituated in north latitude 20° 38′, in eaſt longitude 203° 27′. See *Cook's Diſcoveries*, vol. v. nº 88. and *Sandwich-Iſlands*.

TAHOORA, one of the Sandwich iſlands in the South Sea. It is uninhabited, and lies in north latitude 21° 43′, and in eaſt longitude 199° 36′. See *Sandwich-Iſlands*.

TAJACU, or Peccary, in zoology, a ſpecies of hog. See Sus.

TAI-OUAN, the Chineſe name of the iſland of Formoſa. See Formosa.—Tai-ouan is alſo the name of the capital of the iſland.

TAIL, the train of a beaſt, bird, or fiſh; which in land animals ſerves to drive away flies, &c. and in birds and fiſhes to direct their courſe, and aſſiſt them in aſcending or deſcending in the air or water.

Tail, or fee-tail, in law, is a conditional eſtate or fee, oppoſed to *fee-ſimple*. See Fee.

A conditional fee, at the common law, was a fee reſtrained to ſome particular heirs excluſive of others: as to the heirs of a man's body, by which only his lineal deſcendants were admitted, in excluſion of collateral heirs; or to the heirs male of his body, in excluſion both of collaterals and lineal females alſo. It was called a *conditional fee*, by reaſon of the condition expreſſed or implied in the donation of it, that if the donee died without ſuch particular heirs, the land ſhould revert to the donor. For this was a condition annexed by law to all grants whatſoever, that on failure of the heirs ſpecified in the grant, the grant ſhould be at an end, and the land return to its ancient proprietor. Such conditional fees were ſtrictly agreeable to the nature of feuds, when they firſt ceaſed to be mere eſtates of life, and were not yet arrived to be abſolute eſtates in fee-ſimple.

With regard to the condition annexed to theſe fees by the common law, it was held, that ſuch a gift (to a man and the heirs of his body) was a gift upon condition that it ſhould revert to the donor if the donee had no heirs of his body; but if he had, it ſhould then remain to the donee. They therefore called it a *fee-ſimple* on condition that he had iſſue. Now we muſt obſerve, that when any condition is performed, it is thenceforth entirely gone; and the thing to which it was before annexed becomes abſolute and wholly unconditional. So that as ſoon as the grantee had any iſſue born, his eſtate was ſuppoſed to become abſolute by the performance of the condition; at leaſt for theſe three purpoſes: 1. To enable the tenant to alienate the land, and thereby to bar not only his own iſſue, but alſo the donor, of his intereſt in the reverſion. 2. To ſubject him to forfeit it for treaſon: which he could not do till iſſue born longer than for his own life, leſt thereby the inheritance of the iſſue and reverſion of the donor might have been defeated. 3. To empower him to charge the land with rents, commons, and certain other encumbrances, ſo as to bind his iſſue. And this was thought the more reaſonable, becauſe, by the birth of iſſue, the poſſibility of the donor's reverſion was rendered more diſtant and precarious: and his intereſt ſeems to have been the only one which the law, as it then ſtood, was ſolicitous to protect, without much regard to the right of ſucceſſion intended to be veſted in the iſſue. However, if the tenant did not in fact alienate the land, the courſe of deſcent was not altered by this performance of the condition: for if the iſſue had afterwards died, and then the tenant or original grantee had died, without making any alienation, the land, by the terms of the donation, could deſcend to none but the heirs of his body; and therefore, in default of them, muſt have reverted to the donor. For which reaſon, in order to ſubject the lands to the ordinary courſe of deſcent, the donees of theſe conditional fee-ſimples took care to alienate as ſoon as they had performed the condition by having iſſue; and afterwards repurchaſed the lands, which gave them a fee-ſimple abſolute, that would deſcend to the heirs general, according to the courſe of the common law. And thus ſtood the old law with regard to conditional fees: which things, ſays Sir Edward Coke, though they ſeem ancient, are yet neceſſary to be known, as well for the declaring how the common law ſtood in ſuch caſes, as for the ſake of annuities, and ſuch-like inheritances, as are not within the ſtatutes of entail, and therefore remain as the common law. The inconveniences which attended theſe limited and fettered inheritances were probably what induced the judges to give way to this ſubtle fineſſe (for ſuch it undoubtedly was), in order to ſhorten the duration of theſe conditional eſtates. But, on the other hand, the nobility, who were willing to perpetuate their poſſeſſions in their own families, to put a ſtop to this practice, procured the ſtatute of Weſtminſter the ſecond (commonly called the ſtatute *de donis conditionalibus*) to be made; which paid a greater regard to the private will and intentions of the donor, than to the propriety of ſuch intentions, or any public conſiderations whatſoever. This ſtatute revived in ſome ſort the ancient feodal reſtraints which were originally laid on alienations, by enacting, that from thenceforth the will of the donor be obſerved; and that the tenements ſo given (to a man and the heirs of his body) ſhould at all events go to the iſſue, if there were any; or if none, ſhould revert to the donor.

Upon the conſtruction of this act of parliament, the judges determined that the donee had no longer a conditional fee ſimple, which became abſolute and at his own diſpoſal the inſtant any iſſue was born; but they divided the eſtate into two parts, leaving in the donee a new kind of particular eſtate, which they denominated a *fee-tail;* and veſting in the donor the ultimate fee-ſimple of the land, expectant on the failure of iſſue; which expectant eſtate is what we now call a *reverſion*. And hence it is that Littleton tells us, that tenant in fee-tail is by virtue of the ſtatute of Weſtminſter the ſecond. The expreſſion *fee-tail*, or *feodum talliatum*, was borrowed from the feudiſts (ſee Crag. *l. s. t.* 10. § 24, 25.), among whom it ſignified any mutilated or truncated inheritance, from which the heirs-general were cut off; being derived from the barbarous verb *taliare*, to cut; from which the French *tailler* and the Italian *tagliare* are formed, (Spelm. *Gloſſ.* 531.).

Having thus ſhown the original of eſtates-tail, we now proceed to conſider what things may or may not be entailed under the ſtatute *de donis*. Tenements is the only word uſed in the ſtatute: and this Sir Edward Coke expounds to comprehend all corporeal hereditaments whatſoever; and alſo all incorporeal hereditaments which ſavour of the realty, that is, which iſſue out of corporeal ones, or which concern or are annexed to or may be exerciſed within the ſame; as rents, eſtovers, commons, and the like. Alſo offices and dignities, which concern lands, or have relation to fixed and certain places, may be entailed. But mere perſonal chattels, which ſavour not at all of the reality, cannot be entailed. Neither can an office, which merely relates to ſuch perſonal chattels; nor an annuity, which charges only the perſon, and not the lands of the granter. But in theſe laſt, if granted to a man and the heirs of his body, the grantee hath ſtill a fee conditional at common law as before the ſtatute, and by his alienation may bar the heir or reverſioner. An eſtate to a man and his heirs for another's life cannot be entailed; for this is ſtrictly no eſtate of inheritance, and therefore not within the ſtatute *de donis*. Neither can a copyhold eſtate be entailed by virtue of the ſtatute; for that would tend to encroach upon and reſtrain the will of the lord: but, by the ſpecial cuſtom of the manor, a copyhold may be limited to the heirs of the body; for here the cuſtom aſcertains and interprets the lord's will.

As to the ſeveral ſpecies of eſtates-tail, and how they are reſpectively created; they are either general or ſpecial. Tail-general is where lands and tenaments are given to one, and the heirs of his body begotten: which is called *tail-general;* becauſe, how often ſoever ſuch donee in tail be married, his iſſue in general, by all and every ſuch marriage, is, in ſucceſſive order, capable of inheriting the eſtate-tail *per formam doni*. Tenant in *tail-ſpecial* is where the gift is reſtrained to certain heirs of the donee's body, and does not go to all of them in general. And this may happen ſeveral ways. We ſhall inſtance in only one; as where lands and tenements are given to a man and the heirs of his body, on Mary his now wife to be begotten. Here no iſſue can inherit but ſuch ſpecial iſſue as is engendered between them two; not ſuch as the huſband may have by another wife; and therefore it is called *ſpecial tail*. And here we may obſerve, that the words of inheritance (to him and his heirs) give him an eſtate in fee; but they being heirs to be by him begotten, this makes it a fee-tail; and the perſon being alſo limited, on whom ſuch heirs ſhall be begotten (viz. Mary his preſent wife), this makes it a fee-tail ſpecial.

Eſtates in general and ſpecial tail are farther diverſified by the diſtinction of ſexes in ſuch entails; for both of them may either be in tail male or tail female. As if lands be given to a man, and his heirs-male of his body begotten, this is an eſtate in tail male general; but if to a man, and the heirs female of his body on his preſent wife begotten, this is an eſtate in tail female ſpecial. And in caſe of an entail male, the heirs-female ſhall never inherit, nor any derived from them; nor, *e converſo*, the heirs-male in caſe of a gift in tail female. Thus, if the donee in tail male hath a daughter, who dies leaving a ſon, ſuch grandſon in this caſe cannot inherit the eſtate-tail; for he cannot deduce his deſcent wholly by heirs-male. And as the heir-male muſt convey his deſcent wholly by males, ſo muſt the heir-female wholly by females. And therefore if a man hath two eſtates-tail, the one in tail male and the other in tail female, and he hath iſſue a daughter, which daughter hath iſſue a ſon; this grandſon can ſucceed to neither of the eſtates, for he cannot convey his deſcent wholly either in the male or female line.

As the word *heirs* is neceſſary to create a fee, ſo, in farther imitation of the ſtrictneſs of the feodal donation, the word *body*, or ſome other words of procreation, are neceſſary to make it a fee-tail, and aſcertain to what heirs in particular the fee is limited. If, therefore, either the words of inheritance or words of procreation be omitted, albeit the others are inſerted in the grant, this will not make an eſtate-tail. As if the grant be to a man and the iſſue of his body, to a man and his ſeed, to a man and his children or offspring; all theſe are only eſtates for life, there wanting the words of inheritance, "his heirs." So, on the other hand, a gift to a man, and his heirs male or female, is an eſtate in fee-ſimple and not in fee-tail; for there are no words to aſcertain the body out of which they ſhall iſſue. Indeed, in laſt wills and teſtaments, wherein greater indulgence is allowed, an eſtate-tail may be created by a deviſe to a man and his ſeed, or to a man and his heirs-male, or by other irregular modes of expreſſion.

There is ſtill another ſpecies of entailed eſtates, now indeed grown out of uſe, yet ſtill capable of ſubſiſting in law; which are eſtates *in libero maritagio*, or Frankmarriage. See that article.

The incidents to a tenancy in tail, under the ſtatute Weſtminſter 2. are chiefly theſe: 1. That a tenant in tail may commit waſte on the eſtate tail, by felling timber, pulling down houſes, or the like, without being impeached or called to account for the ſame. 2. That the wife of the tenant in tail ſhall have her dower, or thirds, of the eſtate-tail. 3. That the huſband of a female tenant in tail may be tenant by the curteſy of the eſtate-tail. 4. That an eſtate-tail may be barred, or deſtroyed, by a fine, by a common recovery, or by lineal warranty deſcending with aſſets to the heir. See Assets.

Thus much for the nature of eſtates-tail: the eſtabliſhment of which family-law (as it is properly ſtyled by Pigott) occaſioned infinite difficulties and diſputes. Children grew diſobedient when they knew they could not be ſet aſide: farmers were ouſted of their leaſes made by tenants in tail; for if ſuch leaſes had been valid, then, under colour of long leaſes, the iſſue might have been virtually diſinherited: creditors were defrauded of their debts; for, if a tenant a tenant in tail could have charged his eſtate with their payment, he might alſo have defeated his iſſue, by mortgaging it for as much as it was worth: innumerable latent entails were produced to deprive purchaſers of the lands they had fairly bought; of ſuits in conſequence of which, our ancient books are full: and treaſons were encouraged, as eſtates-tail were not liable to forfeiture longer than for the tenant's life. So that they were juſtly branded as the ſource of new contentions and miſchiefs unknown to the common law; and almoſt univerſally conſidered as the common grievance of the realm. But as the nobility were always fond of this ſtatute, becauſe it preſerved their family-eſtates from forfeiture, there was little hope of procuring a repeal by the legiſlature; and therefore, by the connivance of an active and politic prince, a method was deviſed to evade it.

About 200 years intervened between the making of the ſtatute *de donis*, and the application of common recoveries to this intent, in the 12th year of Edward IV.; which were then openly declared by the judges to be a ſufficient bar of an eſtate-tail. For though the courts had, ſo long before as the reign of Edward III. very frequently hinted their opinion that a bar might be effected upon theſe principles, yet it was never carried into execution; till Edward IV. obſerving (in the diſputes between the houſes of York and Lancaſter) how little effect attainders for treaſon had on families whoſe eſtates were protected by the ſanctuary of entails, gave his countenance to this proceeding, and ſuffered Taltarum's caſe to be brought before the court: wherein, in conſequence of the principles then laid down, it was in effect determined, that a common recovery ſuffered by tenant in tail ſhould be an effectual deſtruction thereof. Theſe common recoveries are fictitious proceedings, introduced by a kind of *pia fraus*, to elude the ſtatute *de donis*, which was found ſo intolerably miſchievous, and which yet one branch of the legiſlature would not then conſent to repeal: and that theſe recoveries, however clandeſtinely begun, are now become by long uſe and acquieſcence a moſt common aſſurance of lands; and are looked upon as the legal mode of conveyance, by which a tenant in tail may diſpoſe of his lands and tenements: ſo that no court will ſuffer them to be ſhaken or reflected on, and even acts of Parliament have by a ſide-wind countenanced and eſtabliſhed them.

This expedient having greatly abridged eſtates-tail with regard to their duration, others were ſoon invented to ſtrip them of other privileges. The next that was attacked was their freedom from forfeitures for treaſon. For, notwithſtanding the large advances made by recoveries, in the compaſs of about threeſcore years, towards unfettering theſe inheritances, and thereby ſubjecting the lands to forfeiture, the rapacious prince then reigning, finding them frequently reſettled in a ſimilar manner to ſuit the convenience of families, had addreſs enough to procure a ſtatute, whereby all eſtates of inheritance (under which general words eſtates-tail were covertly included) are declared to be forfeited to the king upon any conviction of high-treaſon.

The next attack which they ſuffered, in order of time, was by the ſtatute 32 Hen. VIII. c. 28. whereby certain leaſes made by tenants in tail, which do not tend to the prejudice of the iſſue, were allowed to be good in law, and to bind the iſſue in tail. But they received a more violent blow in the ſame ſeſſion of parliament, by the conſtruction put upon the ſtatute of fines, by the ſtatute 32 Hen. VIII. c. 36. which declares a fine duly levied by tenant in tail to be a complete bar to him and his heirs, and all other perſons claiming under ſuch entail. This was evidently agreeable to the intention of Henry VII. whoſe policy it was (before common recoveries had obtained their full ſtrength and authority) to lay the road as open as poſſible to the alienation of landed property, in order to weaken the overgrown power of his nobles. But as they, from the oppoſite reaſons, were not eaſily brought to conſent to ſuch a proviſion, it was therefore couched, in his act, under covert and obſcure expreſſions. And the judges though willing to conſtrue that ſtatute as favourably as poſſible for the defeating of entailed eſtates, yet heſitated at giving fines ſo extenſive a power by mere implication, when the ſtatute *de donis* had expreſsly declared that they ſhould not be a bar to eſtates-tail. But the ſtatute of Henry VIII. when the doctrine of alienation was better received, and the will of the prince more implicitly obeyed than before, avowed and eſtabliſhed that intention. Yet in order to preſerve the property of the crown from any danger of infringment, all eſtates tail created by the crown, and of which the crown has the reverſion, are excepted out of this ſtatute. And the ſame was done with regard to common recoveries, by the ſtatute 34 and 35 Hen. VIII. c. 20. which enacts, that no feigned recovery had againſt tenants in tail, where the eſtate was created by the crown, and the remainder or reverſion continues ſtill in the crown, ſhall be of any force and effect. Which is allowing, indirectly and collaterally, their full force and effect with reſpect to ordinary eſtates-tail, where the royal prerogative is not concerned.

Laſtly, by a ſtatute of the ſucceeding year, all eſtates-tail are rendered liable to be charged for payment of debts due to the king by record or ſpecial contract; as ſince, by the bankrupt-laws, they are alſo ſubjected to be ſold for the debts contracted by a bankrupt. And, by the conſtruction put on the ſtatute 43 Eliz. c. 4. an appointment by tenant in tail of the lands entailed to a charitable uſe is good without fine or recovery.

Eſtates-tail being thus by degrees unfettered, are now reduced again to almoſt the ſame ſtate, even before iſſue born, as conditional fees were in at common law, after the condition was performed by the birth of iſſue. For, firſt, the tenant in tail is now enabled to alienate his lands and tenements by fine, by recovery, or by certain other means; and thereby to defeat the intereſt as well of his own iſſue, though unborn, as alſo of the reverſioner, except in the caſe of the crown: ſecondly, he is now liable to forfeit them for high treaſon: and, laſtly, he may charge them with reaſonable leaſes, and alſo with ſuch of his debts as are due to the crown on ſpecialties, or have been contracted with his fellow ſubjects in a courſe of extenſive commerce.

TAILZIE, in Scots law, the ſame with Tail. See Law, N° clxxx. 9.

TALAPOINS or Talopins, prieſts of Siam.—They enjoy great privileges, but are enjoined celibacy and auſterity of life. They live in monaſteries contiguous to the temples: and what is ſingular, any one may enter into the prieſthood, and after a certain age may quit it to marry, and return to ſociety. There are talapoineſſes too, or nuns, who live in the ſame convents, but are not admitted till they have paſſed their fortieth year. The talapoins educate children; and at every new and full moon explain the precepts of their religion in their temples; and during the rainy ſeaſons they preach from ſix in the morning till noon, and from one in the afternoon till five in the evening. They dreſs in a very mean garb, go bareheaded and barefooted; and no perſon is admitted among them who is not well ſkilled in the Baly language.

They believe that the univerſe is eternal; but admit that certain parts of it, as this world, may be deſtroyed and again regenerated. They believe in a univerſal pervading ſpirit, and in the immortality and tranſmigration of the ſoul; but they extend this laſt doctrine, not only to all animals, but to vegetables and rocks. They have their good and evil genii, and particular local deities, who preſide over foreſts and rivers, and interfere in all ſublunary affairs.

For the honour of human nature, we are happy to find ſo pure a ſyſtem of morality prevail among theſe people: It not only forbids its followers to do ill, but enjoins the neceſſity of doing good, and of ſtifling every improper thought or criminal deſire.

Thoſe who wiſh to peruſe a more particular account of the talapoins, may conſult *Voyage de M. de la Loubere*; Sketches relating to the Hiſtory, &c. of the Hindoos; or Payne's Geography.

TALC, in mineralogy, a ſpecies of foſſil arranged under the magneſian earths. In Magellan's edition of Cronſtedt's Mineralogy, it is conſidered as a ſpecies of Mica, and has accordingly been mentioned by us under that article. On the other hand, Dr Kirwan has claſſed the mica under the ſiliceous earths, while he places talc under the magneſian. According to the analyſis of Dr Kirwan, "talc conſiſts of pure magneſia, mixed with nearly twice its weight of ſilex, and leſs than its own weight of argil." It is compoſed of broad, flat, and ſmooth lamina, or plates. There are two varieties of it, the Venetian talc and Muſcovy talc; for the difference of which, ſee the article Mica.

The Venetian talc has not derived its name from being a production of the territories of Venice (for it is not often to be met with in that country), but probably from being an article of Venetian commerce. It abounds in England, Norway, Hungary, Bohemia, Spain, and in many countries of Aſia. Venice talc, with half its weight of alkaline ſalt, may, in a ſtrong fire, be brought into perfect fuſion, though not to perfect tranſparency: with equal its weight, or leſs, of borax, it runs into a beautiful, pellucid, greeniſh yellow glaſs. Talc does not melt with any other earth, nor even bake or cohere with any but the argillaceous: Mixtures of it with them all are nevertheleſs brought into fuſion by a remarkably leſs quantity of ſaline matter than the ingredients ſeparately would require. Thus equal parts of talc and chalk, with only one fourth their weight of borax, melt in no very vehement heat into a fine tranſparent greeniſh glaſs, of conſiderable hardneſs and great luſtre. On ſubſtituting gypſeous earths to chalk, the fuſion was as eaſy, and the glaſs as beautiful; in colour not green, but yellow like the topaz. Talc, with half its weight of ſand, and a quantity of nitre equal to both, yielded alſo a tranſparent topaz yellow glaſs. Several farther experiments on talc may be ſeen in a memoir by Mr Pott in the *Mem. de l'Acad. de Berlin*, 1746.

Muſcovy talc, called alſo *lapis ſpecularis*, is found in many parts. The iſland of Cyprus abounds with it. It is very common alſo in Ruſſia, and has of late been diſcovered to abound in the Alps, the Apennines, and many of the mountains of Germany. It is imported in large quantities into England, and is uſed by the lanthorn-makers inſtead of horn in their nicer works; by the painters to cover miniature pictures; and by the microſcope-makers to preſerve ſmall objects for viewing by glaſſes. The ancients uſed it inſtead of glaſs in their windows. Some take the lapis ſpecularis to have been a ſpecies of gypſum, and compoſed of the acid of vitriol and calcareous earth. It came into uſe at Rome in the age of Seneca[*]; and ſoon after its introduction was applied not only to lighten apartments, but to protect fruit-trees from the ſeverity of the weather; and it is recorded, that the emperor Tiberius was enabled, principally by its means, to have cucumbers at his table during almoſt every month in the year. Dr Watſon apprehends it is ſtill uſed in ſome countries in the place of glaſs: however, it is well known, that it was ſo uſed in the time of Agricola; for he mentions[†] two churches in Saxony which were lighted by it. Agricola eſteemed it to have been a ſpecies of plaſter-ſtone; and in ſpeaking of it he remarks, that though it could bear, without being injured, the heat of ſummer and the cold of winter, yet the largeſt maſſes of it were waſted by the rain. It differs from plaſter-ſtone in this property, that it does not, after being calcined and wetted with water, ſwell and concrete into a hard ſtony ſubſtance.[*]

Hill's Hiſt. of Foſſ. p. 72.

Although we have treated of Muſcovy talc and lapis ſpecularis as the ſame, we are not ignorant that a diſtinction has been made between them by ſome chemiſts; but as we have found a greater degree of confuſion on this ſubject in ſeveral valuable ſyſtems of mineralogy than we had reaſon to expect, we continue the old names as formerly, till a more ſatisfactory analyſis make it proper to apply them differently.

Talc is employed, in thoſe places where it is found in any conſiderable quantity, in compoſitions for earthen veſſels; and by ſome for teſts and cupels. From its ſmoothneſs, unctuoſity, and brightneſs, it has been greatly celebrated as a coſmetic; and the chemiſts have ſubmitted it to a variety of operations, for procuring from it oils, ſalts, tinctures, magiſteries, &c. for that intention. But all their labours have been in vain; and all the preparations ſold under the name of talc have either contained nothing of that mineral, or only a fine powder of it.

TALENT, ſignifies both a weight and a coin very common among the ancients, but very different among different nations.

The common Attic talent of weight contains 60 Attic minæ, or 6000 Attic drachmæ; and weighed, according to Dr Arbuthnot, 56 lbs. 11 oz. $17\frac{1}{7}$ gr. Engliſh troy weight. There was another Attic talent, by ſome ſaid to conſiſt of 80, by others of 100 minæ. The Egyptian talent was 80 minæ; the Antiochian alſo 80; the Ptolemaic of Cleopatra $86\frac{2}{3}$; that of Alexandria 96; and the Inſular talent 120. In the valuation of money, the Grecian talent, according to Dr Arbuthnot, was equal to 60 minæ, or, reckoning the minæ at L. 3 : 4 : 7, equal to L. 193, 15s: The Syrian talent in this valuation conſiſted of 15 Attic minæ; the Ptolemaic of 20; the Antiochian of 60; the Euboic of 60; The Babylonic of 70; the Greater Attic of 80; The Tyrian of 80; the Eginean of 100; the Rhodian of 100; and the Egyptian of 80 minæ.

There is another talent much more ancient, which Dr Arbuthnot calls the *Homeric talent* of gold, which ſeems to have weighed ſix Attic drachms of three darics, a daric weighing very little more than a guinea. According to this talent, ſome reckon the treaſure of king David, particularly that mentioned 1 Chron. xxii. 14. which, according to the common reckoning, would amount in gold talents to the value of L. 547,500,000, and the ſilver to above L. 342,000,000; or, reckoning according to the decuple proportion of gold to ſilver, the two ſums would be equal. As David reigned in Judæa after the ſiege of Troy, it is not improbable but Homer and he might uſe the ſame numeral talent of gold.

Among the Romans there were two kinds of talents, the *little* and the *great* talent: the little was the common talent; and whenever they ſay ſimply *talentum*, they are to be underſtood of this. The little talent was 60 minæ or Roman pounds; the mina or pound eſtimated at 100 drachmæ or denarii: it was alſo eſtimated at 24 great ſeſterces, which amounted to 60 pounds.

The great talent exceeded the leſs by one-third part. Budæus computes, that the little talent of ſilver was worth L. 75 Sterling, and the greater L. 99 : 6 : 8 Sterling. The greater of gold was worth L. 1125 Sterling

Talent, as a ſpecies or money, among the Hebrews, was

[*] Ep. 90.

[†] De Nat. Foſſ. lib. 5. p. 257.

[*] Watſon's Chem. Eſſ. vol. ii. p. 297, &c.

was ſometimes uſed for a gold coin, the ſame with the ſhekel of gold, called alſo *ſtater*, and weighing only 4 drachms. The Hebrews reckoned by theſe talents as we do by pounds, &c. Thus a million of gold, or million of talents of gold, among them, was a million of ſhekels or nummi; the nummus of gold being the ſame weight with the ſhekel, viz. four drachms.

But the Hebrew talent weight of ſilver, which they called *cicar*, was equivalent to that of 3000 ſhekels, or 113 lb. 10 oz. 1 dwt. $10\frac{2}{7}$ gr. Engliſh Troy weight, according to Arbuthnot's computation.

TALIACOTIUS (Gaſper), chief ſurgeon to the great duke of Tuſcany, was born at Bononia in Italy in 1553. He wrote a Latin treatiſe intitled *Chirurgia Nota de Curtis Membris*, in which he teaches the art of engrafting noſes, ears, lips, &c. giving repreſentations of the inſtruments and proper bandages; though many are of opinion that he never put his art in practice. However, his doctrine is not ſingular; for he ſhows that Alexander Benedictus, a famous chirurgical writer, deſcribed the operation before.

TALLIO *(lex talionis)*, a ſpecies of puniſhment in the Moſaic law, whereby an evil is returned ſimilar to that committed againſt us by another; hence that expreſſion, "Eye for eye, tooth for tooth." This law was at firſt inſerted in the 12 tables amongſt the Romans; but afterwards ſet aſide, and a power given to the prætor to fix upon a ſum of money for the damage done.

TALISMANS, magical figures cut or engraved with ſuperſtitious obſervations on the characteriſms and configurations of the heavens, to which ſome aſtrologers have attributed wonderful virtues, particularly that of calling down celeſtial influences. The taliſmans of Samothrace, ſo famous of old, were pieces of iron formed into certain images, and ſet in rings; theſe were eſteemed preſervatives againſt all kinds of evils. There were likewiſe taliſmans taken from vegetables, and others from minerals.

TALLAGE (*tallagium*), from the French *taillé*, is metaphorically uſed for a part or ſhare of a man's ſubſtance carved out of the whole, paid by way of tribute, toll, or tax.

TALLOW, in commerce, the fat of certain animals melted and clarified. It is procured from moſt animals, but chiefly from bullocks, ſheep, hogs, and bears. Some kinds of tallow are uſed as unguents in medicine, ſome for making ſoap and dreſſing leather, and ſome for making candles. See CHEMISTRY, n° 1429.

TALLOW-Tree. See CROTON.

TALLY, is a ſtick cut in two parts, on each whereof is marked, with notches or otherwiſe, what is due between debtor and creditor, as now uſed by brewers, &c. And this was the ancient way of keeping all accounts, one part being kept by the creditor, the other by the debtor, &c. Hence the tallier of the exchequer, who is now called the *teller*. "But there are two kinds of tallies mentioned in our ſtatutes to have been long uſed in the exchequer. The one is termed *tallies of debt*, which are in the nature of an acquittance for debts paid to the king, on the payment whereof theſe tallies are delivered to the debtors, who carrying them to the clerk of the pipe-office, have there an acquittance in parchment for their full diſcharge. The other are *tallies of reward* or allowance, being made to ſheriffs of counties as a recompenſe for ſuch matters as they have performed to their charge, or ſuch money as is caſt upon them in their accounts of courſe, but not leviable, &c. In the exchequer there is a tally-court, where attend the two deputy chamberlains of the exchequer and the tally-cutter: and a tally is generally the king's acquittance for money paid or lent, and has written on it words proper to expreſs on what occaſion the money is received."

TALLY-Man, a perſon that ſells or lets goods, clothes, &c. to be paid by ſo much a-week.

TALMUD, a collection of Jewiſh traditions. There are two works which bear this name, the Talmud of Jeruſalem, and the Talmud of Babylon. Each of theſe are compoſed of two parts; the Miſhna, which is the text, and is common to both, and the Gemara or commentary. See MISHNA and GEMARA.

The Miſhna, which comprehends all the laws, inſtitutions, and rules of life which, beſide the ancient Hebrew Scriptures, the Jews thought themſelves bound to obſerve, was compoſed, according to the unanimous teſtimony of the Jews, about the cloſe of the ſecond century. It was the work of Rabbi Jehuda (or Juda) Hakkadoſh, who was the ornament of the ſchool at Tiberias, and is ſaid to have occupied him forty years. The commentaries and additions which ſucceeding Rabbins made were collected by Rabbi Jochanan Ben Eliezer, ſome ſay in the 5th, others ſay in the 6th, and others in the 7th century, under the name of *Gemara*, that is, *completion*; becauſe it completed the Talmud. A ſimilar addition was made to the Miſhna by the Babyloniſh doctors in the beginning of the 6th century according to Enfield, and in the 7th according to others.

The Miſhna is divided into ſix parts, of which every one which is intitled *order* is formed of treatiſes, every treatiſe is divided into chapters, and every chapter into miſhnas or aphoriſms. In the *firſt* part is diſcuſſed whatever relates to ſeeds, fruits, and trees: in the *ſecond* feaſts: in the *third* women, their duties, their diſorders, marriages, divorces, contracts, and nuptials: in the *fourth* are treated the damages or loſſes ſuſtained by beaſts or men, of things found, depoſits, uſuries, rents, farms, partnerſhips in commerce, inheritance, ſales and purchaſes, oaths, witneſſes, arreſts, idolatry; and here are named thoſe by whom the oral law was received and preſerved: in the *fifth* part are noticed what regards ſacrifices and holy things: and the *ſixth* treats on purifications, veſſels, furniture, clothes, houſes, leproſy, baths, and numerous other articles. All this forms the Miſhna.

As the learned reader may wiſh to obtain ſome notion of rabbinical compoſition and judgment, we ſhall gratify his curioſity ſufficiently by the following ſpecimen: "Adam's *body* was made of the earth of Babylon, his *head* of the land of Iſrael, his other *members* of other parts of the world. R. Meir thought he was compact of the earth gathered out of the whole earth; as it is written, *thine eyes did ſee my ſubſtance*. Now it is elſewhere written, *the eyes of the Lord are over all the earth*. R. Aha expreſsly marks the twelve hours in which his various parts were formed. His ſtature was from one end of the world to the other; and it was for his tranſgreſſion that the Creator, laying his hand in anger on him, leſſened him; for before (ſays R. Eleazer), 'with his hand he reached the firmament.' R. Jehuda thinks his ſin was hereſy; but R. Iſaac thinks that 'it was nouriſhing his foreſkin."

The Talmud of Babylon is moſt valued by the Jews; and this is the book which they mean to expreſs when they talk of the Talmud in general. An abridgment of it was made by Maimonides in the 12th century, in which he rejected ſome of its greateſt abſurdities. The Gemara is ſtuffed with dreams and chimeras, with many ignorant and impertinent queſtions, and the ſtyle very coarſe. The Miſhna is written in a ſtyle comparatively pure, and may be very uſeful in explaining paſſages of the New Teſtament where the phraſeology is ſimilar. This is indeed the only uſe to which Chriſtians can apply it; but this renders it valuable. Lightfoot has judiciouſly availed himſelf of ſuch information as he could derive from it. Some of the popes, with a barbarous zeal, and a timidity of ſpirit for the ſucceſs of the Chriſtian religion, which the belief of its divinity can never excuſe, ordered great numbers of the Talmud to be burned. Gregory IX. burned about 20 cart-loads, and Paul IV. ordered 12,000 copies of the Talmud to be deſtroyed.

The laſt edition of the Talmud of Babylon, printed at Amſterdam, is in 12 vols folio. The Talmud of Jeruſalem is in one large folio.

TALPA, the MOLE; a genus of quadrupeds belonging to the order of *feræ* and claſs of *mammalia*. It has ſix unequal foreteeth in the upper jaw, and eight in the lower; one tuſk on each ſide in each jaw; ſeven grinders on each ſide above, and ſix below. There are ſeven ſpecies; the European, the flava or American, the criſtata, longicaudata, fuſca, rubra, and aurea.

The European mole is the only ſpecies of this animal found in Britain. There are ſeveral varieties of it; the black, the variegated, the white, and the grey mole. This ſpecies inhabits the whole of Europe except Ireland, where it is ſaid no moles are found. It is alſo common in the northerly parts of Aſia and Africa. It chiefly frequents moiſt fields that are expoſed to the ſun, meadows, and gardens; through theſe it conſtructs ſubterraneous roads or galleries in every direction in ſearch of worms, on which and the larvæ of inſects it feeds, and not at all on vegetables, though it does great damage by looſening the roots of plants. It is moſt active in its operations before rain, becauſe then the worms are in motion. The penis of the male is exceedingly long in proportion; they ſeem to pair and propagate in ſpring, the female bringing four or five young at a birth, which are placed in neſts made of moſs, leaves, and dried graſs, under the largeſt hillocks of the field; theſe are conſtructed with wonderful ingenuity, conſiſting of an interior hillock, ſurrounded with a ditch, which communicates with ſeveral galleries, on purpoſe to carry off the moiſture; and the neſt is covered over with a dome of earth, like the flat arch of an oven. Moles are deſtroyed by means of a paſte compoſed of palma-chriſti and white hellebore, or by flooding the fields which they infeſt; though, in the latter caſe, they ſometimes eſcape by aſcending trees.

This ſpecies is five inches and three quarters in length, and its tail is about one inch long. It has a large head, without any external ears, and eyes ſo very ſmall and ſo completely hid in the fur as to make it vulgarly believed that it has none. As it lives entirely below ground, it has certainly no occaſion for eyes like other quadrupeds; and as it probably finds its food by its ſenſe of ſmell, which is acute, its eyes may ſerve merely as a ſafeguard to warn it when it happens to emerge from the ground to return to its ſubterraneous dwelling. This warning may be given by the light falling upon its eyes, which may produce a painful ſenſation. For the truth of this conjecture, however, we muſt refer to the anatomiſt, who might eaſily determine, from the ſtructure of the eyes, what purpoſe they are fitted to ſerve.

TAMANDAU, in zoology. See MYRMECOPHAGA.

TAMARINDUS, the TAMARIND-TREE, in botany: A genus of plants arranged by Linnæus under the claſs of *triandria* and order of *monogynia*; but Woodville, Schreber, and other late botaniſts, have found that it belongs to the claſs of *monodelphia* and order of *triandria*. In the natural ſyſtem it is ranked under the *lomentaceæ*. There is only one ſpecies, the *indica*, which is a native of both Indies, of America, of Arabia, and Egypt, and was cultivated in Britain before the year 1633.

The tamarind-tree riſes to the height of 30 or 40 feet, ſending off numerous large branches, which ſpread to a conſiderable extent, and have a beautiful appearance; the trunk is erect, and covered with rough bark, of a greyiſh or aſh-colour; the leaves are ſmall and pinnated, and of a yellowiſh green colour: the flowers reſemble the papilionaceous kind, and grow in lateral cluſters: the calyx conſiſts of four leaves, and the corolla of three petals, which are of a yellowiſh hue, and are beautifully diverſified with red veins: the fruit is a pod of a roundiſh compreſſed form, from three to five inches long, containing two, three, or four ſeeds, lodged in a dark pulpy matter. The flowers appear, according to Jacquin, in October and November; but, according to Dr Wright, they continue during the whole of June and July, and then drop off.

The pulp of the tamarind, with the ſeeds connected together by numerous tough ſtrings or fibres, are brought to us freed from the outer ſhell, and commonly preſerved in ſyrup. According to Long, tamarinds are prepared for exportation at Jamaica in the following manner: "The fruit or pods are gathered (in June, July, and Auguſt) when full ripe, which is known by their fragility or eaſy breaking on ſmall preſſure between the finger and thumb. The fruit, taken out of the pod, and cleared from the ſhelly fragments, is placed in layers in a caſk; and boiling ſyrup, juſt before it begins to granulate, is poured in, till the caſk is filled: the ſyrup pervades every part quite down to the bottom, and when cool the caſk is headed for ſale." He obſerves, that the better mode of preſerving this fruit is with ſugar, well clarified with eggs, till a tranſparent ſyrup is formed, which gives the fruit a much pleaſanter flavour: but as a principal medicinal purpoſe of the pulp depends upon its acidity, which is thus counteracted by the admixture of ſugar, it would therefore be of more utility if always imported here in the pods. The fruit produced in the Eaſt Indies is more eſteemed than that of the Weſt, and eaſily to be diſtinguiſhed by the greater length of the pods, and the pulp being dryer and of a darker colour.

Uſes. This fruit, the uſe of which was firſt learned of the Arabians, contains a larger proportion of acid, with the ſaccharine matter, than is uſually found in the *fructus acido-dulcis*, and is therefore not only employed as a laxative, but alſo for abating thirſt and heat in various inflammatory complaints, and for correcting putrid diſorders, eſpecially thoſe of a bilious kind; in which the cathartic, antiſeptic, and refrigerant qualities of the fruit have been found equally uſeful. When intended merely as a laxative, it may be of advantage to join it with manna, or purgatives of a ſweet kind, by which its uſe is rendered ſafer and more effectual. Three drachms of the pulp are uſually ſufficient to open the body; but to prove moderately cathartic, one or two ounces are required. It is an ingredient in *electuarium e caſſia*, and *electuarium e ſenna* or lenitive electuary (A).

We are informed by Dr Wright, that preſerved tamarinds are kept in moſt houſes in Jamaica either as a ſweet-meat, or for occaſional uſe as a medicine. See PHARMACY, nº 394 and 395.

TAMARIX,

(A) "Tournefort relates, that an eſſential ſalt may be obtained from tamarinds, by diſſolving the pulp in water, and ſetting the filtered ſolution, with ſome oil upon the ſurface, in a cellar for ſeveral months; that the ſalt is of a ſouriſh taſte, and difficultly diſſoluble in water; and that a like ſalt is ſometimes found alſo naturally concreted on the branches of the tree. The ſalt, as Beaumé obſerves, may be obtained more expeditiouſly, by clarifying the decoction of the tamarinds

rinds

TAMARIX, the TAMARISK, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *trigynia*; and in the natural ſyſtem ranging under the 13th order, *Succulentæ*. The calyx is quinquepartite; the petals are five; the capſule is unilocular and trivalvular, and the ſeeds pappous. There are only two ſpecies known; the *gallica* or French tamariſk, and the *germanica* or German tamariſk.

TAMBAC, in the materia medica. See EXCÆCANA.

TAMBOUR, in architecture, a term applied to the Corinthian and Compoſite capitals, as bearing ſome reſemblance to a drum which the French call *tambour*. Some chooſe to call it the *vaſe*, and others *campana* or the bell.

TAMBOUR is alſo uſed for a little box of timber work, covered with a ceiling, withinſide the porch of certain churches; both to prevent the view of perſons paſſing by, and to keep off the wind, &c. by means of folding-doors &c.

TAMBOUR, alſo denotes a round courſe of ſtone, ſeveral whereof form the ſhaſt of a column, not ſo high as a diameter.

TAMBOUR, in the arts, is a ſpecies of embroidery. The tambour is an inſtrument of a ſpherical form, upon which is ſtretched, by means of a ſtring and buckle, or other ſuitable appendage, a piece of linen or thin ſilken ſtuff; which is wrought with a needle of a particular form, and by means of ſilken or gold and ſilver threads, into leaves, flowers, or other figures.

TAMBOURIN, is the name of a dance performed on the French ſtage. The air is lively, and the movements are quick.

TAMERLANE, or TIMUR BEK, a celebrated prince and conqueror. At the age of 25 he attained the higheſt dignities, with ſurpriſing courage, and an ambition aſtoniſhing to all the world. Endeavouring to perfect the great talents which he had received from nature, he ſpent nine years in different countries; where his great ſenſe and elevated genius appeared in councils and aſſemblies, while his intrepidity and valour, whether in perſonal combats or pitched battles, drew upon him the admiration of all mankind. He made himſelf maſter of the three empires of Jagatay Khân, Tuſhi Khân, and Hûlâkû Khân; ſo that his power, riches, and magnificence, were immenſe. There remain vaſt monuments of his grandeur in the cities, towns, caſtles, and walls, which he built; in the rivers and canals which he dug, as well as the bridges, gardens, palaces, hoſpitals, moſques, and monſteries, which he erected in divers part of Aſia in ſo great a number, that a king might be accounted very powerful and magnificent, who ſhould have employed 36 years only in building the great edifices which Timûr cauſed to be founded.

Timûr, according to the hiſtorian Arabſhâh, was in his perſon very corpulent and tall. He had a large forehead and big head. His countenance was agreeable, and his complexion fair. He wore a large beard, was very ſtrong, and well limbed; had broad ſhoulders, thick fingers, and long legs. His conſtitution was amazingly vigorous; but he was maimed in one hand and lame of the right ſide. His eyes appeared full of fire; his voice was loud and piercing; he feared nothing; and when far advanced in years, his underſtanding was ſound and perfect, his body vigorous and robuſt, his mind conſtant and unſhaken like a rock. He did not like raillery, and could not bear a lie. There was no joking or fooling before him; for he loved the naked truth, even although it was to his own diſadvantage. He neither grieved if he miſcarried in any attempt, nor appeared overjoyed on any great ſucceſs. The device of his ſeal was, "I am ſincere and plain." He had a clear and ſolid underſtanding, was ſurpriſingly happy in his conjectures; vigilant, active, and unſhaken in his reſolutions. He took great delight in reading hiſtory, and was well verſed in the ſtate of countries provinces, and cities. He was penetrating, ſubtle, cloſe, and diſſembling; juſt by inclination, liberal from diſpoſition; but ambition had in a great meaſure extinguiſhed his humanity; war had familiarized him to blood; and his religious zeal had inſpired him with the moſt cruel, implacable, and pernicious fanaticiſm.

He died on the 1ſt of April 1405, in the 71ſt year of his age and 36th of his reign. When he found death approaching, he ſent for his principal officers, declared his grandſon his heir, and made them ſwear to execute his will. Having recommended brotherly love and concord to the princes his children, he ordered one of the doctors to read the Koran at his bed's head, and often repeat the unity of God. At night he ſeveral times made profeſſion of his belief, "That there is no other God than God," and then expired. See MOGULS, nº 15, &c.

TAMTAM, a flat drum uſed by the Hindoos, reſembling a tabor, but it is larger, and ſounds louder.

TAMUS, BLACK BRIONY, in botany: A genus of plants belonging to the claſs of *diœcia*, and order of *hexandria*; and in the natural ſyſtem ranging under the 11th order, *Sarmentaceæ*. The male and female flowers are both ſexpartite; there is no corolla; the ſtyle is trifid; the berry is trilocular and inferior, and contains two ſeeds. There are only two ſpecies known; the elephantipes, which is a native of the Cape of Good Hope, and we believe was firſt deſcribed by L'Heritier; and the communis.

The *communis*, or common black briony, is a native of England, but has not been obſerved growing wild in Scotland. It has a large root, which ſends forth ſeveral long ſlender ſtems: the leaves are large, heart-ſhaped, dark green, and grow on long foot ſtalks: the flowers are greeniſh, and the berry red. It flowers from May to Auguſt, and is frequent in hedges.

TAN the bark of the oak after it has been ground and uſed by the tanner. The ſmaller ſort is generally made up in little ſquare cakes called *turf*, and ſold for firing. The coarſer ſort is ſometimes dried in the ſun, and uſed by bakers for heating their ovens, &c. but its chief uſe is for making of hot-beds to raiſe pine apples and other plants.—William III. introduced the uſe of it from Holland, for the purpoſe of raiſing orange trees; after which it was diſcontinued for many years: but about 1719, when *ananas* were firſt brought into England, it came into general uſe, and has ever ſince been in great eſtimation with gardeners for all the purpoſes of forcing, &c. on account of its ſtrong and laſting fermentation. The ſmaller the tan the quicker it heats; but the larger ſort acquires heat more gradually and retains it longer: the ſkilful gardener therefore uſes the one or the other, or a mixture of both, according to the time and purpoſe for which it is wanted. It is ſome time after the tan comes out of the tanner's pit before it begins to heat, and therefore it is not fit for immediate uſe; but having

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rinds with whites of eggs, then filtering it, and evaporating it to a proper conſiſtence, and ſetting it to cool: the ſalt ſhoots into cryſtals of a brown colour and very acid taſte; but in diſſolving and cryſtallizing them again, or barely waſhing them with water, they loſe almoſt all their acidity, the acid principle of the tamarinds ſeeming not to be truly cryſtallizable." Vide *Lewis's Mat. Med.* p. 633.

ving laid a week or two, it enters into a ſtate of fermentation, and if put into hot-beds properly prepared, will retain a moderate heat for three or four months. When it becomes uſeleſs for the hot-houſe, it is ſaid by Miller and others to be an excellent manure for ſome kinds of land.

The word *tan* is ſometimes, though improperly, uſed for the *bark* itſelf, which is the chief ingredient in the tanning of leather. Oak bark, on account of its great aſtringency and gummy-reſinous properties, is preferred to all other ſubſtances for the purpoſe of tanning, as it not only preſerves the leather from rotting, but alſo, by condenſing the pores, renders it impervious to water. See TANNING.

TANACETUM, TANSY, in botany: A genus of plants belonging to the claſs of *ſyngeneſia*, and order of *polygamia ſuperflua*; and in the natural ſyſtem ranging under the 49th order, *Compoſitæ*. The receptacle is naked; the pappus ſomewhat emarginated; the calyx imbricated and hemiſpherical; the florets of the radius are trifid, and ſcarcely diſtinguiſhable. Gmelin has enumerated ſeven ſpecies; of which one only is a native of Britain, the *vulgare*.

The *vulgare*, or common tanſy, grows three or four feet high; the leaves are bipinnated and ſerrated; the flowers yellow, and terminate the branches in flat umbels. It is found ſometimes on the borders of fields and dry banks: it abounds at Wark, and Ford-caſtle in the neighbourhood of Kelſo, on the borders of Scotland; and on the ſide of Gareloch on the weſtern coaſt of Roſs-ſhire: it has alſo been found in Breadalbane. It flowers generally in Auguſt. Of this ſpecies there is a variety with curled leaves, which is therefore called *curled tanſy*. The tanſy has a bitter taſte, and an aromatic ſmell diſagreeable to many people.

Uſes. It is eſteemed good for warming and ſtrengthening the ſtomach; for which reaſon the young leaves have obtained a place among the culinary herbs, their juice being an ingredient in puddings, &c. It is rarely uſed in medicine, though extolled as a good emmenagogue. A drachm of the dried flowers has been found very beneficial in hyſteric diſorders ariſing from ſuppreſſion. The ſeeds and leaves were formerly in conſiderable eſteem for deſtroying worms in children, and are reckoned good in colics and flatulencies. In ſome parts of Sweden and Lapland, a bath with a decoction of this plant is made uſe of to aſſiſt parturition. See PHARMACY, n° 193.

TANÆCIUM, in botany: A genus of the *angioſperma* order, belonging to the *didynamia* claſs of plants; and in the natural method ranking under the 25th order, *Putamineæ*. The calyx is monophyllous, tubulated, truncated, and entire; the corolla long, monopetalous, and white; the tube cylindrical; the lymbi erect, ſpreading, and nearly equal; the fruit a berry covered with a thick bark, large, oblong, internally divided into two parts; in the pulp are contained a number of ſeeds. There are only two ſpecies of this genus; the *jaroba* and *paraſiticum*, both natives of Jamaica. They grow by the ſides of rivers, and climb on trees and buſhes.

TANAGRA, TANAGER, in ornithology, a genus of birds belonging to the order of *paſſeres*. The beak is conical, acuminated, emarginated, almoſt triangular at the baſe, and inclining a little towards the point. Dr Latham has deſcribed 44 ſpecies, all of which are of foreign extraction.

TANAIS, or DON. See DON.

TANGENT *of an* ARCH, is a right line drawn perpendicularly from the end of a diameter, paſſing to one extremity of the arch, and terminated by a right line drawn from the centre through the other end of that arch, and called the *ſecant*. See GEOMETRY.

TANGIER, a port-town of Africa, in the empire of Morocco and kingdom of Fez, ſituated at the entrance of the Straits of Gibraltar, in W. Long. 5. 50. N. Lat. 38. 49. In 1662, this place belonged to the Portugueſe, and was given to king Charles II. upon his marriage with the Infanta of Portugal: but he, growing weary of the charge of keeping it, cauſed it to be blown up and deſtroyed in 1684; ever ſince which time it has been only a poor fiſhing town. Anciently it was called *Tingis*, and gave name to the province of Mauritania Tingitana.

TANK, in the language of Indoſtan, a place incloſed for receiving and retaining the rain. During the periodical rains the tanks are filled, and thus in the dry ſeaſon furniſh water for the rice fields and cattle. Some of them are of great extent, meaſuring 300 or 400 feet on the ſide; they are of a quadrangular form, and lined with granite, deſcending in regular ſteps from the margin to the bottom.

TANNER, one who dreſſes hides by tanning them. See TANNING.

TANNER (Dr Thomas), an Engliſh prelate and celebrated antiquarian, born in 1674. He was admitted of Queen's college Oxford, where a ſimilarity of taſte for antiquities produced a cloſe friendſhip between him and Edmund Gibſon afterwards biſhop of London. In 1697, he was choſen fellow of his college; and having already publiſhed ſome ſpecimens of his ſkill in the antiquarian way, ſoon after became known to Dr Moore biſhop of Norwich, who made him chancellor of his dioceſe. In 1722, he was made archdeacon of Norwich, and in 1731 biſhop of St Aſaph. He died at Oxford in 1735; and after his death was publiſhed an elaborate work, ſaid to have employed him for 40 years, under this title, *Bibliotheca Britannica Hibernica, ſive de Scriptoribus qui in Anglia, Scotia, et Hibernia, ad ſæculi* XVII. *initium floruerunt*, &c.

TANNING, the art of manufacturing leather from raw hides and ſkins.

Before we detail the proceſs, it may be proper to obſerve, that raw hides and ſkins being compoſed of minute fibres interſecting each other in every direction, the general operation of tanning conſiſts chiefly in expanding the pores, and diſſolving a ſort of greaſy ſubſtance contained in them; and then, by means of the aſtringency and gummy-reſinous properties of oak bark, to fill and reunite them, ſo as to give firmneſs and durability to the whole texture. But this theory has been controverted by ſome chemiſts, who ſuppoſe that the animal jelly contained in the ſkin is not diſſolved, but unites during the proceſs with the aſtringent principle of the bark, and forms a combination inſoluble in water.

1 Method of tanning. The proceſs of tanning varies conſiderably, not only in different countries, but even in different parts of the ſame country. The following is the method moſt approved and practiſed in London and its vicinity, where the beſt leather is generally allowed to be manufactured.

The leather tanned in England conſiſts chiefly of three ſorts, known by the name of *butts* or *backs*, *hides*, and *ſkins*.

2. Butts. *Butts* are generally made from the ſtouteſt and heavieſt ox hides, and are managed as follows: After the horns are taken off, the hides are laid ſmooth in heaps for one or two days in the ſummer, and for five or ſix in the winter: they are then hung on poles, in a cloſe room called a *ſmoke-houſe*, in which is kept a ſmouldering fire of wet tan; this occaſions a ſmall degree of putrefaction, by which means the hair is eaſily got off, by ſpreading the hide on a ſort of wooden horſe or beam, and ſcraping it with a crooked knife. The hair being taken off, the hide is thrown into a pit or pool of water to cleanſe it from the dirt, &c. which being done, the hide is again ſpread on the wooden beam, and the greaſe, looſe fleſh, extraneous filth, &c. carefully

ſcrubbed out or taken off; the hides are then put into a pit of ſtrong liquor called *ooze* or *wooze*, prepared in pits called *letches* or *taps* kept for the purpoſe, by infuſing ground bark in water; this is termed *colouring*: after which they are removed into another pit called a *ſcowering*, which conſiſts of water ſtrongly impregnated with vitriolic acid, or with a vegetable acid prepared from rye or barley. This operation (which is called *raiſing*), by diſtending the pores of the hides, occaſions them more readily to imbibe the ooze, the effect of which is to aſtringe and condenſe the fibres, and give firmneſs to the leather. The hides are then taken out of the ſcowering, and ſpread ſmooth in a pit commonly filled with water, called a *binder*, with a quantity of ground bark ſtrewed between each. After lying a month or ſix weeks, they are taken up; and the decayed bark and liquor being drawn out of the pit, it is filled again with ſtrong ooze, when they are put in as before, with bark between each hide. They now lie two or three months, at the expiration of which the ſame operation is repeated; they then remain four or five months, when they again undergo the ſame proceſs; and after being three months in the laſt pit, are completely tanned, unleſs the hides are ſo remarkably ſtout as to want an additional pit or layer.—The whole proceſs requires from 11 to 18 months, and ſometimes two years, according to the ſubſtance of the hide, and diſcretion of the tanner. When taken out of the pit to be dried, they are hung on poles; and after being compreſſed by a ſteel pin, and beat out ſmooth by wooden hammers called *beetles*, the operation is complete; and when thoroughly dry, they are fit for ſale. Butts are chiefly uſed for the ſoles of ſtout ſhoes.

3 Hides.

The leather which goes under the denomination of *hides* is generally made from cow hides, or the lighter ox hides, which are thus managed. After the horns are taken off, and the hides waſhed, they are put into a pit of water ſaturated with lime, where they remain a few days when they are taken out, and the hair ſcraped off on a wooden beam, as before deſcribed; they are then waſhed in a pit or pool of water, and the looſe fleſh, &c. being taken off, they are removed into a pit of weak ooze, where they are taken up and put down (which is technically termed *handling*) two or three times a-day for the firſt week; every ſecond or third day they are ſhifted into a pit of freſh ooze, ſomewhat ſtronger than the former, till at the end of a month or ſix weeks they are put into a ſtrong ooze, in which they are handled once or twice a-week with freſh bark for two or three months. They are then removed into another pit, called a *layer*, in which they are laid ſmooth, with bark ground very fine ſtrewed between each hide. After remaining here two or three months, they are generally taken up, when the ooze is drawn out, and the hides put in again with freſh ooze and freſh bark; where, after lying two or three months more, they are completely tanned, except a few very ſtout hides, which may require an extra layer: they are then taken out, hung on poles, and being hammered and ſmoothed by a ſteel pin, are when dry, fit for ſale.

Theſe hides are called *crop hides*; they are from 10 to 18 months in tanning, and are uſed for the ſoles of ſhoes.

4 Skins.

Skins is the general term for the ſkins of calves, ſeals, hogs, dogs, &c. Theſe, after being waſhed in water, are put into lime-pits, as before mentioned, where they are taken up and put down every third or fourth day, for a fortnight or three weeks, in order to dilate the pores and diſſolve the gelatinous parts of the ſkin. The hair is then ſcraped off, and the fleſh and excreſcences being removed, they are put into a pit of water impregnated with pigeon-dung (called a *grainer* or *maſhing*), forming a ſtrong alkaline ley, which in a week or ten days ſoaking out the lime, greaſe, and, ſaponaceous matter (during which period they are ſeveral times ſcraped over with a crooked knife to work out the dirt and filth), ſoftens the ſkins, and prepares them for the reception of the ooze. They are then put into a pit of weak ooze, in the ſame manner as the hides, and being frequently handled, are by degrees removed into a ſtronger and ſtill ſtronger liquor, for a month or ſix weeks, when they are put into a very ſtrong ooze, with freſh bark ground very fine, and at the end of two or three months, according to their ſubſtance, are ſufficiently tanned; when they are taken out, hung on poles, dried, and fit for ſale.

Theſe ſkins are afterwards dreſſed and blacked by the currier; and are uſed for the upper-leathers of ſhoes, boots, &c.

The lighter ſort of hides, called *dreſſing hides*, as well as horſe-hides, are managed nearly in the ſame manner as ſkins; and are uſed for coach work, harneſs-work, &c. &c.

5 Schemes to ſhorten the proceſs and leſſen the expence.

As the method of tanning above deſcribed and all others in general uſe, are extremely tedious and expenſive in their operation, various ſchemes have at different times been ſuggeſted to ſhorten the proceſs and leſſen the expence.—Though moſt of theſe ſchemes have ultimately proved unſucceſsful, yet in a work of this kind it may be expected that we ſhould not paſs them over wholly unnoticed.

Some have imagined, and perhaps juſtly, that cold water alone is not an adequate menſtruum for extracting the reſinous qualities of bark, however aſſiſted by the mucilage of the bark and of the ſkin; a decoction, inſtead of ſimple infuſion, has therefore been recommended as a more effectual mode of obtaining thoſe properties.

The late Dr Macbride of Dublin having been concerned in a leather manufactory, publiſhed in 1778 a new method of tanning. His projected improvements may be briefly claſſed under two heads: the one recommending the uſe of *vitriolic* inſtead of *vegetable* acid, brewed from rye or barley: the other ſubſtituting *lime-water*, for the purpoſe of extracting the virtues of the bark inſtead of the *water* commonly uſed by tanners. With reſpect to the firſt, it is generally acknowledged that the vitriolic acid is very proper for raiſing or diſtending the pores of the hides intended for butts, as its operation is not only more ſimple and certain than the acid formerly uſed, but as it tends more effectually to render the texture of the leather firm and durable: it is therefore ſtill preferred by the moſt ſkilful tanners. As to lime-water inſtead of water, it has been found inefficacious; and if the utmoſt care and attention be not obſerved, the leather is liable to ſuffer much injury. Even the ſhortening of the time and leſſening of the expence (which were its chief recommendations) being very problematical, it is now almoſt generally exploded.

A very ingenious chemiſt has obſerved, that it is neceſſary, on account of a chemical combination between the aſtringent principle and the animal ſubſtance in the proceſs of tanning, that free acceſs ſhould be given to the pure air; and therefore ſuppoſes that the proceſs could not be conducted properly in cloſe veſſels*.

The methods of tanning in different provinces of France are ſo various, ſo complicated, and ſo contrary to the acknowledged principles of the manufacture, that it would be an endleſs and uſeleſs taſk to endeavour to detail them: we ſhall therefore content ourſelves with a general reference to M. de la Lande's elaborate Treatiſe on this ſubject.

It has been ſaid, that every part of the oak tree contains a great portion of aſtringent, gummy-reſinous matter, and will therefore tan leather as effectually as the bark itſelf. This opinion, which was firſt publiſhed in 1674 by the Honourable Charles Howard (Phil. Tranſ. vol. ix.), has ſince been countenanced by the celebrated Buffon; who adds, that the bark of birch will anſwer the purpoſe of tanning even ſole leather, which, it is well known, requires the ſtrongeſt and moſt penetrating materials †.

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* Phil. Tranſ. vol. lxviii. Bartholet.

A long memoir, written by M. Gleditſch, recommends the leaves, branches, fruit, and flowers, of a vaſt number of plants as ſubſtitutes for oak bark. Heath dried and pulveriſed, gall nuts, and the bark of birch, are ſaid by M. Geſner to be uſed in different provinces of Germany. Abbé Nollet informs us, that the leaves of myrrh are uſed by the tanners in Naples. In Corſica they make uſe of the leaves of wild laurel dried in the ſun and beaten into powder, and in the iſland of St Kilda they tan with the tormentil root. In ſome parts of Italy leather is tanned with myrtle leaves. In Ruſſia, is is ſaid, that leather is tanned with the bark of willow: and it may here be obſerved, that a late writer has recommended the extract of bark to be made in America, in order to leſſen the expence of freight, &c. in conveying the bark itſelf to Europe.

In the year 1765, the Society of Arts, &c. granted a premium of L. 100 for the diſcovery of a method of tanning with oak ſaw-duſt; which method has been adopted in Germany: and the Reverend Mr Swaine has lately revived the exploded ſubſtitute (mentioned by Gleditſch and others) of oak leaves.

The following propoſal was communicated to the Bath Society for extracting the eſſence of oak bark:

Suppoſe (ſays the author) the operator has at hand a common family brew-houſe, with its neceſſary utenſils; let him procure a ton of good oak bark ground as uſual for the pit; and having placed a ſtrainer to the maſh-tub, fill it two-thirds with the bark; heat as much water, nearly boiling, as will ſufficiently moiſten it, and maſh it well together. After it has ſtood about two hours, draw it off clear, and put it into a caſk by itſelf. Make a ſecond extract with a ſmaller quantity of boiling water than before, ſo as to draw off a quantity nearly equal to the firſt, and put that alſo into the ſame caſk with the former.

Theſe two extracts will probably contain in them as much of the virtues of the bark as the quantity of liquid will abſorb.

A third extract, rather more in quantity than the other two, may be made from the ſame bark, and as ſoon as drawn off, ſhould be returned into the copper again when empty, and employed for the firſt and ſecond maſh of a quantity of freſh bark, as the three extracts may be ſuppoſed to have carried off the virtues of the firſt. Then proceed as before till all the bark is ſteeped, and a ſtrong liquid extract is drawn from it. The bark, when taken out of the copper, may be ſpread in the ſun to dry, and ſerve as fuel in the ſucceeding operations.

The next proceſs is, to evaporate the watery particles from the extract by a gentle heat, till it comes to the conſiſtence of treacle. This may be done either by the air and heat of the ſun, or by the ſtill or iron pan over the fire.

Anthony Day, Eſq; of London, obtained a patent, dated 17th July 1790, for a new method of tanning, "with half the bark in half the uſual time." This plan chiefly conſiſts in concentrating the bark into a ſtrong extract, and in ſome mechanical improvements in the conſtruction of the tan-yard. But neither the one nor the other have yet been adopted.

The 12th May 1795, a patent was granted to Mr Tucker of Wickham, Hants. He propoſes that the vat, made of wood, be incloſed in a metallic coating or copper pit, completely ſoldered, to prevent the eſcape of any of the fluid. This is to be ſurrounded with a caſe of brick-work, leaving an interſtice of a few inches; and a fire is to be made in a grate near the bottom of the pit, to keep the ooze moderately warm, and thus to ſhorten the proceſs. But the great expence of theſe triple pits and of the fuel, it is to be feared, will counterbalance any advantages which might otherwiſe be derived from this invention.

Monſieur Seguin of Paris has lately ſubmitted to the French Convention a new method of tanning, which is ſaid to poſſeſs wonderful advantages. He has certainly exploded the ignorant and abſurd ſyſtems of the French tanners, which we have above hinted at, and has ſhown much ingenuity and chemical knowledge in the proſecution of his diſcoveries; but his leading principles ſeem, in fact, to be nearly ſimilar to thoſe which have been long known and practiſed in England.

An ingenious manufacturer in London has, by the application of warm air, conveyed by means of flues from ſtoves properly conſtructed, and by other contrivances not generally known, conſiderably abridged the uſual proceſs of tanning. Some experiments have likewiſe been lately made with the bark of aſh and of horſe-cheſnut.

A ſubſtitute for oak bark, the price of which has lately been enormous, is the grand *deſideratum* in the manufacture of leather. Moſt of thoſe above enumerated have hitherto been found ineffectual; but a patent, bearing date 16th January 1794, has been granted to Mr Aſhton of Sheffield, Yorkſhire, for his diſcovery of a cheap and expeditious method of tanning leather. This method chiefly conſiſts in applying a preparation of mineral ſubſtances inſtead of oak bark. Thoſe which, on account of their cheapneſs, are moſt to be preferred, are the droſs of coal-pits, called *ſulphur-ſtone* or *pyrites*, and the yellow ferruginous earth or red ochre; and, in general, all aſtringent, ſulphureous, or vitriolated ſubſtances.

If this diſcovery, which is yet in its infancy, ſhould prove ſucceſsful, it may cauſe a material alteration in the proceſs of this manufacture; and by reducing the expence may ultimately be of great advantage to the public. Many other experiments are now making in England for the improvement of tanning; and as there are many perſons of ingenuity and knowledge engaged in the leather manufacture, much may be expected from their induſtry and ſkill.

6
Acts of Parliament &c. reſpecting leather.

As the acts of parliament reſpecting leather, &c. are very numerous, and many of them almoſt obſolete, we ſhall refer our readers to Burn's Juſtice, or to the Statutes at Large. We cannot, however, help remarking, that the act of 1 James I. cap. 22. which preſcribes the mode and manner in which leather ſhall be tanned, the materials to be uſed, and the time to be employed, is ſo palpably abſurd and oppreſſive, that it ought to be immediately repealed.

The revenue ariſing from the duty on leather tanned in Great Britain (excluſive of oiled leather) is upwards of L. 200,000 *per annum*.

TANTALUS, in fabulous hiſtory, king of Phrygia and Paphlagonia, was the ſon of Jupiter and the nymph Plota. He one day entertained the gods at his table; when, to prove their divinity, he ſerved up his ſon Pelops cut in pieces. All the deities, except Ceres, perceived his cruelty and impiety, and would not touch his proviſions. That goddeſs, whoſe thoughts were ſolely employed about her daughter Proſerpine, inadvertently eat a part of his left ſhoulder. Pelops, however, was reſtored to life; and an ivory ſhoulder given him in the room of that which had been eaten; while Tantalus was thrown into Tartarus, where he was puniſhed with perpetual hunger and thirſt. He was chained in a lake; the water of which reached up to his chin, but retired when he attempted to drink. The branch of a tree loaded with fruit hung down even to his lips, but on his attempting to pluck the fruit the branch ſprung upwards.

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† Mem. Acad. Sc. Paris, 1786.

Tantalus, in ornithology, a genus of birds belonging to the order of grallæ. The bill is long, ſubulated, and ſomewhat crooked; the face naked; the tongue ſhort; and the feet have four toes palmated on the under part. There are, according to Dr Latham, 23 ſpecies; of which the moſt remarkable is the *ibis*, the bird ſo much valued by the ancient Egyptians.

The ibis was formerly held in great veneration in Egypt, on account of its utility in freeing the country from ſerpents. Serpents muſt therefore have been numerous, or they could not have been very offenſive; and the ibis muſt have been numerous, or they could not have been uſeful. Yet we are aſſured by Mr Bruce, that the ibis is at preſent unknown in Egypt, and ſerpents are no nuiſance; and he thinks it impoſſible that a country, covered with water for five months of the year as Egypt is, could ever have abounded with ſerpents. He endeavours, however, to reconcile the accounts of ancient hiſtorians with the ſtate of Egypt.

In former times, when Egypt was in its flouriſhing ſtate, the inhabited country extended much farther than it does at preſent; reaching even a conſiderable way into the ſandy deſert of Libya, where ſerpents have their abode. Theſe parts were ſupplied with water by immenſe lakes, dug by the magnificent princes of thoſe times, and filled by the annual inundation of the Nile. Theſe frontier diſtricts would naturally be infeſted with vipers from the Libyan deſert, and the vaſt lakes would as naturally be ſupplied by numbers of water-fowl, of which the ibis is a ſpecies. This bird being likewiſe an enemy to ſerpents, the inhabitants would ſoon become acquainted with his uſe, and their ſuperſtition would ſoon reward him. In after ages, however, when the ancient improvements were loſt, and thoſe vaſt lakes dried up which brought the ibis thither, the ſerpents ceaſed to give any offence, becauſe there were none of the human ſpecies there whom they could annoy; and in conſequence of the want of water, the birds ceaſed to annoy them, retiring to their native place Ethiopia, where they continue to frequent the great ſtagnant pools which are common in that country.

Mr Bruce found a bird in Abyſſinia, which, after comparing it with the deſcription of the ancient writers, and the embalmed ibis of Egypt, he concludes is the ſame with the Egyptian ibis. It is called *abou Hannes*, ſignifying "father John," from its appearing annually on St John's day.

This bird is minutely deſcribed by Mr Bruce. It has a beak ſhaped like that of a curlew, two-thirds ſtraight, and the remaining third crooked; the upper part of a green horny ſubſtance, and the lower part black. It meaſures four inches and an half from the occiput to the place where it joins the beak. The leg, from the lower joint of the thigh to the foot, is ſix inches; the bone round and very ſtrong; and from the lower joint of the thigh to where it joins the body, is five inches and a half. The height of the body from the ſole to the middle of the back is 19 inches; the aperture of the eye one inch; the feet and legs black: three toes before armed with ſharp and ſtraight claws; and a toe behind. The head is brown, and the plumage of the ſame colour down to the back, or the place where the neck and back are joined. The throat is white, as well as the back, breaſt, and thighs; the largeſt feathers of the wing are of a deep black for 13 inches from the tail; and ſix inches up the back from the extremity of the tail is black likewiſe.

Tantalus's Cup. See Hydrostatics, nº 44.

TANZY, or Tansy, in botany. See Tanacetum.

TAORMINA, a town in Sicily, is ſituated on a rock which riſes to a conſiderable elevation above the level of the ſea, and is ſurrounded by other rocks, the height of which is ſtill more conſiderable. It is 88 miles ſouth of Meſſina, and was founded by a colony from Naxos, which were probably induced to chooſe the ſituation, not ſo much on account of its grandeur, as for the ſecurity which it would afford. It is alſo very wholeſome. The road to Taormina, up the north ſide of the hill on which it ſtands, is very ſteep and difficult of aſcent.

Of the origin of Taormina, as of other cities, almoſt nothing is known. A colony from the iſle of Naxos ſettled at the foot of Etna, at no great diſtance from the ſhore, and about a league or a league and an half from the preſent ſituation of Taormina. Dionyſius the Tyrant attacked this colony, and either took or ſet fire to the city. The inhabitants retired to the rocks of Mount Taurus; among which they found a tract of ground ſufficiently level, and of ſufficient extent, for them to raiſe habitations upon it. It was a ſituation in which they might be ſecure from every attack. Here, therefore, they built a city; which, after the mountain, they named *Tauromenium*. It was at length raiſed to a very flouriſhing ſtate by trade, and became celebrated as a ſeat of the arts. There are ſtill many remains to be ſeen, which ſhow that the fine arts muſt have been once ſucceſsfully cultivated at Tauromenium.

Among other remains of the ancient Tauromenium, ſtill to be ſeen at Taormina, there is a ſpacious theatre. Near the theatre is a tomb, and behind the tomb a large natural grotto. The grotto appears to have been anciently adorned within with artificial ornaments. It was poſſibly conſecrated by the Greeks to ſome rural deity, perhaps to the nymphs, to whom the ancient heathens uſed generally to conſecrate grottos. After the inhabitants of Taormina embraced Chriſtianity, they ſtill continued to viſit this grotto with devout veneration. Inſtead of the Pagan divinities to whom it had before been ſacred, they ſubſtituted a ſaint, the venerable St Leonard, inſtead of the ſportive nymphs. But St Leonard did not long draw crowds to this grotto; and the Chriſtians have either defaced its Pagan decorations, or ſuffered them to fall into decay by the injuries of time. It is now black and ſmoky; and it is with difficulty that any remains of the Greek paintings with which it was once ornamented can be diſtinguiſhed. Perhaps it might be ſacred to Pales rather than the nymphs: She was the protectreſs of flocks; and the circumjacent grounds are, and always have been, excellent for paſture.

There are alſo to be ſeen in the neighbourhood of Taormina a variety of tombs, the remains of a gymnaſium, with a number of other monuments which ſtill preſerve the memory of the ancient Tauromenium.

TAPE-worm. See Tænia.

TAPER, Tapering, is underſtood of a piece of timber, or the like, when thick at one end, and gradually diminiſhing to the other; as is the caſe in pyramids, cones, &c.

To meaſure Taper-Timber, &c. See *Sliding Rule*.

Taper Bored, is applied to a piece of ordnance when it is wider at the mouth than towards the breech.

Taper, alſo denotes a kind of tall wax candle, placed in a candleſtick, and burnt at funeral proceſſions, and in other church ſolemnities.

Tapers are made of different ſizes; in ſome places, as Italy, &c. they are cylindrical; but in moſt other countries, as England, France, &c. they are conical or taper; whence poſſibly the name; unleſs we rather chooſe to derive taper, in the adjective ſenſe from the ſubſtantive taper, in the Saxon *tapen* or *tapon*, *cereus*, "wax-candle." Both kinds are pierced at bottom for a pin in the candleſtick to enter.—There are two ways of making tapers, the firſt with the ladle, the ſecond by hand; for which, ſee Candle.

Taper, Tapeſtry.

Paſchal Taper, among the Romaniſts, is a large taper, whereon the deacon applies five bits of frankincenſe, in holes made for the purpoſe, in form of a croſs; and which he lights with new fire in the ceremony of Eaſter-Saturday.

The Pontifical makes Pope Zoſimus the author of this uſage; but Baronius will have it more ancient, and quotes a hymn of Prudentius to prove it. That pope he ſuppoſes to have only eſtabliſhed the uſe thereof in pariſh-churches, which, till then, had been reſtrained to greater churches.

F. Papebroch explains the original of the paſchal taper more diſtinctly, in his *Conatus Chronico-Hiſtoricus*, &c. It ſeems, though the council of Nice regulated the day whereon Eaſter was to be celebrated, it laid it on the patriarch of Alexandria to make a yearly canon thereof, and to ſend it to the pope. As all the other moveable feaſts were to be regulated by that of Eaſter, a catalogue of them was made every year; and this was written on a taper, *cereus*, which was bleſſed in the church with much ſolemnity.

This taper, according to the abbot Chaſtelain, was not a wax-candle made to be burnt; it had no wick, nor was it any thing more than a kind of column of wax, made on purpoſe to write the liſt of moveable feaſts on; and which would ſuffice to hold that liſt for the ſpace of a year.

For among the ancients, when any thing was to be written to laſt for ever, they engraved it on marble or ſteel; when it was to laſt a long while, they wrote it on Egyptian paper; and when it was only to laſt a ſhort time, they contented themſelves to write it on wax. In proceſs of time they came to write the moveable feaſts on paper, but they ſtill faſtened it to the paſchal taper. Such is the original of the benediction of the paſchal taper.

TAPESTRY, a kind of cloth made of wool and ſilk, adorned with figures of different animals, &c. and formerly uſed for lining the walls of rooms, churches, &c.

The art of weaving tapeſtry is ſuppoſed to have been borrowed from the Saracens; accordingly the workmen employed in this manufacture in France were formerly called *Sarazins* or *Sarazinois*. Guicciardini aſcribes the invention of tapeſtry hangings to the inhabitants of the Netherlands; but he has not mentioned at what time the diſcovery was made. This art was brought into England by William Sheldon, near the end of Henry VIII.'s reign. In 1619 a manufacture was eſtabliſhed at Mortlake in Surry by Sir Francis Crane, who received L. 2000 from King James to encourage the deſign. The firſt manufacture of tapeſtry at Paris was ſet up under Henry IV. in 1606 or 1607, by ſeveral artiſts whom that monarch invited from Flanders. Under Louis XIV. the manufacture of the Gobelins was inſtituted, which has introduced very beautiful cloths, remarkable for ſtrength, for elegance of deſign, and a happy choice of colours. The fineſt paintings are copied, and eminent painters have been employed in making deſigns for the work.

Tapeſtry-work is diſtinguiſhed by the workmen into two kinds, viz. that of high and that of low warp; though the difference is rather in the manner of working than in the work itſelf; which is in effect the ſame in both: only the looms, and conſequently the warps, are differently ſituated; thoſe of the low warp being placed flat and parallel to the horizon, and thoſe of the high warp erected perpendicularly. The Engliſh anciently excelled all the world in the tapeſtry of the high warp; and they ſtill retain their former reputation, though with ſome little change: their low warps are ſtill admired; but as for the high ones, they are quite laid aſide by the French. The French, before the Revolution, had three conſiderable tapeſtry manufactures beſides that of the Gobelins; the firſt at Aubuſſon in Auvergne, the ſecond at Felletin in the Upper Marche, and the third at Beauvais. They were all equally eſtabliſhed for the high and the low warp; but they had all laid aſide the high warp excepting the Gobelins. There were admirable low warps likewiſe in Flanders, generally exceeding thoſe of France; the chief and almoſt only Flemiſh manufactures were at Bruſſels, Antwerp, Oudenard, Liſle, Tournay, Bruges, and Valenciennes; but of the ſtate of theſe manufactures now we are ignorant.

Tapeſtry,

The uſual widths of tapeſtry are from two ells to three ells Paris meaſure.

The Manufacture of Tapeſtry of the High Warp.—The loom on which it is wrought is placed perpendicularly: it conſiſts of four principal pieces; two long planks or cheeks of wood, and two thick rollers or beams. The planks are ſet upright, and the beams acroſs them, one at the top and the other at the bottom, or about a foot diſtance from the ground. They have each their trunnions, by which they are ſuſpended on the planks, and are turned with bars. In each roller is a groove, from one end to the other, capable of containing a long round piece of wood, faſtened therein with hooks. The uſe of it is to tie the ends of the warp to. The warp, which is a kind of worſted, or twiſted woollen thread, is wound on the upper roller; and the work, as faſt as wove, is wound on the lower. Withinſide the planks, which are ſeven or eight feet high, fourteen or fifteen inches broad, and three or four thick, are holes pierced from top to bottom, in which are put thick pieces of iron, with hooks at one end ſerving to ſuſtain the coat-ſtave: theſe pieces of iron have alſo holes pierced, by putting a pin in which the ſtave is drawn nearer or ſet farther off; and thus the coats or threads are ſtretched or looſened at pleaſure. The coat-ſtave is about three inches diameter, and runs all the length of the loom; on this are fixed the coats or threads, which make the threads of the warp croſs each other. It has much the ſame effect here as the ſpring-ſtave and treddles have in the common looms. The coats are little threads faſtened to each thread of the warp with a kind of ſliding knot, which forms a ſort of maſh or ring. They ſerve to keep the warp open for the paſſage of broaches wound with ſilks, woollens, or other matters uſed in the piece of tapeſtry. In the laſt place, there are a number of little ſticks of different lengths, but all about an inch in diameter, which the workman keeps by him in baſkets, to ſerve to make the threads of the warp croſs each other, by paſſing them acroſs; and, that the threads thus croſſed may retain their proper ſituation, a packthread is run among the threads above the ſtick.

The loom being thus formed, and mounted with its warp, the firſt thing the workman does is to draw on the threads of this warp the principal lines and ſtrokes of the deſign to be repreſented on the piece of tapeſtry; which is done by applying cartoons made from the painting he intends to copy to the ſide that is to be the wrong ſide of the piece, and then, with a black lead pencil, following and tracing out the contours thereof on the thread of the right ſide; ſo that the ſtrokes appear equally both before and behind.

As for the original deſign the work is to be finiſhed by, it is hung up behind the workmen, and wound on a long ſtaff, from which a piece is unrolled from time to time as the work proceeds.

Beſides the loom, &c. here deſcribed, there are three other principal inſtruments required for working the ſilk or the wool of the woof within the threads of the warp; theſe are a broach, a reed, and an iron needle. The broach is made of a hard wood, ſeven or eight inches long, and two-thirds of an inch thick, ending in a point with a little handle. This ſerves as a ſhuttle; the ſilks, woollens, gold, or ſilver, to be uſed in the work being wound on it. The reed or comb is alſo of wood, eight or nine inches long, and an inch thick on the back, whence it grows leſs and leſs to the extremity of the teeth, which are more or leſs apart, according to the greater or leſs degree of fineneſs of the intended work. Laſtly, the needle is made in form of the common needle, only bigger and longer. Its uſe is to preſs cloſe the wool and ſilks when there is any line or colour that does not fit well.

All things being prepared for the work, and the workman ready to begin, he places himſelf on the wrong ſide of the piece, with his back towards the deſign: ſo that he works as it were blindfold, ſeeing nothing of what he does, and being obliged to quit his poſt, and go to the other ſide of the loom whenever he would view and examine the piece, to correct it with his preſſing-needle. To put ſilk, &c. in the warp, he firſt turns and looks at the deſign; then, taking a broach full of the proper colour, he places it among the threads of the warp, which he brings croſs each other with his fingers, by means of the coats or threads faſtened to the ſtaff; this he repeats every time he is to change his colour. Having placed the ſilk or wool, he beats it with his reed or comb; and when he has thus wrought in ſeveral rows over each other, he goes to ſee the effects they have, in order to reform the contours with his needle, if there be occaſion. As the work advances, it is rolled upon the lower beam, and they unroll as much warp from the upper beam as ſuffices them to continue the piece: the like they do of the deſign behind them. When the pieces are wide, ſeveral workmen may be employed at once.

We have but two things to add: the firſt is, that the high warp tapeſtry goes on much more ſlowly than the low warp, and takes up almoſt twice the time and trouble. The ſecond is, that all the difference that the eye can perceive between the two kinds, conſiſts in this, that in the low warp there is a red fillet, about one-twelfth of an inch broad, running on each ſide from top to bottom, which is wanting in the high warp.

Manufacture of Tapeſtry of the Low Warp.—The loom or frame, whereon the low warp is wrought, is much like that of the weavers; the principal parts thereof are two ſtrong pieces of wood forming the ſides of the loom, and bearing a beam or roller at each end: they are ſuſtained at bottom with other ſtrong pieces of wood in manner of treſtes; and, to keep them the firmer, they are likewiſe faſtened to the floor with a kind of buttreſſes, which prevent any ſhaking, though there are ſometimes four or five workmen leaning on the fore-beam at once.

The rollers have each their trunnions, by which they are ſuſtained: they are turned by large iron pins three feet long. Along each beam runs a groove, wherein is placed the wich, a piece of wood of about two inches diameter, and almoſt of the length of the roller: this piece fills the groove entirely, and is faſtened therein, from ſpace to ſpace, by wooden pins. To the two wiches are faſtened the two extremities of the warp, which is wound on the farther roller, and the work, as it advances, on the nearer.

Acroſs the two ſides, almoſt in the middle of the loom, paſſes a wooden bar, which ſuſtains little pieces of wood, not unlike the beam of a balance: to theſe pieces are faſtened ſtrings, which bear certain ſpring-ſtaves, wherewith the workman, by means of two treddles under the loom whereon he ſets his feet, gives a motion to the coats, and makes the threads of the warp riſe and fall alternately. Each loom has more or fewer of theſe ſpring-ſtaves, and each ſtaff more or fewer coats, as the tapeſtry conſiſts of more or fewer threads.

The deſign or painting the tapeſtry man is to follow is placed underneath the warp; where it is ſuſtained from ſpace to ſpace with ſtrings, by means of which the deſign is brought nearer the warp.

The loom being mounted, there are two inſtruments uſed in working it, viz. the reed and the flute. The flute does the office of the weaver's ſhuttle; it is made of an hard poliſhed wood, three or four lines thick at the ends, and ſomewhat more in the middle, and three or four inches long. On it are wound the ſilks or other matters to be uſed as the woof of the tapeſtry. The comb or reed is of wood or ivory; it has uſually teeth on both ſides; it is about an inch thick in the middle, but diminiſhes each way to the extremity of the teeth: it ſerves to beat the threads of the woof cloſe to each other, as faſt as the workman has paſſed and placed them with his flute among the threads of the warp.

The workman is ſeated on a bench before the loom, with his breaſt againſt the beam, only a cuſhion or pillow between them; and, in this poſture, ſeparating, with his fingers, the threads of the warp, that he may ſee the deſign underneath, and taking a flute, mounted with a proper colour, he paſſes it among the threads, after having raiſed or lowered them, by means of the treddles moving the ſpring-ſtaves and coats.

Laſtly, To preſs and cloſe the threads of the ſilk or yarn, &c. thus placed, he ſtrikes each courſe (*i. e.* what the flute leaves in its paſſing and coming back again) with the reed.

TAPIOCA, a ſpecies of ſtarch, which the Brazileans make from the roots of the caſſada plant, which is already deſcribed under its botanic name JATROPHA.

TAPIR, in zoology, a quadruped of the order of *belluæ*, reſembling the hippopotamus, has the fore-hoofs divided into four, and the hind-hoofs into three parts. The noſe of the male extends far beyond the lower jaw, is ſlender, and forms a ſort of proboſcis; it is capable of being contracted or extended at pleaſure. and its ſides are ſulcated. The extremities of both jaws end in a point, and there are ten cutting teeth in each. Between them and the grinders there is a vacant ſpace; and there are ten grinders in each jaw. The ears are erect, the eyes ſmall, and the body is ſhaped like that of a hog. The back is arched; the legs are ſhort; and the hoofs ſmall, black, and hollow. The tail is very ſmall. The animal grows to the ſize of a heifer half a year old. The hair is ſhort: when young, it is ſpotted with white; when old, of a duſky colour.—It inhabits the woods and rivers of the eaſtern ſide of South America, from the Iſthmus of Darien to the river of Amazon. It ſleeps during day in the darkeſt and thickeſt foreſt adjacent to the banks, and goes out in the night-time in ſearch of food. It lives on graſs, ſugar-canes, and on fruits. If diſturbed, it takes to the water; ſwims very well; or ſinks below, and, like the hippopotamus, walks on the bottom as on dry ground. It makes a ſort of hiſſing noiſe.—This is the largeſt of the American animals.

TAPPING, in general, the act of piercing a hole in a veſſel, and applying a tube or canula in the aperture, for the commodious drawing off the liquor contained therein.

TAPPING, in ſurgery. See SURGERY.

TAPROBANE, the ancient name of the iſland of Ceylon. See CEYLON.

TAR, a thick, black, unctuous ſubſtance obtained chiefly from old pines and fir-trees by burning them with a cloſe ſmothering heat. It is prepared in great quantities in Norway, Sweden, Germany, Ruſſia, and North America, and in other countries where the pine and fir abound. For the method of obtaining it, ſee the article PINUS, in Vol. XIV. page 765.

Becher, the celebrated chemiſt, firſt propoſed to make tar from pit-coal. Manufactures for this purpoſe have been eſtabliſhed many years ago in the biſhopric of Liege, and in ſeveral parts of England. In the year 1781, the earl of Dundonald obtained a patent for extracting tar from pit-coal by a new proceſs of diſtillation (ſee Coal, page 89.); Great hopes were entertained of the value of this diſcovery, but we have not heard that it has anſwered expectation.

Tar, which is well known for its economical uſes, is properly an empyreumatic oil of turpentine, and has been much uſed as a medicine both internally and externally (ſee Pharmacy-*Index*). Tar-water, or water impregnated with the more ſoluble parts of tar, was formerly a popular remedy. See Pharmacy, nº 405.

TARANTO, the ancient Tarentum, a ſea port town of Italy, in the kingdom of Naples, and in the Terra de Otranto. It is a ſtrong and populous place, with an archbiſhop's ſee, and the title of a principality. It is ſeated on a peninſula, and is defended by a ſtrong caſtle; but the harbour is choaked up. E. Long. 17. 29. N. Lat. 40. 35.

TARANTULA, a ſpecies of Aranea, ſo called from Taranto, the place where they are ſaid to abound. See Aranea, ſpecies 13.

TARASCON, an ancient, populous, and handſome town of France, in the department of the Mouths of the Rhone, and late province of Provence, with a well-built caſtle, ſeated on the river Rhone, oppoſite Beaucaire, with which it communicates by a bridge of boats. Its commerce conſiſts in oil, brandy, ſtarch, and ſtuffs that are much worn, one ſort being of coarſe ſilk, and the other of the ſame material and wool. It is 10 miles north of Arles, and 375 ſouth by eaſt of Paris. E. Long. 4. 45. N. Lat. 43. 46.

TARAZONA, a ſtrong town of Spain, in the kingdom of Arragon, and on the frontiers of Old Caſtile, with a biſhop's ſee. It is ſeated partly on a rock, and partly in a fertile plain, on the river Chiles. It was taken from the Moors in 1110. W. Long. 1. 26. N. Lat. 42. 10.

TARCHONANTHUS, flea-bane, in botany: A genus of plants belonging to the claſs of *ſyngeneſia*, and to the order of *polygymia æqualis*; and in the natural ſyſtem ranging under the 49th order, *Compoſitæ*. The receptacle is villous, and the pappus plumy: the calyx is monophyllous, turbinated, and half divided into ſeven ſegments. There are only three ſpecies known; the *camphoratus*, *glaber*, and *ericoides*.

TARE, is an allowance for the outſide package that contains ſuch goods as cannot be unpacked without detriment; or for the papers, threads, bands, &c. that incloſe or bind any goods imported looſe; or though imported in caſks, cheſts, &c. yet cannot be unpacked and weighed neat.

Tare, or vetch. See Vicia.

TARGET, a kind of ſhield or weapon of defence made uſe of by the ancients.

TARGIONIA, in botany; a genus of plants belonging to the claſs of *cryptogamia*, and natural order of *algæ*. The calyx is bivalved, including a globular body. There is only one ſpecies; the *hypophylla*, which it a native of Great Britain. The hypophylla, or vetch targionia, has leaves about a quarter of an inch long, of a heart-ſhape, inverted, and growing proſtrate in a clump together: their upper ſurface is green, covered with whitiſh papillæ, and their lower ſurface is black. The fructification grows at the great end of the leaf on the lower ſide, and conſiſts of two concave valves or hemiſpheres, of a reddiſh black colour, incloſing a chocolate-coloured globule, reſembling the ſeed of a tare or vetch, full of a yellow powder. The leaves increaſe by ſhooting out young offſets from their ſides like the polypus. This plant is found in the north of England, and near the Tarbet of Cantire in Scotland.

TARGUM, a name given to the Chaldee paraphraſes of the books of the Old Teſtament. They are called *paraphraſes* or *expoſitions*, becauſe they are rather comments and explications than literal tranſlations of the text. They are written in the Chaldee tongue, which became familiar to the Jews after the time of their captivity in Babylon, and was more known to them than the Hebrew itſelf. So that when the Hebrew text was read in the ſynagogue, or in the temple, they generally added to it an explication in the Chaldee tongue for the ſervice of the people, who had but a very imperfect knowledge of the Hebrew tongue. It is probable, that even from the time of Ezra this cuſtom began, ſince this learned ſcribe, reading the law to the people in the temple, explained it, with the other prieſts that were with him, to make it underſtood by the people (Nehem. viii. 7—9.).

But though the cuſtom of making theſe ſorts of expoſitions in the Chaldee language be very ancient among the Hebrews, yet have they no written paraphraſes or targums before the era of Onkelos and Jonathan, who lived about the time of our Saviour. Jonathan is placed about 30 years before Chriſt, under the reign of Herod the Great. Onkelos is ſomething more modern. The targum of Onkelos is the moſt of all eſteemed, and copies are to be found in which it is inſerted verſe for verſe with the Hebrew. It is ſo ſhort and ſo ſimple, that it cannot be ſuſpected of being corrupted. This paraphraſt wrote only upon the books of Moſes; and his ſtyle approaches nearly to the purity of the Chaldee, as it is found in Daniel and Ezra. This targum is quoted in the Miſna, but was not known either to Euſebius, St Jerome, or Origen.

The targum of Jonathan ſon of Uziel is upon the greater and leſſer prophets. He is much more diffuſe than Onkelos, and eſpecially upon the leſſer prophets, were he takes great liberties, and runs on in allegories. His ſtyle is pure enough, and approaches pretty near to the Chaldee of Onkelos. It is thought that the Jewiſh doctors who lived about 700 years after him made ſome additions to him.

The targum of Joſeph the Blind is upon the Hagiographa. This author is much more modern, and leſs eſteemed than thoſe we have now mentioned. He has written upon the Pſalms, Job, the Proverbs, the Canticles, Eccleſiaſtes, Ruth, and Eſther. His ſtyle is a very corrupt Chaldee, with a great mixture of words from foreign languages.

The targum of Jeruſalem is only upon the Pentateuch; nor is that entire or perfect. There are whole verſes wanting, others tranſpoſed, others mutilated; which has made many of opinion that this is only a fragment of ſome ancient paraphraſe that is now loſt. There is no targum upon Daniel, or upon the books of Ezra and Nehemiah.

Theſe targums are of great uſe for the better underſtanding not only of the Old Teſtament, on which they are written, but alſo of the New. As to the Old Teſtament, they ſerve to vindicate the genuineneſs of the preſent Hebrew text, by proving it to be the ſame that was in uſe when theſe targums were made, contrary to the opinion of thoſe who think the Jews corrupted it after our Saviour's time. They help to explain many words and phraſes in the Hebrew original, and they hand down to us many of the ancient cuſtoms of the Jews. And ſome of them, with the phraſeologies, idioms, and peculiar forms of ſpeech, which we find in them, do in many inſtances help as much for the better illuſtration and better underſtanding of the New Teſtament as of the Old; the Jeruſalem Chaldee dialect, in which they are written, being the vulgar language of the Jews in our Saviour's time. They alſo very much ſerve the Chriſtian cauſe againſt the Jews, by interpreting many of the prophecies of the Meſſiah in the Old Teſtament in the ſame manner as the Chriſtians do. Many inſtances are produced to this purpoſe by Dr Prideaux in his *Connect. of the Hiſt. of the Old and New Teſt.* vol. iv. p. 777, &c.

Theſe targums are publiſhed to the beſt advantage in the ſecond edition of the great Hebrew Bible ſet forth at Baſil by Buxtorf the father, *anno* 1610; for he has rectified the Chaldee text, and reformed the vowel pointings in it: the targums having at firſt been written without vowel points, which were afterwards added very erroneouſly by ſome Jews.

TARIF, a table or catalogue containing the names of different ſorts of merchandize, with the duties to be paid as ſettled by authority amongſt trading nations.

TARPA (Spurius Mecius), a Latin critic in the time of Julius Cæſar and Auguſtus. He had his tribunal in the temple of Apollo, where, with four aſſiſtants, he paſſed ſentence on the works of the poets. Cicero and Horace make honourable mention of this critic.

TARPAULIN, a piece of canvaſs, well tarred over, to keep off the rain from any place. The term is alſo often applied in a burleſque ſenſe to a perſon that has been all his life bred to the ſea.

TARPEIAN, in Roman antiquity, an appellation given to a ſteep rock in Rome; whence, by the law of the twelve tables, thoſe guilty of certain crimes were precipitated. It took its name from Tarpeia, a veſtal virgin, who was killed by the Sabines, as related under the article ROME, n° 24.

TARQUIN *the* ELDER, king of Rome, ſucceeded Ancus Martius 615 B.C. See ROME, n° 35—40.

TARQUIN *the Proud*, a tyrant and uſurper. See the article ROME, n° 49—51, &c.

TARRAGON, or DRAGON-WORT. See ARTEMISIA.

TARROCK, in ornithology, a ſpecies of LARUS.

TARSHISH, or TARTESSUS, a town frequently mentioned by ancient authors, the ſituation of which it is difficult to aſcertain. See the opinions of Mr Bruce and Dr Droig on this ſubject under the article OPHIR.

TARTAN, in ſea language, a ſmall coaſting veſſel navigated in the Mediterranean ſea, and having only one maſt and a bowſprit, the principal ſail, which is extremely large, being extended by a lateen-yard. When tartans put up a ſquare ſail, it is called a *ſail of fortune*.

TARTAR, a hard ſolid ſubſtance which ſeparates from wine after complete fermentation, and adheres to the top and ſides of the caſks. See the *Index* to CHEMISTRY and PHARMACY.

TARTARY, a very large country of Aſia, ſituated between 57° and 160° of E. Long. reckoning from the weſt end of the iſle of Ferro, and between 37° and 55° of Lat. It is bounded on the north by Siberia, or that part of Aſia which belongs to Ruſſia; on the weſt by the rivers Don, Wolga, and Kama, which ſeparate it from Ruſſia; on the ſouth by the Euxine and Caſpian Seas, Karaſm, the two Bukharias, China, and Korea; and on the eaſt, by the Oriental or Tartarian ocean. It extends from eaſt to weſt the ſpace of 104 degrees in longitude, or 4145 geographical miles; but its breadth is not proportionable, being not above 960 miles where broadeſt, and where narroweſt 330.

This vaſt region is divided into two great parts; the one called the *Weſtern*, the other the *Eaſtern Tartary*.

Weſtern Tartary, which is much more extenſive than the Eaſtern, containing 139 degrees of longitude out of 161, is inhabited by a great number of nations, or tribes of people, who are called *Mungls* or *Mungals*, by themſelves; and *Moguls* or *Tartars*, indifferently, by other nations.

The principal mountains, or rather chains of mountains, found in this part of Great Tartary, may be divided into three claſſes: firſt, thoſe which run along the northern borders of it; and though perhaps not always contiguous, or of the ſame denomination, go under the general name of *Ulug Tâg*, or *Dag*, that is, the *Great Mountain*. Secondly, thoſe which make the ſouthern bounds, and are called *Kichug Tâg*, or the *Leſſer Mountain*. The third great chain is called *Mount Altay*, lying nearly in the middle, between the Caſpian Sea and Eaſtern Tartary, and extending between the other two, in about the 110th degree of longitude.

The principal rivers of Weſtern Tartary, beſides the Dnieper, Don, and Wolga, are the Jaik or Yaik, and Yem, both deſcending from the Ulug Tag, and falling into the Caſpian Sea on the north ſide: the river Ili or Khonghis, which riſes out of the Kichug Tag, on the borders of Little Bukharia, and runs north-weſt into the lake Palkaſi, which is about forty miles long, and 30 broad, in latitude 48°, longitude 97°, reckoning from the iſle of Ferro: on this river the khan of the Eluths or Kalmucks uſually reſides; the river Irtiſh, Irtis, or Erchis, which riſes in Mount Altay, and runs weſtward, inclining to the north, between two branches of it, into the lake Sayſan, Saſſan, or Iſan, called alſo *Honhotu-Nor*, 90 miles long from weſt to eaſt, and 40 broad, in latitude 47° 30′, longitude 104°; from whence iſſuing again, it paſſes north-weſt, through part of Siberia, and falls into the Oby, which has its ſource in the ſame mountain, about one degree to the north of that of the Irtiſh; and ſeven or eight degrees to the north-eaſt riſes the Kem or Jeniſea, which runs weſtward for the ſpace of ſeven or eight degrees, and then turning northward enters Siberia. The next river of note is the Selinga, which riſes out of the lake Koſogol, Hutuktu or Khutuktu, which is 70 miles long from ſouth to north, and 20 broad, in latitude 52°, longitude 118°, not far from the ſource of the Jeniſea, and taking a ſweep ſouthward, round by the eaſt, falls northward into the lake Baykal in Siberia, about 30 leagues north-weſt of the city Selinghinſkoy, which ſtands upon it. Into the Selinga runs the Orkon, coming from the ſouth-weſt; and into the Orkon the Tula, riſing eaſtward in Mount Kentey. On the ſame mountain riſes alſo two other rivers, *viz.* the Onon, called alſo by the Tartars *Saghalian Ula*, or the Dragon river, and by the Ruſſians *Amur*; which running north-eaſtward, and then taking a large ſweep by the ſouth, rolls along the bounds of Eaſtern Tartary, and falls into the Eaſtern Ocean. On its banks ſtand two cities; Nerchinſkoy or Nipchew, a frontier of the Ruſſians, almoſt due north of Pekin in China; and Saghalian Ula, poſſeſſed by the Chineſe. Another large river is the Kerlon or Kerulon, which running north-eaſtward, falls into the lake Kulon or Dalay, which is 60 miles long from ſouth-weſt to north-eaſt, and 27 broad, in latitude 48° 30′, longitude 135°, and iſſuing out again under the name of *Ergona* or *Argun*, joins the Saghalian Ula, about 170 miles beyond Nerchinſkoy. To theſe let us add the river Kalka, from whence, though ſmall, the Kalka-Moguls or Mongols take their name. It riſes in the mountains, ſeparating Eaſtern from Weſtern Tartary, and, running eaſtward, falls into the lake Puir, and then into that of Kulon, before ſpoken of.

In the middle of a deſert, on the banks of the river Irtiſh, is a remarkable piece of antiquity called SEDMY PALATY, or *the ſeven palaces*.

Above the Sedmy Palaty, towards the ſource of the Irtiſh, grows the beſt rhubarb in the world, without the leaſt culture. In the plain of this country alſo, about eight or ten days journey from Tomſky in Siberia, are found many tombs and burying-places of ancient heroes, who in all probability fell in battle. Theſe tombs are eaſily diſtinguiſhed by the mounds of earth and ſtone raiſed over them. The Tartars ſay, Tamerlane had many engagements in this country with the Kalmucks, whom he in vain endeavoured to conquer. Many perſons go from Tomſky, and other parts, every ſummer, to theſe graves, which they dig up, and find among the aſhes of the dead conſiderable quantities of gold, ſilver, braſs, and ſome precious ſtones, but particularly hilts of ſwords and armour. They find alſo ornaments of ſaddles and bridles, and other trappings for horſes; and ſometimes thoſe of elephants. Whence it appears, that when any general or perſon of diſtinction was interred, all his arms, his favourite horſe and ſervant, were buried with him in the ſame grave; this cuſtom privails to this day among the Kalmucks and other Tartars, and ſeems to be of great antiquity. It appears from the number of graves, that many thouſands muſt have fallen in thoſe places; for the people have continued to dig for treaſure many years and ſtill find it unexhauſted. They are, indeed, ſometimes interrupted, and robbed of all their booty, by parties of Kalmucks, who abhor diſturbing the aſhes of the dead. Armed men on horſeback, caſt in braſs of no mean deſign and workmanſhip, with the figures of deer caſt in pure gold, have been dug out of theſe tombs. They once diſcovered an arched vault, where they found the remains of a man, with his bow, lance, and other arms, laying on a ſilver table. On touching the body, it fell to duſt. The value of the table and arms was very conſiderable. For the manners and cuſtoms of theſe Tartars, ſee KALMUCKS.

Great quantities of a kind of ivory, called by the natives *Mammons-horn*, are found in this country and in Siberia, on the banks of the Oby. They are commonly found on the banks of rivers that have been waſhed by floods. Some of them are very entire and freſh, like the beſt ivory in all reſpects, excepting only the colour which is of a yellowiſh hue. In Siberia they make ſnuff-boxes, combs, and divers ſorts of turnery ware of them. Some have been found weighing above 100 pounds Engliſh.

The moſt conſiderable tribes in Weſtern Tartary, next to the Kalmucks, are the Kalkas and Mungls, or Mongals, properly ſo called. The country of the Kalkas extends eaſtward, from mount Altay to the ſource of the river Kalka, whence they derive their name, in the borders of Eaſtern Tartary and 139th degree of longitude. The territories of the Mungls or Mongalia, lie to the ſouth of thoſe of the Kalkas, between them and the great will of China, to which empire both nations are ſubject. Beſides theſe tribes, who are idolaters of the religion of the Delay Lama, there are others, who poſſeſs that part of Weſtern Tartary called *Turkeſtan*, the original country of the Turks and Turkmans, ſituated to the north of Great Bukharia and Karaſm, between thoſe countries and the dominions of the Eluths. Under Weſtern Tartary alſo is comprehended Tibet, Thibet, or Tobbut, ſubject to the Delay Lama, or great high-prieſt of the Pagan Tartars and Chineſe.

In all the vaſt region of Weſtern Tartary, there are but few towns, moſt of the inhabitants living under tents, eſpecially in ſummer, and moving from place to place with their flocks and herds. They generally encamp near ſome river for the convenience of water.

The air of this country is temperate, wholeſome, and pleaſant, being equally removed from the extremes of heat and cold. As to the ſoil though there are many mountains, lakes, and deſerts in it, yet the banks of the rivers, and the plains, ſome of which are of great extent, are exceeding fertile. The mountains, woods, and deſerts, abound with veniſon, game, and wild fowl; and the rivers and lakes both with fiſh and fowl. In particular, here are wild mules, horſes, and dromedaries, wild boars, ſeveral kinds of deer, a ſpecies of goats with yellow hair, ſquirrels, foxes; an animal called *hautehan*, reſembling an elk; another called *chulon* or *cheliſon*, that ſeems to be a ſort of lynx; and a creature called *tael-pe*, as ſmall as an ermine, of whoſe ſkins the Chineſe make mantles to keep out the cold. Among other birds of extraordinary beauty, bred in this country, there is one called the *ſhonkar*, which is all over white except the beak, wings, and tail, which are of a very fine red. Notwithſtanding the ſoil in many parts of Tartary is ſo luxuriant, yet we are told it does not produce a ſingle wood of tall trees of any kind whatever, excepting in ſome few places towards the frontiers; all the wood that is found in the heart of the country conſiſting of ſhrubs, which never exceed the height of a pike, and even theſe are rare.

It is remarkable, that in all the vaſt dominions of Mongalia, there is not ſo much as a ſingle houſe to be ſeen. All the people, even the prince and high-prieſt, live conſtantly in tents, and remove their cattle from place to place as conveniency requires. Theſe people do not trouble themſelves with ploughing or digging the ground in any faſhion, but are content with the produce of their flocks, though the ſoil is exceedingly fine, and capable, by proper culture, of producing grain of ſeveral ſorts.

In the country of the Mongals the graſs is very thick and rank, and would with little labour make excellent hay. This graſs is often ſet on fire by the Mongals in the ſpring during high winds. At ſuch times it burns moſt furiouſly, running like wild-fire, and ſpreading its flames to the diſtance of perhaps 10 or 20 miles, till its progreſs is interrupted by ſome river or barren hill. The rapidity of thoſe flames, their ſmoke, and crackling noiſe, cannot eaſily be conceived by thoſe who have not ſeen them. When any perſon finds himſelf to the leeward of them, the only method by which he can ſave himſelf from their fury, is to kindle immediately the graſs where he ſtands, and follow his own fire. For this purpoſe every perſon is provided with flints, ſteel, and tinder. The reaſon why the Mongals ſet fire to the graſs, is to procure early paſture to their cattle. The aſhes left upon the ground ſink into the earth at the melting of the ſnow, and prove an excellent manure; ſo that the graſs in the ſpring riſes on the lands which have been prepared in this manner as thick as a field of wheat. Caravans, travellers with merchandiſe, but eſpecially armies, never encamp upon this rank graſs; and there are ſeveral inſtances of conſiderable bodies of men being put in confuſion, and even defeated, by the enemy's ſetting fire to the graſs.

Eaſtern Tartary, according to the limits uſually aſſigned it by hiſtorians and geographers, is bounded to the weſt by Weſtern Tartary, or by that part poſſeſſed by the proper Mungls and Kalkas; on the north by Siberia; on the eaſt by that part of the Oriental Ocean called the *Tartarian Sea;* and on the ſouth by the ſame ſea, the kingdom of Korea, and the Yellow Sea, which ſeparates it from China. It is ſituated between the 137th and 160th degrees of longitude, being about 900 miles long from ſouth to north, and near as many in breadth from weſt to eaſt, yet but thinly peopled. This large region is at preſent divided into three great governments, all ſubject to the Chineſe, viz. Shing-yang or Mugden, Kurin-ula, and Tſitſikar.

The government of Shing-yang, containing all the ancient Lyau-tong or Quan-tong, is bounded on the ſouth by the great wall of China and the Yellow Sea; on the eaſt, north, and weſt, it is incloſed by a wooden paliſade, ſeven or eight feet high, fitter to mark its bounds and keep out petty robbers than to oppoſe an army.

The lands of this province are for the general very fertile, producing abundance of wheat, millet, roots, and cotton. They alſo afford paſture to great numbers of ſheep and oxen, which are rarely ſeen in any of the provinces of China. They have indeed but little rice; yet, to make amends, there is plenty of apples, pears, hazel nuts, filberds, and cheſnuts, even in the foreſts. The eaſtern part, which borders on the ancient country of the Manchews and kingdom of Korea, is full of deſerts and bogs. The principal cities of this government are Shing-yang or Mugden, Fong-whang ching, Inden, Ichew, and Kingchew. This country was the original ſeat of the Tartar tribe of the Manchews, who have been maſters of China above 100 years.

The government of Kirin-ula-hotun is bounded weſtward by the paliſade of Lyau-tong; on the eaſt, by the Eaſtern Ocean; ſouthward, by the kingdom of Korea; and on the north by the great river Saghalian; ſo that it extends no fewer than 12 degrees, and almoſt 20 degrees in longitude being 750 miles in length and 600 in breadth.

This vaſt country abounds in millet and oats, with a ſort of grain unknown in Europe, called by the Chineſe *may-ſem-mi*, as being of a middle kind between wheat and rice. It is wholeſome, and much uſed in thoſe cold regions. There is but little wheat or rice here; but whether that is the fault of the ſoil or the inhabitants, we cannot aſſert. The cold begins much ſooner in theſe parts than at Paris, whoſe latitude is near 50 degrees. The foreſts, which are very thick and large the nearer you advance to the Eaſtern Ocean, contribute not a little to bring it on and keep it up. The banks of the rivers here, in ſummer, are enamelled with a variety of flowers common in Europe, excepting the yellow lilies, which are of a moſt lively colour, in height and ſhape exactly reſembling our white lilies, but are of a much weaker ſcent. But the plant which is moſt eſteemed, and draws a great number of herbaliſts into theſe deſerts, is the gin-ſeng*, called by the Manchews *orhota*, that is, the chief or queen of plants. It is highly valued for its virtues in curing ſeveral diſeaſes, and all decays of ſtrength proceeding from exceſſive labour of body or mind. For this reaſon it has always been the principal riches of Eaſtern Tartary; what is found in the north of Korea being conſumed in that kingdom.

Formerly the Chineſe uſed to get into the gin-ſeng country among the mandarins and ſoldiers continually paſſing; but in 1700 the emperor Kang-hi, that his Manchews might reap this advantage, ordered 10,000 of his ſoldiers, encamped without the great wall, to go and gather it, on condition that each ſhould give him two ounces of the beſt, and take an equal weight of fine ſilver for the remainder: by which means the emperor got in that year 20,000 pounds of it for leſs than one fourth of the price it bears at Pekin. The root is the only part that is uſed medicinally. Its value is enhanced by its age for the largeſt and firmeſt are the beſt. This country abounds alſo in fine ſables, grey ermines, and black foxes.

One of the tribes of Tartars inhabiting this country are called the *Yu-pi Tartars*, whoſe manner of life is ſomewhat extraordinary. All the ſummer they ſpend in fiſhing: one part of what they catch is laid up to make oil for their lamps; another ſerves for their daily food; and the reſt, which they dry in the ſun, without ſalting, for they have no ſalt, is laid up for their winter's proviſions, whereof both men and cattle eat when the rivers are frozen. Notwithſtanding this diet, a great deal of ſtrength and vigour appears in moſt of theſe poor people. Their raiment conſiſts of the ſkins of fiſh, which after dreſſing and dyeing of three or four colours, they ſhape and ſew in ſo delicate a manner, that one would imagine they made uſe of ſilk, till, on ripping a ſtitch or two, you perceive an exceeding fine thong, cut out of a very thin ſkin. When the rivers are frozen, their ſledges are drawn by dogs trained up for the purpoſe, and highly valued.

Although the Manchew language is as much uſed at the court of Pekin as the Chineſe, and all public acts are drawn up in the one as well as the other; yet it began to decline, and would probably have been loſt, had not the Tartars taken great pains to preſerve it, by tranſlating Chineſe books, and compiling dictionaries, under the emperor's patronage. Their language is ſingular in this reſpect, that the verb differs as often as the ſubſtantive governed by it; or, which is the ſame thing, to every different ſubſtantive they uſe a different verb; as for inſtance, when they would ſay, *make a verſe, a picture, a ſtatue*; for though the repetition of the ſame verb in diſcourſe might be excuſable, it is with them unpardonable in writing, as making a monſtrous grating to their ears.

Another ſingularity of their language is the copiouſneſs of it; for inſtance, beſides names for each ſpecies of animals, they have words to expreſs their ſeveral ages and qualities. *Judagon* is the general name for a dog; but *tayha* ſignifies a dog who has very long and thick hair both on his ears and tail; and *yolo*, a dog with a long thick muzzle and tail, large ears, and hanging lips. The horſe, as more ſerviceable to them, has 20 times more names than the dog; almoſt every motion of him giving occaſion to a different name. Where they could get that aſtoniſhing multitude of names and terms, is not eaſy to determine.

This country is but thinly peopled, and contains only four cities, namely, Kirinula-hotun or Khotun, Pedne or Petuna, Ninguta, and Putay-ula-hotun, which are very ill-built, and encompaſſed with no better than mud-walls. The firſt ſtands on the river Songari, and is the reſidence of the Manchew general, who has all the privileges of a viceroy, and commands the mandarines as well as the troops. Ninguta, which the family now reigning in China conſiders as its ancient patrimony, is ſituated on the Hurkapira, which runs northward into the Songari. Its name is compounded of two Tartarian words which ſignify ſeven chiefs, to expreſs the riſe of the Manchew kingdom, which was firſt eſtabliſhed by ſeven brothers of the late emperor Kanghi's great-grandfather's father.

The tribe of the Manchews, who inhabit a part of Eaſtern Tartary, and are lords of all the other inhabitants thereof, are called by the Ruſſians *Bogdoy*, and the emperor of China *Bogdoy Khan* and *Amulon Bogdoy Khan*.

The third government into which Eaſtern Tartary is divided, is that of Tſitſikar. It is 740 miles long and 600 broad; and belongs partly to China and partly to Ruſſia. The people are great hunters, dexterous archers, and pay their tribute in ſable-ſkins; each family being aſſeſſed two or three, or more a-year, according to the number of able perſons.

This province is inhabited chiefly by three ſorts of Tartars, the Manchews, the Solons, and Taguri, of whom the firſt are maſters. The Taguri are a large robuſt people, but not very numerous. They live in houſes or huts, and cultivate barley, oats, and millet. Their cattle are principally horſes, dromedaries, oxen, cows, and ſheep. They make much uſe of their oxen to ride on.

The Solons alſo are a brave robuſt people. Their dreſs is a ſhort jacket of wolves ſkins, with a cap of the ſame; and they have long cloaks made of fox or tigers ſkins, to defend them againſt the cold, eſpecially of the night. They hang their bows at their backs. Their women ride on horſeback, drive the plough, hunt ſtags and other game.

Beſides the country towns or villages, there are three cities

* See Panax.

ties in the province of Tſitſikar, namely, Tiſitſikar, Merghen, and Saghalian-ula-hotun. The garriſon of Tſitſikar, the capital, conſiſts of Manchews; but the inhabitants are moſtly Chineſe. According to their own account, they are all ſhammams, or conjurors, and invoke the devil with frightful cries. They give their dead two burials, firſt leaving a hole at top of the grave, where the relations daily bring victuals, which they convey to the mouth of the deceaſed with a ſpoon, and leave drink in ſmall tin cups ſtanding round the grave. This ceremony holds for ſeveral weeks, after which they burry the body deeper in the ground.

Several rivers in this country produce pearls, which, though much cried up by the Tartars, would be little valued by Europeans, on account of their defects in ſhape and colour.

The kingdoms or countries of Corea, Lyau-tong, and Nyu-che, forming a part of Katay, Kitay, or Cathay, and by ſome included under Eaſtern Tartary, are more properly provinces of China, though they lie without the great wall.

Uſbeck TARTARY. To the north and north-eaſt of Perſia lie the countries of Karaſm, and great and Little Bukharia, which being moſtly ſubject to and inhabited by the tribe of Uſbeck Tartars, are commonly known by the general name of *Uſbeck Tartary*.

The kingdom of Karaſm was known to the ancient Greeks, as appears from Herodotus, Ptolemy, and other authors of that nation, by the name of *Khoraſmia*. At preſent it is bounded on the north by the country of Turkeſtan, and the dominions of the great khan of the Eluths or Kalmucks; on the eaſt, by Great Bukharia, from which it is ſeparated partly by the mountains of Irdar, and partly by the deſerts of Karak and Gaznah; on the ſouth, by the provinces of Aſterabad and Khoraſſan, belonging to Iran or Perſia at large, from which it is divided by a river Jihun or Amu, and ſundry deſerts of a vaſt extent; and on the weſt by the Caſpian Sea.

It may be about 440 miles in length from ſouth to north, and 300 from weſt to eaſt; being ſituated between the 39th and 46th degrees of north latitude, and the 71ſt and 77th degrees of eaſt longitude. The country conſiſts, for the moſt part, of vaſt ſandy plains, ſome of which are barren deſerts, but others afford excellent paſture. There is good land in ſeveral of the provinces where vines grow, and wine is made; but water being ſcarce, a great part of the country turns to no account.

Karaſm owes all its fertility to three rivers and a lake. The rivers are the Amu, Kheſil, and Sir. The Amu, as it is called by the Uſbecks and Perſians, is the Jihun of the Arabs, and Oxus of the ancient Greeks. It has its ſource in thoſe high mountains which ſeparate Little Bukharia from the dominions of the Great Mogul; and, after paſſing through Great Bukharia and Karaſm, divides into two branches, one of which falls into the Kheſil, and the other into the Caſpian Sea, towards the borders of the province of Aſtarabad. The Amu abounds with all ſorts of excellent fiſh, and its banks are the moſt charming in the world. Along them grow thoſe excellent melons and other fruits ſo much eſteemed in Perſia, the Indies, and Ruſſia.

The river Kheſil riſes in the mountains to the north-eaſt of the province of Samarkant, and falls into the lake of Aral or Eagles, 50 or 60 miles below its junction with a branch of the Amu. Its banks are exceeding fertile wherever they are cultivated.

The Sir or Daria riſes in the mountains to the eaſt of Little Bukharia, and after a long courſe weſtward, along the borders of the Bukharias and Karaſm, falls at laſt into the lake Aral.

Karaſm is at preſent inhabited by three ſorts of people, the Sarts, Turkmans, and Uſbeck Tartars. With regard to the firſt of theſe, we are told, that they are the ancient inhabitants of the country, or thoſe who were ſettled there before the Uſbecks became maſters of it; and that they ſupport themſelves like the Turkmans by their cattle and huſbandry. The Turkmans or Turkomans came originally from Turkeſtan or the parts of Tartary to the north of Karaſm and Great Bukharia, towards the 11th century. They divided into two parties; one of which went round the north ſide of the Caſpian Sea, and ſettled in the weſtern parts of the Greater Armenia, from thence called *Turkomania*, or *the country of the Turkomans*. The ſecond party turned ſouth, and reſted about the banks of the river Amu and the ſhores of the Caſpian Sea, where they ſtill poſſeſs a great many towns and villages, in the countries of Karaſm and Aſtarabad.

The name of *Uſbecks*, which the ruling tribe of the Tartars of Karaſm and Great Bukharia bear at preſent, is derived from one of their khans. The Uſbecks of Karaſm are divided into ſeveral hords, and live for the moſt part by rapine; reſembling in all reſpects thoſe of Great Bukharia, excepting that they are much more rude and uncivilized. Like the Turkmans, they dwell in winter in the towns and villages which are towards the middle of Karaſm; and in ſummer the greater part of them encamp in the neighbourhood of the Amu, or in other places where they can meet with paſture for their cattle, always watching for ſome convenient opportunity to rob and plunder. They never ceaſe making incurſions upon the adjacent territories of Perſia or Great Bukharia, and are to be reſtrained by no treaties or engagements whatſoever. Although they have fixed habitations, yet, in travelling from one place to another, they carry with them all their effects of value, conformable to the way of living in uſe among their anceſtors before they had ſettled dwellings.

Theſe Tartars, it is ſaid, never ride without their bows, arrows, and ſwords, although it be in hawking or taking any other diverſion. They have no arts or ſciences among them, neither do they till or ſow. They are great devourers of fleſh, which they cut in ſmall pieces, and eat greedily by handfuls, eſpecially horſe fleſh.

Their chief drink is ſour mare's milk, like that in uſe with the Nogays. They eat their victuals upon the ground, ſitting with their legs double under them, which is their poſture alſo when they pray.

All theſe tribes have abundance of camels, horſes, and ſheep, both wild and tame. Their ſheep are extraordinary large, with great tails weighing 60 or 80 pounds. There are many wild horſes in the country, which the Tartars frequently kill with their hawks. Theſe birds are taught to ſeize upon the head or neck of the beaſt; which being tired with toiling to get rid of this cruel enemy, the hunter, who follows his game, comes up and kills him. Some travellers tell us, that the inhabitants of this country have not the uſe of gold, ſilver, or any other coin, but barter their cattle for neceſſaries. Others tell us, that they have money, particularly a piece of ſilver called *tanga*, the value near the fourth part of a crown. It is round, and has on one ſide the name of the country, and on the other that of the khan, with the year of the hegira. There are alſo, it is ſaid ſmall pieces of copper of different ſizes, which anſwer to our pence, halfpence, and farthings.

As to the government of Karaſm, the Uſbecks being maſters, it is commonly veſted in divers princes of that tribe of the ſame houſe; of whom, notwithſtanding, only one has the title of *khan*, with a kind of ſuperiority over the others.

This khan has no ſort of dependence on him of Great Bukharia, or any other prince.

Bukharia, Bokharia, Bokaria, Bogaria, or *Boharia,* is the name given to all that region or tract of land lying between Karaſm and the Great Kobi, or Sandy Deſert, bordering on China. It is divided into the Great and Little Bukharia. For an account of which, ſee the article Bukharia.

The inhabitants of theſe different countries, which are known by the name of *Tartary,* have a tradition among themſelves that they are all ſprung from one common ſtock, and that they are of the moſt remote antiquity. To this tradition much credit is due; for they are known to be the deſcendants of the ancient Scythians. But when M. Bailly contends that the Tartars are the moſt ancient of nations, and the civilizers of mankind, he writes without authority, and advances a paradox at which every mind muſt recoil. Among the Tartars there are no hiſtorical monuments of antiquity of any credit; for all their writings extant, even thoſe in the Mogul dialect, are long ſubſequent to the time of Mohammed; nor is it poſſible, ſays Sir William Jones, to diſtinguiſh their traditions from thoſe of the Arabs, whoſe religious opinions they have in general adopted. M. Bailly diſplays indeed great learning and ingenuity in his attempt to derive civilization from this ſource; but the greateſt learning and acuteneſs, together with the charms of a moſt engaging ſtyle, can hardly render tolerable a ſyſtem, which places an earthly paradiſe, the gardens of *Heſperus,* the iſlands of the *Macares,* the groves of Elyſium, if not of Eden, the heaven of Indra, the Periſtan or fairy-land of the Perſian poets, with its city of diamonds and its country of *Shadcam,* ſo named from Pleaſure and Love, not in any climate which the common ſenſe of mankind conſiders as the ſeat of delights, but beyond the mouth of the Oby, in the Frozen Sea, in a region equalled only by that where the wild imagination of Dante led him to fix the worſt of criminals in a ſtate of puniſhment after death, and of which he could not, he ſays, even think without ſhivering.

Before the era of Mohammed the Tartars had no literature. The magnificent Chengiz, whoſe empire included an area of near 80 ſquare degrees, could find none of his own Mongals, as the beſt authors inform us, able to write his diſpatches; and Timur or Tamerlane, a ſavage of ſtrong natural parts, and paſſionately fond of hearing hiſtories read to him, could himſelf neither write nor read. It is true, that by ſome Arabian writers mention is made of a ſet of Tartarian characters, ſaid to conſiſt of 41 letters; but from the deſcription of theſe characters, Sir William Jones, with much plauſibility, ſuſpects them to have been thoſe of Tibet.

Aſiatic Reſearches, vol. ii.

" From ancient monuments therefore (continues the learned preſident) we have no proof that the Tartars were themſelves well inſtructed, much leſs that they inſtructed the world; nor have we any ſtronger reaſon to conclude from their general manners and character, that they had made an early proficiency in arts and ſciences; even of poetry, the moſt univerſal and moſt natural of the fine arts, we find no genuine ſpecimens aſcribed to them, except ſome horrible war-ſongs expreſſed in Perſian by Ali of Yezd, and poſſibly invented by him. After the conqueſt of Perſia by the Mongals, their princes indeed encouraged learning, and even made aſtronomical obſervations at Samarkand; as the Turks became poliſhed by mixing with the Perſians and Arabs, though *their very nature,* as one of their own writers confeſſes, *had before been like an incurable diſtemper, and their minds clouded with ignorance:* thus alſo the Mancheu monarchs of China have been patrons of the learned and ingenious, and the emperor Tien-Long is, if he be now living, a fine Chineſe poet. In all theſe inſtances the Tartars have reſembled the Romans, who, before they had ſubdued Greece, were little better than tigers in war, and Fauns or Sylvans in ſcience and art.

" We may readily believe thoſe who aſſure us, that ſome tribes of wandering Tartars had real ſkill in applying herbs and minerals to the purpoſes of medicine, and pretended to ſkill in magic: but the general character of their nation ſeems to have been this; they were profeſſed hunters or fiſhers, dwelling, on that account, in foreſts or near great rivers, under huts or rude tents, or in waggons drawn by their cattle from ſtation to ſtation; they were dexterous archers, excellent horſemen, bold combatants, appearing often to flee in diſorder for the ſake of renewing their attack with advantage; drinking the milk of mares, and eating the fleſh of colts; and thus in many reſpects reſembling the old Arabs, but in nothing more than in their love of intoxicating liquors, and in nothing leſs than in a taſte for poetry and the improvement of their language."

Krim Tartary. See Crimea.

TASSEL, a ſort of pendant ornament at the corners of a cuſhion or the like. In building, taſſels denote thoſe pieces of board that lie under the ends of the mantlet trees.

TASSO (Torquato), a juſtly celebrated Italian poet, was born at Sorrento in the kingdom of Naples, in 1544. He was the ſon of Bernardo Taſſo, the author of ſeveral ingenious compoſitions both in verſe and proſe; and of Portia de Roſſi, a lady of an illuſtrious family of Naples.

His father being obliged to accompany the prince of Salerno to the emperor Charles V. upon a deputation from Naples to remonſtrate againſt erecting the inquiſition there, committed the care of his ſon, then three years old, to Angeluzza, a man of great learning; who, we are told, at this tender age began to teach him grammar: at four he was ſent to the Jeſuit's college, and at ſeven was well acquainted with Latin and Greek. At 12 years of age he went from Rome to Mantua, where his father had entered into the ſervice of the duke Guglielmo Gonzago: he had then completed his knowledge of the Latin and Greek languages; he was well acquainted with rhetoric and poetry, and a maſter of Ariſtotle's ethics; he had alſo ſtudied the precepts of Mauritio Cataneo with particular attention, and ever after reverenced him as a ſecond father.

He was ſoon after ſent to the univerſity of Padua; and, in his 18th year, publiſhed his Rinaldo, a poem written upon the plan of Homer's Odyſſey. This extended his reputation throughout all Italy; but greatly diſpleaſed his father, who foreſaw that it would ſeduce him from ſtudies of more advantage. He went to Padua, to remonſtrate againſt his apparent purpoſe of giving himſelf up to philoſophy and poetry, and made uſe of many very harſh expreſſions, which Taſſo heard with a patience and tranquillity that made the old gentleman ſtill more angry: " Of what uſe is that philoſophy on which you value yourſelf ſo much?" " It has enabled me (replied Taſſo) to endure the harſhneſs of your reproofs."

He ſoon after went to Bologna, by the invitation of the city and college; but in a little time returned to Padua at the preſſing inſtances of Scipio Gonzaga, who had been elected prince of the academy that had been eſtabliſhed in that city by the name of the *Ætherei.* He was incorporated into this ſociety, and took upon himſelf the name of *Pentito.*

In this retreat he formed the deſign of his *Jeruſalem Delivered,* invented the fable, diſpoſed the parts, and determined to dedicate it to the houſe of Eſte; but whether to Alphonſo II the laſt duke of Ferrara, or his brother the cardinal Luigi, to whom he had already dedicated his *Rinaldo,* he was yet in doubt. Being preſſed by both the brothers to reſide with them at Ferrara, he conſented. The duke gave him an apartment in his palace, where he lived in peace and affluence, and proſecuted his work; which he now determined to dedicate to the duke, and which was publiſhed by his patrons, book by book, as he finiſhed them.

When he was about 27, he publiſhed a paſtoral comedy called *Aminta;* which was received with univerſal applauſe, as a maſterpiece in its kind, and is the original of the *Paſtor Fido* and *Filli di Sciro*.

In the 30th year of his age he finiſhed his *Jeruſalem*, and the whole was reprinted and publiſhed together: the ſucceſs of it was aſtoniſhing; it was tranſlated into Latin, French, Spaniſh, and even the Oriental languages, almoſt as ſoon as it appeared.

But it was Taſſo's fate to become wretched from the moment that he gained the ſummit of reputation: very ſoon after his *Jeruſalem* was publiſhed he loſt his father, who died at Oſtia upon the Po, the government of which place had been given him by the duke of Mantua; his *Jeruſalem* was attacked by a ſwarm of ignorant but petulant critics, who gave the preference to the rhapſodies of Pulci and Boyardo; and the perfidy of a friend drew upon him much greater misfortunes.

This friend was a gentleman of Ferrara, to whom Taſſo had indiſcreetly communicated ſome tranſactions of a very delicate nature concerning his patron the duke, with whom he lived. This ſecret being betrayed, Taſſo reproached, his friend for his treachery; and this reproach was retorted in ſuch a manner as provoked Taſſo to ſtrike him. A challenge immediately enſued, and the opponents met and engaged; but during the rencounter, three brothers of Taſſo's antagoniſt came up, and all fell upon him together: Taſſo defended himſelf ſo well, that he wounded two them, and kept his ground againſt the others till ſome people came up and parted them. This made a grear noiſe at Ferrara, where nothing was talked of but the valour of Taſſo; and it became a kind of proverb, "That Taſſo, with his pen and his ſword, was ſuperior to all men."

The duke being informed of the quarrel, baniſhed the brothers from his dominions, confiſcated their eſtates, and Taſſo himſelf he ſhut up in priſon, under pretence of ſecuring him from any future attacks of his enemies.

Taſſo found means to eſcape from this confinement, after having ſuffered it about a year; and, being now about 34 years of age, retired to Turin, where he was ſoon known and recommended to the duke of Savoy, who ſhowed him many marks of eſteem and affection: but Taſſo, fearing that the duke of Ferrara would require him to be delivered up, and that the duke of Savoy would chooſe rather to comply than forfeit the friendſhip of that prince, precipitately ſet out for Rome alone, and without proper neceſſaries for ſuch a journey.

He got ſafe, however, to Rome; where he went directly to his friend Mauritio Cataneo, who received him with great kindneſs, and the whole city ſeemed to rejoice at the preſence of ſo extraordinary a perſon. He was viſited by princes, cardinals, prelates, and all the learned in general. But being impatient of exile, he took meaſures to make his peace with the duke, and ſucceeded.

The duke received him with great appearance of ſatisfaction, and gave him freſh marks of his eſteem. But Taſſo having made ſome attempts on the princeſs Leonora, whom he has celebrated in ſeveral of his verſes, the duke her brother, believing, or pretending to believe, that his ill conduct proceeded from a diſordered underſtanding, cauſed him to be ſtrictly confined in the hoſpital of St Anne. Taſſo applied to the duke, by every friend he had, to releaſe him from this confinement; but the duke coldly anſwered, that inſtead of endeavouring to procure the enlargement of a perſon in his condition, they ought rather to exhort him to ſubmit patiently to ſuch remedies as were judged proper for him. Taſſo was certainly diſordered in his mind, whether as the effect or cauſe of this confinement: he was conſcious that he laboured under ſome diſtemper, and he believed the cauſe of it to be ſupernatural, and fancied himſelf haunted by a ſpirit that continually diſordered his books and papers; to which, however, the tricks played him by his keepers might contribute. He continued, notwithſtanding, to ſolicit the interpoſition of all the powers in Italy, to whom he could find means to apply, particularly the emperor and the pope; but without ſucceſs. At laſt, after he had been a priſoner ſeven years, Vincentio Gonzaga prince of Mantua came to Ferrara among other great perſonages, during the feſtivals and rejoicings that were held there on the marriage of Cæſar of Eſte with Virginia of Medicis, procured his liberty, and took him with him to Mantua, he being then in the 42d year of his age.

At Mantua he lived about a year in great favour with the prince, and in all the ſplendour and affluence which the favour of great princes confers: but he was weary of a ſtate of dependence, however ſplendid and luxurious; and therefore reſolved to go to Naples, and endeavour to recover his mother's jointure, which had been ſeized by her relations when he went into exile with his father Bernardo. With this view he procured letters of recommendation to the viceroy; and having taken leave of the prince of Mantua, he went firſt to Bergamo, where he ſtaid ſome time, and from thence proceeded to Naples.

At Naples he immediately commenced a ſuit at law for the recovery of his right, and divided his time between a proſecution of that and his ſtudies. But during the ſummer he retired to Biſaccio with one Giovanni Batiſta Manſo, with whom he had contracted an intimate friendſhip.

Taſſo, who was now in his 45th year, appeared to Manſo, while they were at Biſaccio, to be affected with a melancholy, which had very ſingular effects; he therefore very frequently queſtioned him about them; and Taſſo told him that he had a familiar ſpirit; with whom he frequently and freely converſed. Manſo treated this as an illuſion, but Taſſo ſtill affirmed it to be real; and telling him that the ſpirit would meet and converſe with him the next day, invited him to be preſent. Manſo coming at the hour appointed, ſaw Taſſo fix his eyes with great earneſtneſs upon a window, and perceiving him to continue without motion, he called him ſeveral times by his name. Taſſo made no reply; but at length cried out with great vehemence, "There is the friendly ſpirit that is come to converſe with me; look, and be convinced that what I have ſaid is true." Manſo looked, not without ſome ſurpriſe, but ſaw nothing except the ſun-beams which ſhone through the window. He was juſt going to aſk where the pretended ſpirit was, when he was prevented by Taſſo's ſpeaking with great earneſtneſs to ſome imaginary being ſometimes putting queſtions, and ſometimes giving anſwers, in a manner ſo pleaſing, and with ſuch elevation of expreſſion, that Manſo had no deſire to interrupt him: the converſation at laſt ended by the ſuppoſed departure of the ſpirit; when Taſſo turning round to his friend, aſked if his doubts were removed? To which he made no reply, being ſo much amazed that he gladly waved all farther converſation on the ſubject.

Finding his law-ſuit not likely to be ſoon determined, he went from Naples to Rome, where he continued about a year in high favour with Pope Sextus Quintus; and then went to Florence, at the preſſing invitation of Ferdinando grand duke of Tuſcany, who had been cardinal at Rome when Taſſo firſt reſided there.

Having ſpent about another year at Florence, he returned again to Naples; and there applied himſelf to correct his *Jeruſalem Delivered.* Soon after the publication of this work, Hippolito Aldrobandini ſucceeded Sextus Quintus to the papacy, by the name of *Clement the VIIth;* and his two nephews, Cynthio and Pietro Aldrobandini, were created cardinals. Cynthio, who was a great patron of learning and genius, and had known Taſſo when he laſt reſided at Rome, prevailed with him once more to leave his retreat at Naples, and live with him in that city. Here he continued till his 50th year; and being then again weary of his ſituation, and deſirous to proſecute his law-ſuit, he obtained permiſſion to retire once more to Naples, where he took up his abode with the Benedictine fathers in the convent of St Severin. Cardinal Cynthio, however, found means to recal him again to Rome, after a very ſhort abſence, by having prevailed with the Pope to confer upon him the honour of being publicly and ſolemnly crowned with laurel in the Capitol.

He ſet out from Naples to receive this honour, with a preſage that he ſhould never return; and arrived at Rome in the beginning of the year 1595, being then about 51 years old: he was met at the entrance of the city by many prelates and perſons of diſtinction, and was introduced by the two cardinals to the pope, who complimented him by ſaying, "That his merit would confer as much honour on the laurel he was about to receive, as the laurel had formerly conferred on others." Orders were immediately given to decorate not only the pope's palace and the Capitol, but all the principal ſtreets through which the proceſſion was to paſs: but Taſſo, whether from an habitual dejection of mind, or a ſecret ſenſation of the firſt approaches of a diſeaſe which he apprehended would be fatal, declared that all theſe pompous preparations would be in vain.

It happened, that while they were waiting for fair weather to celebrate the ſolemnity, cardinal Cynthio fell ſick; and, before he was perfectly recovered, Taſſo himſelf was taken ill, and died on the 15th day of his ſickneſs, aged 51. His poems have acquired him an immortal reputation. The principal of them are, 1. Jeruſalem Delivered. 2. Jeruſalem Conquered. 3. Rinaldo. 4. The Seven Days of the Creation. 5. The Tragedy of Torimond. 6. Aminta, &c. All Taſſo's works were printed together at Florence in 1724, in ſix volumes folio, with the pieces for and againſt his Jeruſalem Delivered. A ſplendid edition of this laſt poem was printed at Venice in 1745, in folio. The beſt edition of Mirebaud's French tranſlation is that of Paris in 1735, in two vols 12mo. His *Aminta* and *Gieruſalemme Liberata* have been tranſlated into Engliſh.

TASTE, a certain ſenſation, or claſs of ſenſations, excited in the mind by certain bodies, which are called *ſapid,* applied to the tongue and palate, and moiſtened with the ſaliva. This is the original and proper meaning of the word *taſte* (ſee METAPHYSICS, nº 46); but as the qualities of bodies which produce theſe ſenſations are unknown, they have in all languages got the names of the ſenſations themſelves, by that figure of ſpeech which ſubſtitutes the cauſe for the effect. Hence we talk of the taſtes of ſugar, wormwood, honey, vinegar, &c.; and ſay, that the taſte of ſugar is ſweet, and of vinegar ſour. Taſtes have been divided into ſimple and compound; and philoſophers have to very little purpoſe eadeavoured to aſcertain the number of each ſpecies. Attempts have likewiſe been made to determine from their taſtes the effects of different ſubſtances on the human body, taken into the ſtomach as food or phyſic; but by ſtating the reſults of the various inquiries, we ſhould be more likely to miſlead the unlearned reader, than to communicate uſeful information to readers of any deſcription. Whoever is deſirous of information on the ſubject may conſult *Phil. Tranſ.* Nº 280, 299; and *Abercromb. Nov. Med. Clavis.*

TASTE is likewiſe uſed in a figurative ſenſe, to denote that faculty of the mind by which we perceive and enjoy whatever is beautiful or ſublime in the works of nature or of art. Like the taſte of the palate, this faculty reliſhes ſome things, is diſguſted with others, and to many is indifferent; and from theſe obvious analogies between it and the external ſenſe it has obtained its name. It has likewiſe been called an internal *ſenſe,* and by one philoſopher * a *reflex ſenſe;* whilſt others have conſidered it, not as a diſtinct faculty or ſenſe, but as the joint exertion of perception and judgment in ſome caſes, and as a play of the imagination in others.

To decide among theſe different opinions, it will be neceſſary to aſcertain, if we can, what are the objects of this faculty; for we hardly think that every thing which is beautiful, either in nature or art, can with propriety be called an object of taſte. *Scarlet, blue, green,* and *yellow,* are all beautiful colours, and a *cube* and a *ſphere* are beautiful figures; but it does not appear to us, that a man could be ſaid to have either a good or a bad taſte for reliſhing the perception of a *ſcarlet* more than that of a *yellow* colour, or a *ſpherical* more than a *cubical* figure. A native of Africa conſiders thick lips and a flat noſe as eſſential to female beauty; whilſt the inhabitant of Europe prefers to all other forms of the noſe that which is called *Grecian,* and is diſguſted with lips either very thick or very thin. But upon what principles can we ſay that the African has a bad, and the European a good, taſte?

With reſpect to the objects of the external ſenſe, we are generally ſo conſtituted by nature as to reliſh, in the higheſt degree, thoſe kinds of food which are moſt wholeſome; and ſuch a taſte, which we believe is always found in infants, is juſtly ſaid to be ſound and uncorrupted. It is in the higheſt perfection too at firſt; for it depends not upon culture of any kind, and is incapable of improvement. The reverſe of all this is the caſe with reſpect to internal taſte; of which the variety is obvious to the moſt careleſs obſerver, and is found, on examination, to be ſtill greater in reality than it is in appearance. Every voice is indeed united in applauding elegance, propriety, ſimplicity, ſpirit in writing; and in blaming ſuſtian, affectation, coldneſs, and a falſe brilliancy: but when critics come to particulars, this ſeeming unanimity vaniſhes; and it is found that they had affixed very different meanings to the ſame expreſſions. Perhaps no man ever attentively beheld the riſing or the ſetting ſun without feeling ſome emotions of pleaſure which filled his mind; or went for the firſt time into ſuch a building as the cathedral church of York, without being ſtruck with a pleaſing, though ſolemn, reverence. Yet it is certain, that the emotions of the clown, however acute he may be by nature, and perfect in all his faculties, are not the ſame, at leaſt in degree, with thoſe of the poet or philoſopher when contemplating the riſing or ſetting ſun; or of the ſcientific mechanic when viewing the ſtructure of the pillars and roof of the Gothic cathedral. We are not indeed ſure that the pleaſure of the clown on theſe occaſions riſes above that of mere ſenſation. Any bright and beautiful object preſented to the eye, gives a pleaſing ſenſation to the mind, in conſequence of that peculiar agitation which ſuch objects communicate to the optic nerves and the brain; and to us it appears, that the clown feels nothing more than this from the view of the riſing ſun or the magnificent church. Perhaps he may compare the ſenſations which he feels on theſe occaſions with others which he has formerly felt in ſome degree ſimilar to them, and have his pleaſure heightened by the exerciſe of that faculty of which the province is to judge upon compariſon; but we have no reaſon to ſuppoſe, that from the riſing ſun he receives any emotions different in kind from what he would receive from a blazing heath, were it accompanied with the ſame varying tints of colour; or that the church impreſſes on his fancy more than that wonder with which he would view any other building equally large and equally novel, though of a form very different. In poetry and painting the vulgar are always delighted with the melody of the verſe and the brilliancy of the colours; and think of nothing elſe as beauties, either in the one or in the other, unleſs the painting be the picture of ſome known object, and the poem deſcribe ſcenes or actions in which they may be ſelfiſhly intereſted. Hence it is that the vulgar are more captivated by the ſplendor of the Venetian ſtyle of painting, than by the ſimple grandeur of the Roman and Bolognian Schools; for the art of the former, which has been carried to the higheſt degree of perfection, is to give pleaſure to the eye or the ſenſe; that of the latter is to fill the imagination. The powers exerted in the former ſchool Sir Joſhua Reynolds calls the *language* of painters, which he compares to an *empty tale told by an idiot, full of ſound and fury, ſignifying nothing*. The compoſitions of the latter ſchools may be compared to the ſublimity of Milton's ſentiments, which would be diſgraced by thoſe petty ornaments to which it leaves not the reader at leiſure to attend.

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* Dr Hutcheſon.

If this be ſo, the pleaſures which the vulgar derive from what are called objects of taſte are merely gratifications of the ſenſes; or if any of theſe objects ever intereſt their higher faculties, it muſt be by inſpiring them with confidence or dread; confidence of their own ſafety, for inſtance, if the building which they admire appear to them to be ſtable; and dread, if they have formed of it a contrary opinion. Very different is the pleaſure which the man of cultivated taſte derives from the beauties either of nature or of art: when he beholds the riſing or the ſetting ſun, he has indeed the pleaſing ſenſation, which is all that the rude man feels; but along with this ariſes in his imagination a train of ideas, which hurries him beyond the object before him to its beneficent effects and its Almighty Creator: and if he has been much converſant with the works of deſcriptive poets, a number of pleaſing ideas treaſured up in his memory will, by the principle of aſſociation, paſs in review before him, though they be not connected either with one another, or with the riſing or ſetting ſun, by a relation ſo cloſe as that of cauſe and effect. In like manner, when the ſcientific architect views the Gothic cathedral, he muſt admire its ſolemn magnificence, though with leſs wonder than it excites in the breaſt of the clown; but he feels an additional pleaſure, derived from a ſource to which the other has no acceſs. He perceives the many contrivances diſplayed in its ſtructure for uniting ſtability with lightneſs; and from contemplating the building, he is inſtantly led by a natural train of thought to admire the ſkill of the builder.

The nature of any perſon's taſte, therefore, is generally determined from the character of his imagination and the ſoundneſs of his judgment. When any object either of ſublimity or beauty is preſented to the mind, every man is conſcious of a train of thought being immediately awakened in his imagination, analogous to the character or expreſſion of the original object. The ſimple perception of the object we frequently find is inſufficient to excite theſe emotions, unleſs it is accompanied with this operation of mind; unleſs, according to common expreſſion, our imagination is ſeized, and our fancy buſied in the purſuit of all thoſe trains of thought which are allied to this character or expreſſion. Thus, when we feel either the beauty or ſublimity of natural ſcenery, the gay luſtre of a morning in ſpring, or the mild radiance of a ſummer evening, the ſavage majeſty of a wintry ſtorm, or the wild magnificence of a tempeſtuous ocean, we are conſcious of a variety of images in our minds, very different from thoſe which the objects themſelves can preſent to the eye. Trains of pleaſing or of ſolemn thought ariſe ſpontaneouſly within our minds; our hearts ſwell with emotions, of which the objects before us ſeem to afford no adequate cauſe; and we are never ſo much ſatiated with delight, as when, in recalling our attention, we are unable to trace either the progreſs or the connection of thoſe thoughts which have paſſed with ſo much rapidity through our imagination.

If the mind is in ſuch a ſtate as to prevent this freedom of imagination, the emotion, whether of ſublimity or beauty, is unperceived. In ſo far as the beauties of art or nature affect the external ſenſes, their effect is the ſame upon every man who is in poſſeſſion of theſe ſenſes. But to a man in pain or in grief, whoſe mind by theſe means is attentive only to one object or conſideration, the ſame ſcene or the ſame form will produce no feeling of admiration, which, at other times, when his imagination was at liberty, would have produced it in its fulleſt perfection. It is upon the vacant and the unemployed, accordingly, that the objects of taſte make the ſtrongeſt impreſſion. It is in ſuch hours alone that we turn to the compoſitions of muſic or of poetry for amuſement. The ſeaſons of care, of grief, or of buſineſs, have other occupations, and deſtroy, for the time at leaſt, our ſenſibility to the beautiful or the ſublime, in the ſame proportion that they produce a ſtate of mind unfavourable to the indulgence of imagination.

There are many objects of taſte, however, which produce not their full effect on the imagination, but through the medium of the judgment. We have given one inſtance in architecture, and ſhall give another in ſculpture. The beauty of the Farneſe Hercules is one kind of beauty; that of the gladiator in the palace of Chighi another; and that of the Apollo of Belvidere a third. Each of theſe figures is acknowledged to be perfect in its kind; and yet Sir Joſhua Reynolds affirms, that the higheſt perfection of the human figure is not to be found in any one of them, but in that form which might be taken from them all, and would partake equally of the activity of the gladiator, of the delicacy of the Apollo, and of the muſcular ſtrength of the Hercules. If the judgment of this eminent artiſt be admitted, the perfection of theſe ſtatues cannot conſiſt in any thing which is the immediate object of ſenſe, either external or internal; but in ſomething which, being perceived by the eye, is referred by the underſtanding to what we know of the characters of Hercules, Apollo, and the Gladiator, and which we believe it was the intention of the ſtatuaries to expreſs. Nay, there are objects of which taſte is ſometimes ſaid to judge, though they have little or no effect whatever on the imagination. A book of abſtract ſcience, written in a prolix and intricate ſtyle, might be ſaid to be in a bad taſte; and had Swift, in his clear and ſimple ſtyle, written *An Eſſay on the Human Underſtanding*, his work, ſuppoſing him maſter of the ſubject, would undoubtedly have diſplayed more taſte than Locke's, in which the terms are ſometimes vague, and the periods often encumbered. This is actually the caſe of Berkeley, whom every man admits to have been a writer of good taſte, though neither *The Principles of Human Knowledge*. *The Dialogues on Matter*, nor the beautiful work entitled *The Minute Philoſopher*, is capable of affording pleaſure to the ſenſes or the imagination. His beauty conſiſts merely in the perſpicuity of his ſtyle, of which the underſtanding alone is the judge. The metaphyſical writings of Dr Reid poſſeſs in an eminent degree the ſame beauty; and no man of true taſte can read them without admiring the elegant ſimplicity of the compoſition as much as the ſtrength of the reaſoning, and feeling from the whole a pleaſure which the poetical ſtyle of Shafteſbury cannot communicate.

If this be a juſt account of the pleaſures of taſte, that faculty cannot be properly conſidered as a mere internal ſenſe, ſince to its enjoyments a well-ſtored fancy is neceſſary in ſome caſes, and the reaſoning power in all; and the poet and the painter who wiſh to excel in their reſpective profeſſions, muſt not content themſelves, the one with filling the ear of the reader with mellifluous ſounds, and the other with dazzling or deceiving the eye of the ſpectator by the brilliancy of his colours, but both muſt ſtrive for fame by captivating the imagination; whilſt the architect, who aſpires to a ſimilar celebrity, muſt make the purpoſe of his ornaments obvious to every perſon capable of judging. The landſcapes of Claude Lorrain, the muſic of Handel, the poetry of Milton, excite feeble emotions in our minds, when our attention is confined to the qualities they preſent to our ſenſes, or when it is to ſuch qualities of their compoſition that we turn our regard. It is then only we feel the ſublimity or beauty of their productions, when our imaginations are kindled by their power, when we loſe ourſelves amid the number of images that paſs before our minds, and when we waken at laſt from this play of fancy as from the charm of a romantic dream.

It is well obſerved by Sir Joſhua Reynolds,* that taſte is ſometimes praiſed in ſuch terms by orators and poets, who call it *inſpiration*, and *a gift from heaven*, that though a ſtudent by ſuch praiſe may have his attention rouſed, and a deſire excited of obtaining this gift, he is more likely to be deterred than encouraged in the purſuit of his object. "He examines his own mind, and perceives *there* nothing of that divine inſpiration with which he is told ſo many others have been favoured. He never travelled to heaven to gather new ideas; and he finds himſelf poſſeſſed of no other qualifications than what mere common obſervation and a plain underſtanding are able to confer. Thus he becomes gloomy amidſt the ſplendour of figurative declamation, and thinks it hopeleſs to purſue an object which he ſuppoſes out of the reach of human induſtry. But on this, as on many other occaſions, we ought to diſtinguiſh how much is to be given to enthuſiaſm, and how much to common ſenſe; taking care not to loſe in terms of vague admiration that ſolidity and truth of principle upon which alone we can reaſon." Whoever poſſeſſes the ordinary powers of perception, ſenſibility of heart, good ſenſe, and an imagination capable of being rouſed by the ſtriking objects of nature and of art, may, without inſpiration, become, by mere experience, a man of fine taſte in the objects of which he aſpires to be a critical judge.

This being the caſe, we may eaſily account for the variety of taſtes which prevail among men, not only as individuals but as nations. We have already mentioned the difference in one inſtance between the European taſte and the African reſpecting female beauty; and we may now affirm, as we hope to prove our affirmation, that the one taſte is equally correct with the other. The charms of female beauty exiſt not in the mere external form and colour conſidered by themſelves (for then the inanimate ſtatue of the Venus de Medicis would give more delight to the European beholder than the fineſt woman that ever lived); but we aſſociate external beauty with ſweetneſs of diſpoſition, and with all the train of endearments which take place in the union of the ſexes; and it is this aſſociation which delights the man of taſte, as giving refinement to an appetite which in itſelf is groſs and ſenſual. A ſimilar aſſociation muſt be formed in the breaſt of the African who has any taſte; and as he never knew feminine ſoftneſs, or any of the endearing qualities of the ſex, but as united with thick lips, a flat noſe, a black ſkin, and woolly hair—a ſable beauty of that deſcription muſt excite in his breaſt the ſame emotions that are excited in the breaſt of an European by the fair woman with Grecian features.

But is there not an ideal or perfect beauty of the human form? There certainly is, as of every other natural object; but it cannot be the ſame in Europe as in Africa, unleſs to a Being who is acquainted with all the peculiarities of form, national and individual, that are to be found among the inhabitants of the whole earth. It has been ſuppoſed, and we think completely proved, by one of the beſt writers that we have on the philoſophy of taſte,* that the ſublimity or beauty of forms ariſes altogether from the aſſociations we connect with them, or the qualities of which they are expreſſive to us. The qualities expreſſed by the male and female forms are very different; and we would by no means think the woman beautiful who ſhould have the form of the Farneſe Hercules, or admire the ſhapes of the hero who ſhould be formed like the Venus de Medicis; becauſe the proportions of ſuch a woman would indicate ſtrength and intrepidity, where we wiſh to find only gentleneſs and delicacy; and the delicate form of the hero would indicate ſoftneſs and effeminacy, where the oppoſite qualities only can be eſteemed. As we aſſociate with the female form many deſirable qualities, every woman is eſteemed more or leſs beautiful as her figure and features indicate a greater or ſmaller number of theſe qualities; and the ſame is the caſe with reſpect to the qualities which adorn the male character, and the form and features by which they are expreſſed. Upon comparing a number of human beings with one another, we find, that with reſpect to every feature and limb, there is one central form to which nature always tends, though ſhe be continually deviating from it on the right hand and on the left: (See Nose). This form therefore is conſidered as the moſt perfect form of the ſpecies, and moſt expreſſive of the qualities for which that ſpecies is valued; but in Africa, the central form, with reſpect to the proportions of the human body and the features of the human face, is very different from what it is in Europe; and therefore the ideal or perfect beauty of the human form and features cannot be the ſame in both countries. No doubt, if a man could examine the limbs and features of every individual of the human race, he would diſcover one central form belonging to the whole, and be led to eſteem it the ſtandard of beauty; but as this is obviouſly impoſſible, the common idea or central form belonging to each great claſs of mankind muſt be eſteemed the ſtandard of beauty in that claſs, as indicating moſt completely the qualities for which individuals are eſteemed. Thus there is a common form in childhood and a common form in age; each of which is the more perfect as it is the more remote from peculiarities: but though age and childhood have ſomething in common, we ſhould not deem the child beautiful who was formed exactly like the moſt handſome man, nor the man handſome who was formed exactly like the moſt beautiful child. This doctrine is well illuſtrated by Sir Joſhua Reynolds,* who has applied it to every object eſteemed beautiful in nature; and proved, that the ſuperiority of Claude Lorrain over the landſcape-painters of the Dutch and Flemiſh ſchools, ariſes chiefly from his having generalized his conceptions, and formed his pictures by compounding together the various draughts which he had previouſly made from various beautiful ſcenes and proſpects. "On the whole (ſays he), it ſeems to me that there is but one preſiding principle which regulates and

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Diſcourſe elivered at he Royal cademy, ec. 14. 770.

* Mr Aliſon.

gives ſtability to every art. The works, whether of poets, painters, moraliſts, or hiſtorians, which are built upon general nature, live for ever; while thoſe which depend for their exiſtence on particular cuſtoms and habits, a particular view of nature, or the fluctuation of faſhion, can only be coeval with that which firſt raiſed them from obſcurity. All the individual objects which are exhibited to our view by nature, upon cloſe examination, will be found to have their blemiſhes and defects. The moſt beautiful forms have ſomething about them like weakneſs, minuteneſs, or imperfection. But it is not every eye that perceives theſe blemiſhes: It muſt be an eye long uſed to the contemplation and compariſon of theſe forms; which alone can diſcern what any ſet of objects of the ſame kind has in common, and what each wants in particular."

From theſe reaſonings the ſame great artiſt concludes, that the man who is ambitious of the character of poſſeſſing a correct taſte, ought to acquire a "habit of comparing and digeſting his notions. He ought not to be wholly unacquainted with that part of philoſophy which gives him an inſight into human nature, and relates to the manners, characters, paſſions, and affections. He ought to know *ſomething* concerning the *mind*, as well as a great deal concerning the *body*, and the various external works of nature and of art; for it is only the power of diſtinguiſhing right from wrong that is properly denominated *taſte*.

"Genius and taſte, in their common acceptation, appear to be very nearly related; the difference lies only in this, that genius has ſuperadded to it a habit or power of execution. Or we may ſay, that taſte, when this power is added, changes its name, and is called *genius*. They both, in the popular opinion, pretend to an entire exemption from the reſtraint of rules. It is ſuppoſed that their powers are intuitive; that under the name of *genius* great works are produced, and under the name of *taſte* an exact judgment is given, without our knowing why, and without being under the leaſt obligation to reaſon, precept, or experience.

"One can ſcarce ſtate theſe opinions without expoſing their abſurdity; yet they are conſtantly in the mouths of men, and particularly of illiterate and affected connoiſſeurs. The natural appetite, or taſte of the human mind, is for *truth*; whether that truth reſults from the real agreement or equality of original ideas among themſelves, from the agreement of the repreſentation of any object with the thing repreſented, or from the correſpondence of the ſeveral parts of any arrangement with each other. It is the very ſame taſte which reliſhes a demonſtration in geometry, that is pleaſed with the reſemblance of a picture to an original, and touched with the harmony of muſic.

"But beſides *real*, there is alſo *apparent* truth, or opinion, or prejudice. With regard to real truth, when it is known, the taſte which conforms to it is and muſt be uniform. With regard to the ſecond ſort of truth, which may be called *truth upon ſufferance*, or *truth by courteſy*, it is not fixed but variable. However, whilſt theſe opinions and prejudices on which it is founded continue, they operate as truth; and the art, whoſe office it is to pleaſe the mind as well as inſtruct it, muſt direct itſelf according to *opinion*, or it will not attain its end. In proportion as theſe prejudices are known to be generally diffuſed or long received, the taſte which conforms to them approaches nearer to certainty, and to a ſort of reſemblance to real ſcience, even where opinions are found to be no better than prejudices. And ſince they deſerve, on account of their duration and extent, to be conſidered as really true, they become capable of no ſmall degree of ſtability and determination by their permanent and uniform nature.

"Of the judgment which we make on the works of art, and the preference that we give to one claſs of art over another, if a reaſon be demanded, the queſtion is perhaps evaded by anſwering, I judge from my taſte; but it does not follow that a better anſwer cannot be given, though for common gazers this may be ſufficient. Every man is not obliged to inveſtigate the cauſes of his approbation or diſlike. The arts would lie open for ever to caprice and caſualty, if thoſe who are to judge of their excellencies had no ſettled principles by which they are to regulate their deciſions, and the merit or defect of performances were to be determined by unguided fancy. And indeed we may venture to aſſert, that whatever ſpeculative knowledge is neceſſary to the artiſt, is equally and indiſpenſably neceſſary to the critic and the connoiſſeur.

"The firſt idea that occurs in the conſideration of what is fixed in art or in taſte, is that preſiding principle which we have already mentioned, the general idea of nature. The beginning, the middle, and the end of every thing that is valuable in taſte, is compriſed in the knowledge of what is truly nature; for whatever ideas are not conformable to thoſe of nature or univerſal opinion, muſt be conſidered as more or leſs capricious; the idea of nature comprehending not only the forms which nature produces, but alſo the nature and internal fabric and organization, as I may call it, of a human mind and imagination. General ideas, beauty, or nature, are but different ways of expreſſing the ſame thing, whether we apply theſe terms to ſtatues, poetry, or picture. Deformity is not nature, but an accidental deviation from her accuſtomed practice. This general idea therefore ought to be called *nature*; and nothing elſe, correctly ſpeaking, has a right to that name. Hence it plainly appears, that as a work is conducted under the influence of general ideas, or partial, it is principally to be conſidered as the effect of a good or a bad taſte."

Upon the whole, we may conclude that the real ſubſtance, as it may be called, of what goes under the name of *taſte*, is fixed and eſtabliſhed in the nature of things; that there are certain and regular cauſes by which the imagination and paſſions of men are affected; and that the knowledge of theſe cauſes is acquired by a laborious and diligent inveſtigation of nature, and by the ſame ſlow progreſs as wiſdom or knowledge of every kind, however inſtantaneous its operations may appear when thus acquired. A man of real taſte is always a man of judgment in other reſpects; and thoſe inventions which either diſdain or ſhrink from reaſon, are generally more like the dreams of a diſtempered brain than the exalted enthuſiaſm of a ſound and true genius. In the midſt of the higheſt flights of fancy or imagination, reaſon ought to preſide from firſt to laſt; and he who ſhall decide on the beauties of any one of the fine arts by an imaginary innate ſenſe or feeling, will make as ridiculous an appearance as the connoiſſeur mentioned by Dr Moor, who praiſed as a work of the divine Raphael the wretched daubing by a Swiſs copyiſt. The reader who wiſhes for further inſtruction in the philoſophy of taſte, may conſult Gerard's Eſſay on Taſte, with the diſſertations of Voltaire, d'Alembert, and Monteſquieu; Dr Blair's Lectures on the Belles Lettres; Dr Reid's Eſſays on the Intellectual Powers of Man; Aliſon's Eſſays on the Nature and Principles of Taſte; and Sir Joſhua Reynolds' Diſcourſes delivered in the Royal Academy.

TATE (Nahum), an Engliſh poet, born about the middle of the reign of Charles II. in Ireland, where he received his education. He was made poet-laureat to King William upon the death of Shadwell, and held that place until the reign of George I. whoſe firſt birth-day ode he lived to write, and executed it with unuſual ſpirit. He died in the mint in 1716, and was ſucceeded in the laurel by Mr Euſden. He was the author of nine dramatic performances, a great number of poems, and a verſion of the Pſalms in conjunction with Dr Nicholas Brady.

TATIAN, a writer of the primitive church in the ſecond century. He was born in Aſſyria, and trained up in the heathen religion and learning. Coming over to Chriſtianity, he became the diſciple of Juſtin Martyr, whom he attended to Rome. While Juſtin lived, he continued ſteadily orthodox: but after Juſtin's death he made a ſchiſm, and became the author of a new ſect, condemning marriage, enjoining abſtinence from wine and animal-food, and ſuffering only water to be uſed in the holy myſteries; whence his followers were called *Encratitæ* and *Hydroparaſtatæ*. None of his works are now extant but his piece againſt the Gentiles; or, as it is uſually intitled, his *Oration to the Greeks*.

TATIUS (Achilles), a native of Alexandria, was the author of a book on the ſphere, which father Petau tranſlated into Latin. There is alſo attributed to him a Greek romance on the loves of Leucippe and Clitophon, of which Salmaſius has given a beautiful edition in Greek and Latin, with notes. Suidas ſays, that this Achilles Tatius was a Pagan, but that he afterwards embraced the Chriſtian religion, and became a biſhop. Photius mentions him in his Bibliotheca.

TATONNEUR, in zoology. See LEMUR.

TATTOOING, or TATTOWING, an operation in uſe among the iſlanders in the South Sea for marking their bodies with figures of various kinds which they conſider as ornamental. It is performed by puncturing the ſkin, and rubbing a black colour into the wounds. The inſtrument uſed ſomewhat reſembles a comb, the teeth of which are repeatedly ſtruck into the ſkin by means of a ſmall mallet. It is very painful; but the children are forced by their relations to ſubmit to it.

TATTOU, a beat of a drum at night to advertiſe the ſoldiers to retreat, or repair to their quarters in the garriſon, or to their tents in a camp.

TAVERNIER (John Baptiſt), a famous French traveller, was born in 1605. In the courſe of 40 years he travelled ſix times to Turkey, Perſia, and the Eaſt Indies, and viſited all the countries in Europe, travelling moſtly on foot. His travels have been frequently reprinted in ſix vols 12mo. He died on his ſeventh journey to the eaſt, at Moſcow, in 1669.

TAVIRA, or TAVILA, a conſiderable town of Portugal, and capital of the province of Algarve, with a handſome caſtle, and one of the beſt harbours in the kingdom, defended by a fort. It is ſeated in a pleaſant fertile country, at the mouth of the river Gilaon, between Cape Vincent and the Strait of Gibraltar, 100 miles weſt by north of Cadiz. W. Long 7. 46. N. Lat. 37. 18.

TAVISTOCK, a town of Devonſhire in England, ſituated on the river Tavey or Tave, W. Long. 4. 12. N. Lat. 50. 37. It ſends two members to parliament, and gives the title of *marquis* to the noble family of Ruſſel duke of Bedford.

TAUNTON, a large, elegant, and well built town of Somerſetſhire, 146 miles from London. It conſiſts principally of four ſtreets paved and lighted; the market-place is ſpacious, and has a handſome market-houſe, with a town hall over it, which was finiſhed in 1773. It has an extenſive woollen manufactory; and in 1780 a ſilk manufactory was introduced. Its caſtle, the ruins of which remain, was in 1645 defended for the parliament by colonel Blake againſt an army of 10,000 men under lord Goring, but was diſmantled by Charles II. In 1685 the duke of Monmouth made this place his head-quarters. Its church, which is large and beautiful, is a fine ſpecimen of the florid Gothic ſtyle of architecture. The tower, which is lofty, is of excellent workmanſhip, crowned at the top with four ſtately pinnacles, 32 feet high. The whole perhaps is not equalled in the kingdom. Taunton is pleaſantly ſeated on the river Tone, which is navigable to Bridgewater; is reckoned the beſt town in the county; and ſends two members to parliament. W. Long. 3. 17. N. Lat. 50. 59.

TAURIS, or TEBRIS, a town of Perſia, and capital of Aderbeitzan. It was formerly the capital of Perſia, and is now the moſt conſiderable next to Iſpahan; for it contains 15,000 houſes, beſides many ſeparate ſhops, and about 200,000 inhabitants. It is about five miles in circumference, and carries on a prodigious trade in cotton, cloth, ſilks, gold and ſilver brocades, fine turbans, and ſhagreen leather. There are 300 caravanſeras, and 250 moſques. Some travellers ſuppoſe it to be the ancient Ecbatana; but of this there is no certainty. It is ſeated in a delightful plain, ſurrounded with mountains, from whence a ſtream iſſues, which runs through the city. E. Long. 47. 50. N. Lat. 38. 18.

TAURUS, a great chain of mountains in Aſia, which begin at the eaſtern part of Little Carimania, and extend very far into India. In different places they have different names.

TAURUS, in aſtronomy, one of the 12 ſigns of the zodiac.

TAUTOLOGY, a needleſs repeating of the ſame thing in different words.

TAWING, the art of dreſſing ſkins in white, ſo as to be fit for divers manufactures, particularly gloves, &c.

All ſkins may be tawed; but thoſe chiefly uſed for this purpoſe are lamb, ſheep, kid, and goat ſkins.

The method of tawing is this: Having cleared the ſkins of wool or hair by means of lime, they are laid in a large vatt of wood or ſtone, ſet on the ground full of water, in which quicklime has been ſlaked; wherein they are allowed to lie a month or ſix weeks, according as the weather is more or leſs hot, or as the ſkins are required to be more or leſs ſoft and pliant.

While they are in the vatt, the water and lime is changed twice, and the ſkins are taken out and put in again every day: and when they are taken out for the laſt time, they are laid all night to ſoak in a running water, to get out the greateſt part of the lime; and in the morning are laid together by ſixes one upon another, upon a wooden leg, and are ſcraped ſtoutly one after another, to get the fleſh off from the fleſhy ſide, with a cutting two-handled inſtrument called a *knife*; and then they cut off the legs (if they are not cut off before) and other ſuperfluous parts about the extremes. Then they are laid in a vatt or pit with a little water, where they are fulled with wooden peſtles for the ſpace of a quarter of an hour; and then the vatt is filled up with water, and they are rinſed in it.

In the next place, they are thrown on a clean pavement to drain and afterwards caſt into a freſh pit of water, out of which they rinſe them well, and are laid again on the wooden leg, ſix at a time, with the hair ſide outermoſt: over which they rub a kind of whetſtone very briſkly, to ſoften and fit them to receive four or five more preparations, given them on the leg both on the fleſh-ſide and the hair-ſide, with the knife, after the manner abovementioned.

After this they are put into a pit of water and wheaten-bran, and ſtirred about in it with wooden poles, till the bran is perceived to ſtick to them, and then they are left: as they riſe of themſelves to the top of the water by a kind of fermentation, they are plunged down again to the bottom; and at the ſame time fire is ſet to the liquor, which burns as eaſily as if it were brandy, but goes out the moment the ſkins are all covered.

They repeat this operation as often as the ſkins riſe above the water; and when they have done riſing they take them out, lay them on the wooden leg, the fleſhy ſide outwards, and paſs the knife over them to ſcrape off the bran.

Having thus cleared them of the bran, they lay the ſkins in a large baſket, and load them with huge ſtones to promote their draining: and when they have drained ſufficiently, they give them their feeding; which is performed after the manner following:

For 100 of large ſheep ſkins, and for ſmaller in proportion, they take eight pounds of alum and three of ſea-ſalt, and melt the whole with water in a veſſel over the fire, pouring the ſolution out, while yet lukewarm, into a kind of trough, in which is twenty pounds of the fineſt wheat-flower, with the yolks of eight dozen of eggs; of all which is formed into a kind of paſte, a little thicker than children's pap; which, when done, is put into another veſſel, to be uſed in the following manner.

They pour a quantity of hot water into the trough in which the paſte was prepared, mixing two ſpoonfuls of the paſte with it; to do which they uſe a wooden ſpoon, which contains juſt as much as is required for a dozen of ſkins: and when the whole is well diluted, two dozen of the ſkins are plunged into it; but they take care that the water be not too hot, which would ſpoil the paſte and burn the ſkins.

After they have lain ſome time in the trough they take them out, one after another, with the hand, and ſtretch them out; this they do twice: and after they have given them all their paſte, they put them into tubs, and there full them afreſh with wooden peſtles.

Then they put them into a vatt, where they are ſuffered to lie for five or ſix days, or more; then they take them out in fair weather, and hang them to dry on cords or racks: and the quicker they are dried the better; for if they be too long a-drying, the ſalt and alum within them are apt to make them riſe in a grain, which is an eſſential fault in this kind of dreſſing.

When the ſkins are dry, they are made up into bundles, and juſt dipt in fair water, and taken out and drained: they are then thrown into an empty tub; and after having lain ſome time are taken out and trampled under foot.

Then they draw them over a flat iron inſtrument, the top of which is round like a battledore, and the bottom fixed into a wooden block, to ſtretch and open them; and having been opened, they are hung in the air upon cords to dry; and being dry, they are opened a ſecond time, by paſſing them again over the ſame inſtrument.

In the laſt place, they are laid on a table, pulled out, and laid ſmooth, and are then fit for ſale.

TAX (*Taxa*, from the Greek ταξις, i. e. *ordo*, *tributum*), a tribute or impoſition laid upon the citizen or ſubject for the ſupport of government. See REVENUE.

"It is the ancient indiſputable privilege and right of the Britiſh houſe of commons, that all grants of ſubſidies or parliamentary aids do begin in that houſe, and are firſt beſtowed by them; although their grants are not effectual to all intents and purpoſes until they have the aſſent of the other two branches of the legiſlature. See COMMONS. The general reaſon given for this excluſive privilege of the houſe of commons is, that the ſupplies are raiſed upon the body of the people, and therefore it is proper that they alone ſhould have the right of taxing themſelves. This reaſon would be unanſwerable, if the commons taxed none but themſelves: but it is notorious, that a very large ſhare of property is in the poſſeſſion of the houſe of lords; that this property is equally taxable, and taxed, as the property of the commons; and therefore the commons, not being the ſole perſons taxed, this cannot be the reaſon of their having the ſole right of raiſing and modelling the ſupply. The true reaſon, ariſing from the ſpirit of the conſtitution, ſeems to be this. The lords being a permanent hereditary body, created at pleaſure by the king, are ſuppoſed more liable to be influenced by the crown, and when once influenced to continue ſo, than the commons, who are a temporary elective body, freely nominated by the people. It would therefore be extremely dangerous to give the lords any power of framing new taxes for the ſubject; it is ſufficient that they have a power of rejecting, if they think the commons too laviſh or improvident in their grants. But ſo reaſonably jealous are the commons of this valuable privilege, that herein they will not ſuffer the other houſe to exert any power but that of rejecting. They will not permit the leaſt alteration or amendment to be made by the lords to the mode of taxing the people by a money-bill: under which appellation are included all bills by which money is directed to be raiſed upon the ſubject, for any purpoſe or in any ſhape whatſoever; either for the exigencies of government, and collected from the kingdom in general, as the land-tax; or for private benefit, and collected in any particular diſtrict, as by turnpikes, pariſh-rates, and the like. Yet Sir Matthew Hale mentions one caſe, founded on the practice of parliament in the reign of Henry VI. wherein he thinks the lords may alter a money-bill: and that is, if the commons grant a tax, as that of tonnage and poundage, for four years; and the lords alter it to a leſs time, as for two years: here, he ſays, the bill need not be ſent back to the commons for their concurrence, but may receive the royal aſſent without farther ceremony; for the alteration of the lords is conſiſtent with the grant of the commons. But ſuch an experiment will hardly be repeated by the lords, under the preſent improved idea of the privilege of the houſe of commons; and, in any caſe where a money bill is remanded to the commons, all amendments in the mode of taxation are ſure to be rejected.

"The commons, when they have voted a ſupply to his majeſty, and ſettled the *quantum* of that ſupply, uſually reſolve themſelves into what is called *a committee of ways and means*, to conſider the ways and means of raiſing the ſupply ſo voted. And in this committee every member (though it is looked upon as the peculiar province of the chancellor of the exchequer) may propoſe ſuch ſcheme of taxation as he thinks will be leaſt detrimental to the public. The reſolutions of this committee (when approved by a vote of the houſe) are in general eſteemed to be (as it were) final and concluſive. For though the ſupply cannot be actually raiſed upon the ſubject till directed by an act of the whole parliament, yet no monied man will ſcruple to advance to the government any quantity of ready caſh, on the credit of a bare vote of the houſe of commons, though no law be yet paſſed to eſtabliſh it.

"The taxes which are raiſed upon the ſubject are either annual or perpetual.

"I. The uſual annual taxes are thoſe upon land and malt. See LAND and MALT.

"II. The perpetual are, 1. The cuſtoms. 2. The exciſe-duty. 3. The ſalt-duty. 4. The poſt-office. 5. The ſtamp-duty. 6. Houſe and window duty. 7. The duty on hackney-coaches and chairs. 8. That on offices and penſions.—See the articles CUSTOMS, EXCISE, POST, STAMP, HOUSE, HACKNEY, and *OFFICES and Penſions*.

"As to the application of all theſe, ſee the articles REVENUE, *NATIONAL Debt*, FUNDS, and *CIVIL LIST*."

Taxation, Taxus.

TAXATION. See Revenue, Tax, and *Feodal Syſtem.*

TAXUS, the Yew tree, in botany: A genus of plants belonging to the claſs of *diœcia,* and order of *monodelphia;* and in the natural ſyſtem ranging under the 51ſt order, *Coniferæ.* The male calyx is triphyllous, gemmaceous, and imbricated: there is no corolla; the ſtamina are numerous; the antheræ peltated and octofid. The female calyx reſembles the male; there is no corolla nor ſtyle, and only one ſeed with a calycle reſembling a berry very entire. There are only two ſpecies mentioned by Linnæus, the baccata and nucifera. M. Sonnerat has added a third, called *capenſis;* and Sir Charles Thunberg has inſerted two more, the macrophylla and verticillata, in his *Flora Japonica.*

The *baccata,* or common yew tree, is a native of Britain, France, Switzerland, &c. and of North America. It is diſtinguiſhed from the other ſpecies by linear leaves which grow very cloſe, and by the receptacles of the male flowers being ſubgloboſe. The wood is reddiſh, full of veins, and flexible, very hard and ſmooth, and almoſt incorruptible. Its hardneſs renders it very proper for turners and cabinet-makers. It produces berries which are red, mucilaginous, and have a ſweet mawkiſh taſte. They are often eaten by birds, and are therefore not poiſonous: But it is a common opinion that the leaves are poiſonous to cattle, and many facts are mentioned of horſes and cows having died by eating them. Others, however, deny theſe facts. It is found in ſeveral parts of the Highlands of Scotland in a wild ſtate. At Glenlure, near Glen-Creran, in Upper-Lorn, are the remains of an old wood of it. The place takes its name from the trees which grow in it; for *Glenlure* in the Gaelic language is no other than a corruption of *Gleaniuir, i. e.* "The valley of yew trees." It is of no great height, but the trunk grows to a large ſize. Mr Pennant has taken notice of a very remarkable decayed one in Fortingal church-yard, the remains of which meaſured 56 feet and an half in circumference.

The yew is at preſent almoſt peculiar to church-yards; hence ſome naturaliſts ſuſpect that it is an exotic. Several reaſons have been aſſigned for its frequency in church-yards. The firſt is, that before the invention of gunpowder the warrior might never be at a loſs for a bow. This is an opinion for which we have found no hiſtorical evidence; and till ſome be produced it is conſidered merely as a conjecture. There are ſeveral laws enacted by our forefathers for encouraging archery, but none of them mention the cultivation of the yew. The bows uſed in England were indeed made frequently of yew, but it was yew of foreign growth. In the reign of Elizabeth, a bow of the beſt foreign yew ſold for 6 s. 8 d. while one made of Engliſh yew ſold only for 2 s. In 12 Edw. IV. it was ordained that every foreign merchant that ſhould convey any goods from any country from which bow ſtaves had formerly been brought to England, ſhould for every ton of goods bring four bow ſtaves. A ſimilar law was framed in the time of Richard III. It appears therefore that the church-yards did not ſupply the nation with bows.

A ſecond opinion concerning the introduction of yew trees into church-yards is, that they were intended to defend the church againſt ſtorms. But there are many other trees that would have anſwered this purpoſe much better; for the yew is of ſo ſlow a growth, that it would be long before it could be of any ſervice at all, and is ſo low that it could never be a ſufficient ſhelter. A third opinion is, that being an evergreen, it is an emblem of immortality. This is a pretty idea; but the misfortune is, that yew is always conſidered as a tree of baleful influence. This opinion is as old as Statius, who ſays, *metuenda ſucco taxus.* A fourth opinion is, that when anciently it was the cuſtom, as it ſtill is in Catholic countries, to carry palms on Palm Sunday, the yew was ſubſtituted on ſuch occaſions for the palm. Two or three trees, the uſual number growing in church-yards, were ſufficient for ſuch purpoſes. This is the only opinion which receives any countenance from hiſtory. The following extract from Caxton's Direction for keeping Feaſts all the year, printed in 1483, will probably be conſidered as deciſive on this ſubject. It is taken out of the lecture for Palm-Sunday; where the writer, after giving the ſcriptural account of our Saviour's triumphant entrance into Jeruſalem, proceeds thus: "Wherefore holy chirche this day makyth ſolempne proceſſyon, in mynd of the proceſſyon that Cryſt made this day. But for encheſion that we have non olyue that berith grene leef, algate therefore *we take ewe in ſtede of palme and olyue,* and beren about in proceſſyon, and ſo is thys day callyd Palme Sonday." As a confirmation of this fact, we may add, that the yews in the church-yards of Eaſt Kent are at this day called *palms.*

Tay.

TAY, called by the Romans *Tavus* or *Taus,* the largeſt river in Scotland. It riſes in Braidalbane, on the frontiers of Lorn; and having in the paſſage of a few miles augmented its ſtream by the acceſſion of ſeveral ſmall rills, ſpreads itſelf into a Lake called *Loch Dochart;* out of which having run but a little ſpace, it expands itſelf again. Leaving this ſecond lake, it rolls ſome miles with a conſiderable body of water, and then diffuſes itſelf abroad in the ſpacious Loch Tay; which, reckoning from the ſources of the river, is 24 miles in length, though, ſtrictly ſpeaking, the lake is but 13: almoſt as ſoon as it iſſues from hence, it receives the river Lyon, coming out of Loch Lyon, and running through Glen Lyon; which, having travelled in a manner parallel to it, from its ſource, for a ſpace of 25 miles, at length joins the Tay as it enters Athol, which it next traverſes, and, directing its courſe in a manner due eaſt, receives almoſt all the waters of that country. Bending then to the ſouth, at the diſtance of ſix miles, it reaches Dunkeld; which, in the ancient language ſignifies "the hill of hazels," was the very centre of the old Caledonia, and is at preſent eſteemed the heart of the Highlands. The river is very broad here, inſomuch that there is a ferry-boat over it at each end of the town. Declining ſtill to the ſouth-eaſt, with a winding courſe, for above 12 miles, the Tay receives a large ſupply of waters from the county of Angus; and then running ſouth-weſt for eight miles more, is joined in that ſpace by ſeveral rivers, the moſt conſiderable of which is the Almond. Turning then to the ſouth-eaſt, at the diſtance of about three miles, this copious river comes with a ſwelling ſtream to Perth, or St Johnſton's, which is the capital of the ſhire of that name.

The Tay, continuing ſtill a ſouth-eaſt courſe, receives, a few miles below Perth, the river Erne; which, iſſuing from a loch of the ſame name, traverſes the county of Strathern, and paſſes by Abernethy, once the capital of the Pictiſh kingdom; ſwelled by the waters of this laſt river, the Tay, running next directly eaſt, enlarges itſelf till it becomes about three miles broad; but contracts again before the town of Dundee; ſoon after which it opens into the German ocean. At the entrance of the frith, there are ſands both on the north and on the ſouth ſide: the former ſtyled *Goa,* the latter *Aberlay* and *Drumlan:* and before theſe, in the very mouth of the frith, thoſe which are called the *Croſs Sands.* At Buttonneſs, which is the northern promontory, there are two light-houſes. The ſpace between the north and the ſouth ſands may be near a mile, with about three fathoms water; but being within the frith, it grows deeper, and in the road of Dundee is full ſix fathoms. The frith of Tay is not indeed ſo large or ſo commodious as that of Forth, but from Buttonneſs to Perth it is not leſs than 40 miles; and the whole may be, without any great impropriety, ſtyled a harbour, which has Fiſe on one ſide, and the ſhires of Perth and Angus on the other, both very fertile and pleaſant countries.

TAYLOR (Dr Jeremy), biſhop of Down and Connor in Ireland, was the ſon of a barber at Cambridge, and there had his education. Upon entering into orders, he became divinity lecturer of St Paul's in London: and was, by the intereſt of archbiſhop Laud, elected fellow of All Soul's college, Cambridge, in 1636. Two years after he became one of the chaplains of the archbiſhop, who beſtowed on him the rectory of Uppingham in Rutlandſhire. In 1642 he was chaplain to the king; and a frequent preacher before him and the court at Oxford. He afterward attended in the king's army in the condition of a chaplain. Upon the declining of his majeſty's cauſe, he retired into Wales, where he was permitted to officiate as miniſter, and to keep a ſchool, in order to maintain himſelf and his children. In this retirement he wrote ſeveral of his works. Having ſpent ſeveral years there, his family was viſited with ſickneſs; and he loſt three ſons of great hopes within the ſpace of two or three months. This affliction touched him ſo ſenſibly, that it made him deſirous to leave the country; and, going to London, he for a time officiated in a private congregation of loyaliſts to his great hazard. At length meeting with Edward lord Conway, that nobleman carried him over with him into Ireland, and ſettled him at Portmore, where he wrote his *Ductor Dubitantium.* Upon the Reſtoration he returned to England; ſoon after, he was advanced to the biſhopric of Down and Connor in Ireland; and had the adminiſtration of the ſee of Dromore granted to him. He was likewiſe made privy-counſellor and vice-chancellor of the univerſity of Dublin; which place he held till his death. He died of a fever at Liſnegarvy in 1667, and was interred in a chapel which he himſelf had built on the ruins of the old cathedral of Dromore.

TAYLOR (Dr Brook), was born at Edmonton, Auguſt 18th 1685. He was the ſon of John Taylor, Eſq; of Biffron's-houſe in Kent, by Olivia, daughter of Sir Nicholas Tempeſt, of Durham, Baronet. His grandfather, Nathaniel Taylor, was one of thoſe puritans whom "Cromwell thought fit to elect by a letter, dated June 14th 1653, to repreſent the county of Bedford in parliament." The character of his father partook in no ſmall degree of the auſterity that had been tranſmitted to him in the line of his anceſtors, and by the ſpirit of the times in which they lived; and to this cauſe may be aſcribed the diſaffection which ſometimes ſubſiſted between the father and even ſuch a ſon as is the ſubject of this article. The old gentleman's moroſe temper, however, yielded to the powers of muſic; and the moſt eminent profeſſors of the art in that period were hoſpitably welcomed in his houſe. His ſon Brook was induced by his natural genius, and by the diſpoſition of his father, which he wiſhed by all the means in his power to conciliate, to direct his particular attention to muſic; and he became in very early life a diſtinguiſhed proficient in it.—"In a large family-piece, he is repreſented at the age of 13 ſitting in the centre of his brothers and ſiſters; the two elder of whom, Olivia and Mary, crown him with laurel, bearing the inſignia of harmony."

To muſic he added another accompliſhment, in which he equally excelled. "His drawings and paintings, of which ſome are ſtill preſerved, require not thoſe allowances for error or imperfection with which we ſcan the performances of even the ſuperior *dilettanti*:—they will bear the teſt of ſcrutiny and criticiſm from artiſts themſelves, and thoſe of the firſt genius and profeſſional abilities." Though he was eminent in the culture and practice both of muſic and drawing in his early youth, his whole attention was not occupied by theſe faſcinating arts. His claſſical education was conducted at home under a private tutor; and his proficiency in the ordinary branches of the languages and the mathematics was ſo great, that he was deemed qualified for the univerſity at the early age of 15.

In 1701 he was entered a Fellow Commoner of St John's College, Cambridge. At that period mathematics engaged more particularly the attention of the univerſity; and the examples of eminence in the learned world, derived from that branch of ſcience, attracted the notice and rouſed the emulation of every youth poſſeſſed of talents and of application. We may preſume, that Brook Taylor, from the very hour of his admiſſion at college, adopted the courſe of ſtudy which a Machin, a Keil, and, above all, a Newton, had opened to the mind of man, as leading to diſcoveries of the celeſtial ſyſtem.—That he applied early to theſe ſtudies, and without remiſſion, is to be inferred from the early notice and kind attention with which he was honoured by thoſe eminent perſons, and from the extraordinary progreſs which he made in their favourite ſcience."

In 1708 he wrote his treatiſe On the Centre of Oſcillation, which was not publiſhed in the Philoſophical Tranſactions till ſome years afterwards. In 1709, he took his degree of Bachelor of Laws. In 1712, he was choſen a Fellow of the Royal Society. During the interval between theſe two periods, he correſponded with Profeſſor Keil on ſeveral of the moſt abſtruſe ſubjects of mathematical diſquiſition. Sir William Young informs us, that he has in his poſſeſſion a letter, dated in 1712, addreſſed to Mr Machin, which contains at length a ſolution of Kepler's problem, and marking the uſe to be derived from that ſolution. In this year he preſented to the Royal Society three different papers; one On the Aſcent of Water between two Glaſs Planes; a ſecond, On the Centre of Oſcillation; and a third, On the Motion of a ſtretched String. It appears from his correſpondence with Keil, that in 1713 he preſented a paper on his favourite ſubject of Muſic: but this is not preſerved in the Tranſactions.

His diſtinguiſhed proficiency in thoſe branches of ſcience, which engaged the particular attention of the Royal Society at this period, and which embroiled them in conteſts with foreign academies, recommended him to the notice of its moſt illuſtrious members; and in 1714 he was elected to the office of ſecretary. In this year he took at Cambridge his degree of Doctor of Laws; and at this time he tranſmitted, in a letter to Sir Hans Sloane, An Account of ſome curious Experiments relative to Magnetiſm; which, however, was not delivered to the Society till many years afterward, when it was printed in the Tranſactions. His application to thoſe ſtudies to which his genius inclined was indefatigable: for we find that in 1715 he publiſhed in Latin his *Methodus Incrementorum*; alſo a curious eſſay preſerved in the Philoſophical Tranſactions, entitled An Account of an Experiment for the Diſcovery of the Laws of Magnetic Attraction; likewiſe a treatiſe well known to mathematicians, and highly valued by the beſt judges, On the Principles of Linear Perſpective. In the ſame year (ſuch were his admirable talents, and ſo capable were they of being directed to various ſubjects), he conducted a controverſial correſpondence with the Count Raymond de Montmort, on the Tenets of Malebranche; which occaſioned his being particularly noticed in the eulogium pronounced by the French academy on the deceaſe of that eminent metaphyſician.

The new philoſophy of Newton (as it was then called) engaged the attention of mathematicians and philoſophers both at home and abroad. At Paris it was in high eſtimation; and the men of ſcience in that city were deſirous of obtaining a perſonal acquaintance with the learned ſecretary of the Royal Society, whoſe reputation was ſo generally acknowledged, and who had particularly diſtinguiſhed himſelf in the Leibnitzian or German controverſy as we may denominate it, of that period. In conſequence of many urgent invitations, he determined to viſit his friends at Paris in the year 1716. He was received with every poſſible token of affection and reſpect; and had an opportunity of diſplaying many traits of character, which mark the general ſcholar and accompliſhed gentleman, as well as the profound mathematician. His company was courted by all "who had temper to enjoy, or talents to improve, the charms of ſocial intercourſe." Beſides the mathematicians, to whom he had always free acceſs, he was here introduced to Lord Bolingbroke, the Count de Caylus, and Biſhop Boſſuet. "He inſpired partiality on his firſt addreſs; he gained imperceptibly on acquaintance; and the favourable impreſſions which he made from genius and accompliſhments, he fixed in further intimacy by the fundamental qualities of benevolence and integrity."

Among the ladies who honoured Dr Brook Taylor with a particular regard, we may mention the names of Marcilly de Villette, and of Miſs Brunton, the beautiful and accompliſhed niece of Sir Iſaac Newton.

Early in 1717 he returned to London, and compoſed three treatiſes, which were preſented to the Royal Society, and publiſhed in the 30th volume of the Tranſactions. About this time his intenſe application had impaired his health to a conſiderable degree; and he was under the neceſſity of repairing, for relaxation and relief, to Aix-la-Chapelle. Having likewiſe a deſire of directing his attention to ſubjects of moral and religious ſpeculation, he reſigned his office of ſecretary to the Royal Society in 1718.

After his return to England in 1719, he applied to ſubjects of a very different kind from thoſe that had employed the thoughts and labours of his more early life. Among his papers of this date, Sir William Young has found detached parts of A Treatiſe on the Jewiſh Sacrifices, and a diſſertation of conſiderable length On the Lawfulneſs of eating Blood. He did not, however, wholly neglect his former ſubjects of ſtudy, but employed his leiſure hours in combining ſcience and art; with this view he reviſed and improved his treatiſe on Linear Perſpective. Drawing continued to be his favourite amuſement to his lateſt hour; and it is not improbable, that his valuable life was ſhortened by the ſedentary habits which this amuſement, ſucceeding his ſeverer ſtudies, occaſioned.

"He drew figures with extraordinary preciſion and beauty of pencil. Landſcape was yet his favourite branch of deſign. His original landſcapes are moſtly painted in water colours, but with all the richneſs and ſtrength of oils. They have a force of colour, a freedom of touch, a varied diſpoſition of planes of diſtance, and a learned uſe of aerial as well as linear perſpective, which all profeſſional men who have ſeen theſe paintings have admired. Some pieces are compoſitions; ſome are drawn from nature; and the general characteriſtic of their effect may be exemplified, in ſuppoſing the bold fore-grounds of Salvator Roſa to be backed by the ſucceſſion of diſtances, and mellowed by the ſober harmony, which diſtinguiſhed the productions of Gaſpar Pouſſin. The ſmall figures interſperſed in the landſcapes would not have diſgraced the pencil of the correct and claſſic Nicholas."

The work of Dr Brook Taylor in linear perſpective was cenſured by Bernoulli, in a treatiſe publiſhed in the Acts of Leipſic, as "abſtruſe to all, and as unintelligible to artiſts for whom it was more eſpecially written." It muſt be acknowledged that this excellent work, for ſo it deſerves to be called, was not level to the apprehenſions of practitioners in the art of drawing and deſign: but it was much eſteemed by mathematicians. Three editions of it have been publiſhed; and as it is now ſcarce, a republication of it in its moſt improved and perfect ſtate would be very acceptable. Mr Kirby, however, has made it more plain and popular, in his treatiſe entitled "Brook Taylor's Perſpective made eaſy;" and this book, detailing and illuſtrating the principles of the original work, has been the *vade mecum* of artiſts. Dr Brook Taylor was incenſed by the invidious attacks of Bernoulli; and he publiſhed An Apology againſt J. Bernoulli's Objections, which may be ſeen in the 30th volume of the Philoſophical Tranſactions. Bernoulli, with his uſual envy of Britiſh mathematicians, had diſputed our author's right to his own work. We have no reaſon to doubt Dr Taylor's claims to the undecided diſcovery of the method which he deſcribes, though he is not an original inventor. This method was long before publiſhed by Guido Ubaldi, in his Perſpective, printed at Peſaro in 1600; where it is delivered very clearly, and confirmed by moſt elegant demonſtrations; and where it is actually applied to the art of delineating the ſcenes of a theatre.

Toward the end of the year 1720, Dr Brook Taylor accepted the invitation of Lord Bolingbroke to ſpend ſome time at La Source, a country-ſeat near Orleans, which he held in right of his wife, the widow of the Marquis de Villette, nephew of Madame de Maintenon. During his reſidence at this beautiful ſpot, he fixed and cemented a friendſhip with its noble owners which terminated only with life.

In the next year he returned to England, and publiſhed the laſt paper which appears with his name in the Philoſophical Tranſactions, entitled, An Experiment made to aſcertain the Proportion of Expanſion of Liquor in the Thermometer, with regard to the degree of Heat.

In 1721, Dr Brook Taylor married Miſs Bridges of Wallington in the county of Surry, a young lady of good family, but of ſmall fortune; and this marriage occaſioned a rupture with his father, whoſe conſent he had never obtained. The death of this lady in 1725, and that of an infant ſon, whom the parents regarded as the preſage and pledge of reconciliation with the father, and who actually proved ſuch, deeply affected the ſenſibility of Dr Taylor. However, during the two ſucceeding years he reſided with his father at Bifrons, where "the muſical parties, ſo agreeable to his taſte and early proficiency, and the affectionate attentions of a numerous family welcoming an amiable brother, ſo long eſtranged by paternal reſentment, not only ſoothed his ſorrows, but ultimately engaged him to a ſcene of country retirement, and domeſticated and fixed his habits of life. He could no more recur to the deſultory reſources and cold ſolace of ſociety, which caſual viſits, ſlight acquaintance, and diſtant friendſhips, afford the man—who hath *none to make, and cheer a conſtant home*."

In 1725 he formed a new connection; and with the full approbation of his father and family, married Sabetta, daughter of John Sawbridge, Eſq; of Olantigh, in Kent. In 1729, on the death of his father, he ſucceeded to the family eſtate of Bifrons. In the following year he loſt his wife in child-bed. The daughter whoſe birth occaſioned this melancholy event ſurvived and became the mother of Sir William Young, to whom we owe theſe memoirs of his grandfather.

In the interval that elapſed between the years 1721 and 1730, no production by Brook Taylor appears in the Philoſophical Tranſactions; nor did he publiſh in the courſe of that time any work. His biographer has found no traces of his learned labour, excepting a Treatiſe of Logarithms, which was committed to his friend Lord Paiſley (afterward Abercorn), in order to be prepared for the preſs; but which probably was never printed. His health was now much impaired; relaxation became neceſſary, and he was diverted by new connections from the habit of ſevere ſtudy, which had diſtinguiſhed the early period of his life, and which had contributed to contract the duration of it. Happy in the ſocial circle of domeſtic enjoyment, and devoting his attention to buſineſs or amuſement as they occurred, his application and his literary emulation ſeem to have declined. He did not long ſurvive the loſs of his ſecond wife; and his remaining days were days of increaſing imbecillity and ſorrow.

“ The eſſay entitled *Contemplatio Philoſophica*, publiſhed by Sir William Young, 1793, appears to have been written about this time, and probably with a view to abſtract his mind from painful recollections and regret. It was the effort of a ſtrong mind, and is a moſt remarkable example of the cloſe logic of the mathematician applied to metaphyſics. But the blow was too deep at heart for ſtudy to afford more than temporary relief. The very reſource was hurtful, and intenſe ſtudy but accelerated the decline of his health. His friends offered every comfort; in particular Lord Bolingbroke preſſed his conſolation, and ſought to call his mind from regret of domeſtic endearments to ſocial friendſhip at Dawley.

The attention and kindneſs of his friends, however, could not ward off the approaches of diſſolution. “ Having ſurvived his ſecond wife little more than a year, Dr Brook Taylor died of a decline in the 46th year of his age, December the 29th 1731, and was buried in the church-yard of St Ann's, Soho. I am ſpared (ſays his deſcendant) the neceſſity of cloſing this biographical ſketch with a prolix detail of his character: in the beſt acceptation of duties relative to each ſituation of life in which he was engaged, his own writings, and the writings of thoſe who beſt knew him, prove him to have been the finiſhed Chriſtian, gentleman, and ſcholar.”

TAYLOR (Dr John), a learned diſſenting miniſter, born in Lancaſhire. He ſettled firſt at Kirkſtead in Lincolnſhire, where he preached to a ſmall congregation, and taught a grammar-ſchool for near 20 years. Afterwards he removed to Norwich, where he preached many years in great repute, until he was invited to ſuperintend the academy formed at Warrington in Lancaſhire: but a few idle differences on formal punctilios and uncertain doctrines kindled into ſuch a flame there, as ſubjected him to much ſcurrility and ill treatment, and endangered the very being of the academy. He died in 1761; and among ſeveral other judicious performances, his Hebrew and Engliſh Concordance, 2 vols folio, will remain a monument of his critical ſkill and indefatigable induſtry.

TAYLOR-Bird. See MOTACILLA.

TEA, the dried leaves of the tea plant.—A commodity with which we are ſo well acquainted, which affords a beverage ſo generally uſed and ſo generally agreeable, and which forms ſo conſiderable an article of commerce, muſt excite the curioſity of the public at large to know ſomething of its hiſtory, and of the nature of the plant from which it is obtained. We are ſorry that we can neither gratify their curioſity nor our own completely. We have conſulted all the botanical books to which we had acceſs, and we believe we have had acceſs to the beſt, yet we have not been able to diſcover with certainty whether there be various ſpecies of the tea plant; or whether all the different kinds of tea, ſo unlike to one another in their flavour, and ſtrength, and colour, be derived from one ſingle ſpecies. As an apology for this imperfection in botanical knowledge, it is proper to obſerve, that the country of which the tea plant is a native is hidden from the exploring eye of the philoſopher; that it is jealous of Europeans, and ſeldom gives them an opportunity of ſtudying its productions. While we apologize for the ignorance of Europeans in this point, and ſincerely regret it, we ſhall be careful to ſelect every important fact, that we may preſent our readers with as accurate and complete an account as our materials can ſupply.

The tea plant is a native of Japan, China, and Tonquin, and has not, as far as we can learn, been found growing ſpontaneouſly in any other parts of the world. Linnæus arranged it under the claſs of *polyandria*, and order of *monogynia*. We are told he was led into this miſtake from having no ſpecimens of the flower to examine but ſuch as were dried. If Linnæus has in this arrangement fallen into error, it is ſurpriſing that he has not been corrected by one who had the beſt opportunity of examining the matter. Sir Charles Thunberg, one of the moſt diſtinguiſhed pupils of that illuſtrious botaniſt, who reſided 16 months in Batavia and Japan, has given a full botanical deſcription of the tea plant; and having claſſed it in the ſame manner as his maſter, ſays expreſsly that it has only one ſtyle. Several of the Britiſh botaniſts, on the other hand, refer it to the order of *trigynia*; deriving their authority from a plant in the Duke of Northumberland's garden at Sion-houſe, which had three ſtyles.

Linnæus ſays that there are two ſpecies of the tea plant; the *bohea*, the corolla of which has ſix petals; and the *viridis* or green tea, which has nine petals. Thunberg makes only one ſpecies, the bohea, conſiſting of two varieties: the one with broad and the other with narrow leaves. This botaniſt's authority is deciſive reſpecting the Japaneſe tea plants; but as China has not yet been explored, we cannot determine what number of ſpecies there are in that country. Of the bohea plant we have been favoured with a beautiful drawing, and an accurate botanical deſcription, by a learned gentleman, which we ſhall here preſent to our readers.

Calyx. K, fig. 1, 2, 3, 10. a perianthium quinquepartite, very ſmall, flat, the ſegments round, obtuſe, permanent. Fig. 1. K.

Corolla. C, fig. 1, 3, 4, 5, 7, 8. the petals ſix, roundiſh, concave; two exterior (fig. 4, 7.) CC; leſs, unequal, incloſing the flower before fully blown (fig. 3.) C; four interior (fig. 5, 6.) CCCC; large, equal, before they fall off recurvate (fig. 8.) CC; (A).

Stamens. *f*, fig. 6, 9, 10, 11. the filaments numerous (B) fig. 6, 9. *f a*; about 200; filiform, white, ſhorter than the corolla, and inſerted in the receptacle; *a*, the antheras cordate; and didymous (fig. 10, 11.) *, magnified (C).

Piſtillum. Fig. 1, 10, 12. * magnified; *g*, the germen, three globular bodies joined in a triangular form; *s*, the ſtyles, three, connected at their baſe (fig. 12.); ſubulate, re-

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(A) Thunberg ſays, that three of the petals are exterior and three inferior.

(B) In a flower received from J. Ellis, Eſq; upwards of 280 filaments were told.

(C) Kempfer deſcribes the antheras as ſingle.

TEA TREE.

Plate CCCCC.

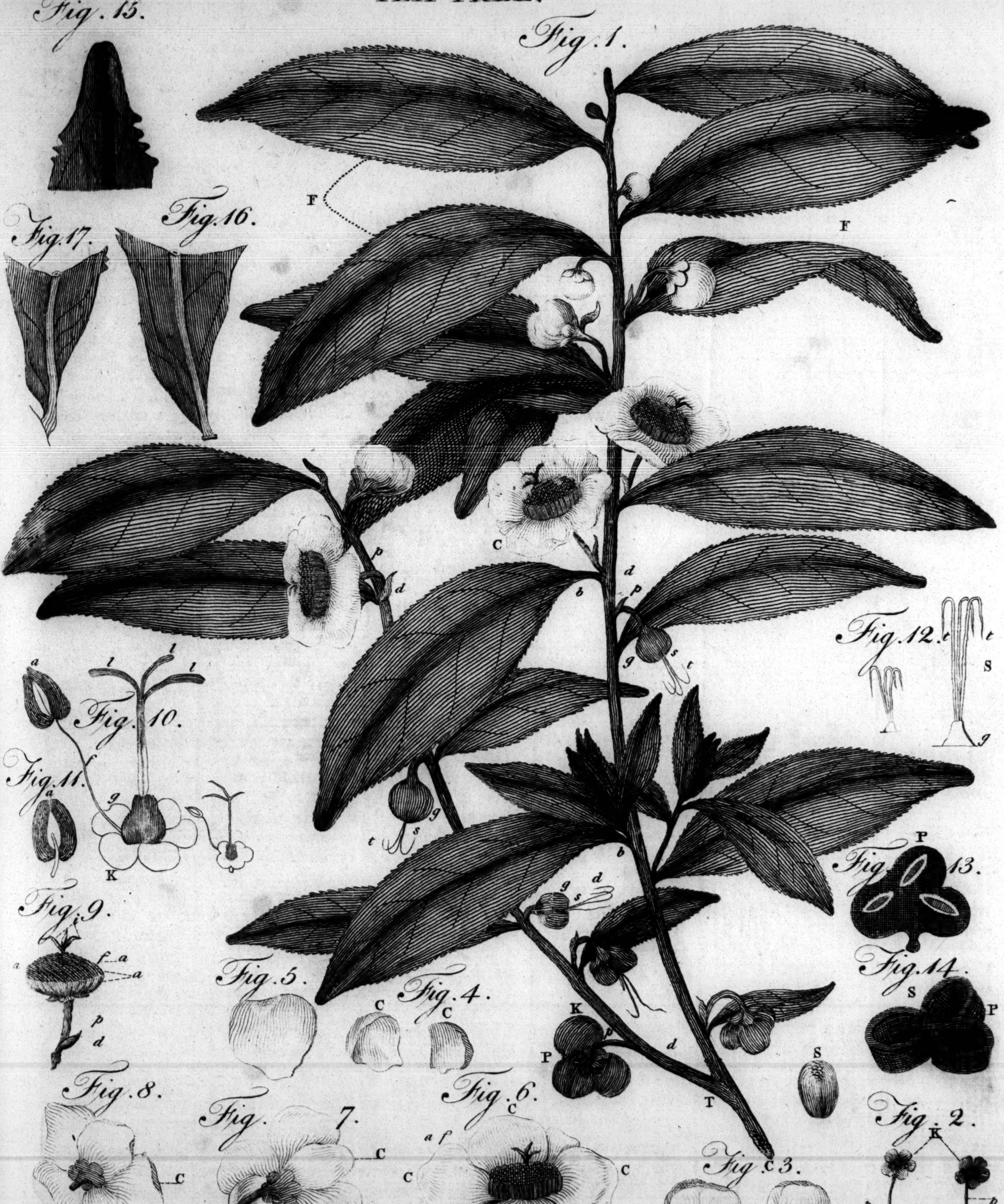

Fig. 1.
F
F
C
p
d
b
d
p
g
s
t
g
s
t
b
g
s
d
K
P
p
d
T
S
Fig. 2.
K
p
d
p
d
Fig. 3.
C
K
Fig. 4.
C
C
Fig. 5.
Fig. 6.
C
a f
C
C
C
Fig. 7.
C
p
d
C
Fig. 8.
C
C
Fig. 9.
a
f
a
a
p
d
Fig. 10.
a
t
t
t
f
g
K
Fig. 11.
a
Fig. 12.
t
t
S
g
Fig. 13.
P
Fig. 14.
S
P
Fig. 15.
Fig. 16.
Fig. 17.

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recurvate, of the length of the ſtamens, preſſed together, and as if united in one by the thickſet ſurrounding ſtamens (D) fig. 6, 9, 10.; but after the petals and ſtamens have fallen off they part, ſpread open, increaſe in length, and wither on the germen, fig. 1, 12.; the ſtigmas ſimple, *t*, fig. 1, 9, 10, 12.

Pericarpium. P, fig. 1, 13, 14. a capſule in the form of three globular bodies united, fig. 13. trilocular, fig. 14. gaping at the top in three directions, fig. 13.

Seeds. S, fig. 14. ſingle, globoſe, angulate on the inward ſide.

Trunk. T, fig. 1. ramoſe, ligneous, round; branches alternate, vague, ſtiffiſh, inclining to aſh colour, towards the top reddiſh; the peduncles axillary, *p*, fig. 1. alternate, ſingle, curved, uniflorous, incraſſate, fig. 1, 2, 7. ſtipulate, the ſtipula ſingle; ſubulate, erect, *d*, fig. 1, 2, 7, 9.

Leaves. F, fig. 1, 15, 16, 17. alternate, elliptical, obtuſely ſerrated, with the edges between the teeth recurvate, with the apex emarginate (E) * magnified, fig. 15. *e*, at the baſe very entire, fig. 16, 17. the ſurface ſmooth, gloſſy, bullate, venoſe on the under ſide, of a firm texture, petiolate; the petiols very ſhort, *b*, fig. 1, 16, 17. round on the under ſide, gibbous, fig 16. *b*,* magnified; on the upper ſide flattiſh and ſlightly channelled, fig. 17. *b*.

The tea plant, which is an evergreen, grows to the height of five or ſix feet; Le Compte ſays ten or twelve. The leaves, which are the only valuable part of it, are about an inch and a half long, narrow, indented, and tapering to a point, like thoſe of the ſweet briar, and of a dark green colour. The root is like that of the peach tree, and its flowers reſemble thoſe of the white wild roſe. The ſtem ſpreads into many irregular branches. The wood is hard, of a whitiſh green colour, and the bark is of a greeniſh colour, with a bitter, nauſeous, and aſtringent taſte. The fruit is ſmall, and contains ſeveral round blackiſh ſeeds, about the bigneſs of a bean or large pea.

This plant delights in valleys, is frequent on the ſloping ſides of mountains and the banks of rivers, where it enjoys a ſouthern expoſure. It flouriſhes in the northern latitudes of Pekin as well as round Canton, but attains the greateſt perfection in the mild temperate regions of Nankin. It is ſaid only to be found between the 30th and 45th degree of north latitude. In Japan it is planted round the borders of fields, without regard to the ſoil; but as it is an important article of commerce with the Chineſe, whole fields are covered with it, it is by them cultivated with care. The Abbé Rochen ſays, it grows equally well in a poor as in a rich ſoil; but that there are certain places where it is of a better quality. The tea which grows in rocky ground is ſuperior to that which grows in a light ſoil; and the worſt kind is that which is produced in a clay ſoil. It is propagated by ſeeds; from ſix to twelve are put into a hole about five inches deep, at certain diſtances from each other. The reaſon why ſo many ſeeds are ſown in the ſame hole is ſaid to be, that only a fifth part vegetate. Being thus ſown, they grow without any other care. Some, however, manure the land, and remove the weeds; for the Chineſe are as fond of good tea, and take as much pains to procure it of an excellent quality, as the Europeans do to procure excellent wine.

The leaves are not fit for being plucked till the ſhrub be of three years growth. In ſeven years it riſes to a man's height; but as it then bears but few leaves, it is cut down to the ſtem, and this produces a new crop of freſh ſhoots the following ſummer, every one of which bears nearly as many leaves as a whole ſhrub. Sometimes the plants are not cut down till they are ten years old. We are informed by Kœmpfer, that there are three ſeaſons in which the leaves are collected in the iſles of Japan, from which the tea derives different degrees of perfection.

The firſt gathering commences at the end of February or beginning of March. The leaves are then ſmall, tender, and unfolded, and not above three or four days old: theſe are called *ficki-tſiaa*, or "tea in powder," becauſe it is pulveriſed; it is alſo called *imperial tea*, being generally reſerved for the court and people of rank; and ſometimes alſo it is named *bloom tea*. It is ſold in China for 20 d. or 2 s. *per* pound. The labourers employed in collecting it do not pull the leaves by handfuls, but pick them one by one, and take every precaution that they may not break them. However long and tedious this labour may appear, they gather from 4 to 10 or 15 pounds a day.

The ſecond crop is gathered about the end of March or beginning of April. At this ſeaſon part of their leaves have attained their full growth, and the reſt are not above half their ſize. This difference does not, however, prevent them from being all gathered indiſcriminately. They are afterwards picked and aſſorted into different parcels, according to their age and ſize. The youngeſt, which are carefully ſeparated from the reſt, are often ſold for leaves of the firſt crop, or for imperial tea. Tea gathered at this ſeaſon is called *too-tſiaa*, or "Chineſe tea," becauſe the people of Japan infuſe it, and drink it after the Chineſe manner.

The third crop is gathered in the end of May or in the month of June. The leaves are then very numerous and thick, and have acquired their full growth. This kind of tea, which is called *Ben-tſiaa*, is the coarſeſt of all, and is reſerved for the common people. Some of the Japaneſe collect their tea only at two ſeaſons of the year, which correſpond to the ſecond and third already mentioned; others confine themſelves to one general gathering of their crop, towards the month of June: however, they always form afterwards different aſſortments of their leaves.

The fineſt and moſt celebrated tea of Japan is that which grows near Ud-ſi, a ſmall village ſituated cloſe to the ſea, and not far diſtant from Meaco. In the diſtrict of this village is a delightful mountain, having the ſame name, the climate of which is ſaid to be extremely favourable to the culture of tea; it is therefore incloſed by a hedge, and ſurrounded with wide ditches, which prevent all acceſs to it. The tea ſhrubs that grow on this mountain are planted in regular order, and are divided by different avenues and alleys.

The care of this place is entruſted to people who are ordered to guard the leaves from duſt, and to defend them from the inclemency of the weather. The labourers who are appointed to collect the tea abſtain from every kind of groſs food for ſome weeks before they begin, that their breath and perſpiration may not in the leaſt injure the leaves. They gather them with the moſt ſcrupulous nicety, and never touch them but with very ſine gloves. When this choice tea has undergone the proceſs neceſſary for its

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(D) It was this circumſtance that led Linnæus to place it under the order monogynia.

(E) No author has hitherto remarked this obvious circumſtance; even Kœmpfer ſays the leaves terminate in a ſharp point.

preparation, it is eſcorted by the ſuperintendant of the mountain and a ſtrong guard to the emperor's court, and reſerved for the uſe of the imperial family.

As the tea ſhrub grows often on the rugged banks of ſteep mountains, acceſs to which is dangerous, and ſometimes impracticable, the Chineſe, in order to come at the leaves, make uſe of a ſingular ſtratagem: Theſe ſteep places are generally frequented by great numbers of monkeys, which being irritated and provoked, to revenge themſelves tear off the branches, and ſhower them down upon thoſe who have inſulted them. The Chineſe immediately collect theſe branches, and ſtrip them of their leaves.

When the tea leaves have been collected, they are expoſed to the ſteam of boiling water; after which they are put upon plates of copper, and held over the fire until they become dry and ſhrivelled, and appear ſuch as we have them here. According to the teſtimony of Kœmpfer, tea is prepared in the ſame manner in the iſles of Japan. "There are to be ſeen there (ſays this traveller) public buildings erected for the purpoſe of preparing the freſh gathered tea. Every private perſon who has not ſuitable conveniences, or who is unacquainted with the operation, may carry his leaves thither as they dry. Theſe buildings contain a great number of ſmall ſtoves raiſed about three feet high, each of which has a broad plate of iron fixed over its mouth. The workmen are ſeated round a large table covered with mats, and are employed in rolling the tea leaves which are ſpread out upon them. When the iron plates are heated to a certain degree by the fire, they cover them with a few pounds of freſh gathered leaves, which being green and full of ſap crackle as ſoon as they touch the plate. It is then the buſineſs of the workman to ſtir them with his naked hands as quickly as poſſible, until they become ſo warm that he cannot eaſily endure the heat. He then takes off the leaves with a kind of ſhovel, and lays them upon mats. The people who are employed in mixing them, take a ſmall quantity at a time, roll them in their hands always in the ſame direction; while others keep continually ſtirring them, in order that they may cool ſooner, and preſerve their ſhrivelled figure the longer. This proceſs is repeated two or three times, and even oftener, before the tea is depoſited in the warehouſes. Theſe precautions are neceſſary to extract all the moiſture from the leaves."

The people of Japan and China generally keep their tea a year before uſing it, becauſe, when quite freſh and newly gathered, it poſſeſſes a narcotic quality which hurts the brain. Imperial tea is generally preſerved in porcelain vaſes, or in leaden or tin caniſters covered with fine mats made of bamboo. Common tea is kept in narrow-mouthed earthen pots; and coarſe tea, the flavour of which is not ſo eaſily injured, is packed up in baſkets of ſtraw.

An infuſion of tea is the common drink of the Chineſe: and indeed when we conſider one circumſtance in their ſituation, we muſt acknowledge that Providence has diſplayed much goodneſs in ſcattering this plant with ſo much profuſion in the empire of China. The water is ſaid to be unwholeſome and nauſeous, and would therefore perhaps, without ſome corrective, be unfit for the purpoſes of life. The Chineſe pour boiling water over their tea, and leave it to infuſe, as is done here; but they drink it without any mixture, and even without ſugar. The people of Japan reduce theirs to a fine powder, which they dilute with warm water until it has acquired the conſiſtence of thin ſoup. Their manner of ſerving tea is as follows: They place before the company the tea equipage, and the box in which this powder is contained; they fill the cups with warm water, and taking from the box as much powder as the point of a knife can contain, throw it into each of the cups, and ſtir it with a tooth-pick until the liquor begins to foam: it is then preſented to the company, who ſip it while it is warm. According to F. du Halde, this method is not peculiar to the Japaneſe; it is alſo uſed in ſome of the provinces of China.

The firſt European writer who mentions tea is Giovanni Botero, an eminent Italian author, who publiſhed a treatiſe about the year 1590, Of the Cauſes of the Magnificence and Greatneſs of Cities. He does not indeed mention its name, but deſcribes it in ſuch a manner that it is impoſſible to miſtake it. "The Chineſe (ſays he) have an herb out of which they preſs a delicate juice, which ſerves them for drink inſtead of wine: it alſo preſerves their health, and frees them from all thoſe evils which the immoderate uſe of wine produces among us *."

Tea was introduced into Europe in the year 1610 by the Dutch Eaſt India Company. It is generally ſaid, that it was firſt imported from Holland into England, in 1666, by the lords Arlington and Oſſory, who brought it into faſhion among people of quality. But it was uſed in coffeehouſes before this period, as appears from an act of parliament made in 1660, in which a duty of 8 d. was laid on every gallon of the infuſion ſold in theſe places. In 1666 it was ſold in London for 60 s. *per* pound, though it did not coſt more than 2 s. 6 d. or 3 s. 6 d. at Batavia. It continued at this price till 1707. In 1715 green tea began to be uſed; and as great quantities were then imported, the price was leſſened, and the practice of drinking tea deſcended to the lower ranks.† In 1720 the French began to ſend it to us by a clandeſtine commerce. Since that period the demand has been increaſing yearly, and it has become almoſt a neceſſary of life in ſeveral parts of Europe, and among the loweſt as well as the higheſt ranks.

The following table will give an idea of the quantity of tea imported annually into Great Britain and Ireland ſince 1717:

From 1717 to 1726	-	700,000 lbs.
1732 to 1742	-	1,200,000
1755 near	-	4,000,000
1766	- -	6,000,000
1785 about	-	12,000,000
1794 from	-	16 to 20,000,000

Beſides theſe immenſe quantities imported into Britain and Ireland, much has been brought to Europe by other nations. In 1766 the whole tea imported into Europe from China amounted to 17 millions of pounds; in 1785 it was computed to be about 19 millions of pounds.‡

Several reſearches have been made in Europe to determine whether the tea plant grows ſpontaneouſly; but theſe reſearches have been hitherto in vain. When Captain Cook viſited Teneriffe in his laſt voyage, Mr Anderſon his ſurgeon was informed by a gentleman of acknowledged veracity, that a ſhrub is common near Santa Cruz which agrees exactly with the deſcription given of the tea-plant by Linnæus. It is conſidered as a weed, and large quantities are rooted out of the vineyards every year: But the Spaniards who inhabit the iſland ſometimes make uſe of it, and aſcribe to it all the qualities of the tea imported from China.

Many attempts have been made to introduce this valuable plant into Europe; but from want of proper precautions moſt of theſe attempts have miſcarried. The ſeeds, being of an oily nature, are apt to grow rancid during a long voyage, unleſs proper care is taken to preſerve them. There are two methods of preſerving theſe ſeeds: The firſt is, to incloſe them in wax after they have been dried in the ſun; the ſecond is, to leave them in their huſks, and ſhut them up cloſely in a box made of tin: but neither of theſe methods has been attended with general ſucceſs, whatever

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* Anderſon's Commerce, vol. ii. p. 138.

† Hanway's Journal.

‡ Raynal, vol. i. and Robertſon's India.

care has been taken to obtain freſh ſeeds, or to preſerve them. The beſt method would be, to ſow freſh ſeeds in fine light earth immediately on leaving Canton, and to cover them with wire to ſecure them from rats and other animals that might attack them. The boxes ought not to be too much expoſed to the air, nor to that kind of dew which riſes from the ſea. The earth in the boxes muſt neither be hard nor dry, and ſhould from time to time be gently watered with freſh or rain water; and when the ſhoots begin to appear, they ought to be kept in a ſlight moiſture, and ſheltered from the ſun. The tea-plants to be found in England have been procured by theſe means only; and though ſeveral of the young riſing roots periſhed, the laſt method propoſed is probably that which may be followed with greateſt ſucceſs.

The fineſt tea-plant known in England was raiſed in Kew gardens; it was carried thither by Sir J. Ellis, who brought it from ſeed: but the firſt that ever flouriſhed in Europe was one belonging to the Duke of Northumberland at Sion, from a drawing of which our engraving is taken. The plants which are cultivated in the gardens near London thrive well in the green-houſe during winter, and ſome ſtand that ſeaſon in the open air. Linnæus, who obtained this ſhrub in its growing ſtate, contrived to preſerve it in the open air in the northern latitude of Sweden. France has alſo procured ſome plants. There can be no doubt but they would ſucceed in many countries of Europe, if proper care were paid to their cultivation till they became inured to the climate. It will be a great advantage if we can rear that plant, which can never ſuffer ſo much from change of ſoil as from growing muſty during the long voyage from China. Beſides, the demand for tea is now become ſo great, that the Chineſe find it neceſſary, or at leaſt profitable, to adulterate it. Bad tea is now become an univerſal complaint. The Abbé Groſier tells us, that there is a kind of moſs which grows in the neighbourhood of the little city of Mang-ing-hien, which is ſold as a delicate ſpecies of tea. If this delicious commodity is adulterated in China, can we flatter ourſelves that none comes to us but what is pure and unmixed? How would our fine ladies like to be told, that inſtead of tea they drink nothing but the infuſion of moſs from the rocks of Mang-ing-hien (F)?

Of the chemical qualities and effects of tea on the conſtitution, many various and oppoſite opinions have been formed. About a century ago, Bontikoe, a Dutch phyſician, beſtowed extravagant encomiums on the benefits of tea. With him it was good for every thing; and any quantity might be drunk, even to the amount of 200 diſhes in a day. Whether Bontikoe in this caſe acted as a phyſician, or, being a Dutchman, was eager to encourage the ſale of an important article of his country's commerce, is not eaſy to ſay. On the other hand, the pernicious effects of tea upon the nervous ſyſtem have been often repeated, and very oppoſite effects have been aſcribed to it. Some affirm that green tea is mildly aſtringent; others ſay it is relaxing: Some ſay it is narcotic, and procures ſleep; while others contend, that taken before bed-time it aſſuredly prevents it.

Dr Lettſom, who has written the Natural Hiſtory of the Tea Tree, made ſeveral experiments to determine its chemical qualities. He found an infuſion of it preſerved beef freſh; it is therefore antiſeptic: and from its ſtriking a purple colour with the ſalt (ſulphate) of iron, he juſtly concludes that it is aſtringent. He concludes alſo, that the eſſential qualities of tea reſide in its fragrant and volatile parts.

We have heard much of the bad effects of tea, but we have neither felt nor obſerved it. If it were ſo pernicious as it has been repreſented by ſome, its effects muſt certainly be evident in China, where it is drunk by all ranks; yet ſo far from being thought hurtful in that country, it is in high eſtimation. The preſent emperor has compoſed a kind of eloge on the virtues of tea. We are told by thoſe who have written the hiſtory of China, that inflammatory diſeaſes are leſs frequent there than in many other countries, which is aſcribed ſolely to the liberal uſe of tea. It muſt be obſerved by all, that tea is an antidote againſt intemperance, and that he who reliſhes the one ſeldom runs into the other. Raynal ſays, that tea has contributed more to the ſobriety of this nation than the ſevereſt laws, the moſt eloquent harangues of Chriſtian orators, or the beſt treatiſes of morality. We have no doubt but it may be hurtful to ſome conſtitutions in particular circumſtances; but we ſuſpect that the nervous diſorders ſo often attributed to tea, are rather owing to hereditary diſeaſes, to want of exerciſe, and to irregularity in food or ſleep, than to tea. "Weak tea drunk too hot (ſays Dr Leake) will enervate, and if very ſtrong, may prove equally pernicious by affecting the head or ſtomach. But when it is drunk in moderation, and not too warm, with a large addition of milk, I believe it will ſeldom prove hurtful, but, on the contrary, ſalutary. After ſtudy or fatigue it is a moſt refreſhing and grateful repaſt; it quenches thirſt, and cheers the ſpirits, without heating the blood; and the pleaſing ſociety, in which we ſo often partake of it, is no inconſiderable addi-

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(F) There is very good reaſon to believe, that the adulteration of tea is not confined to China. It is practiſed, and often with too much ſucceſs, among ourſelves. Mr Twining, a conſiderable tea-dealer in London, publiſhed a pamphlet ſome years ago, in which he has expoſed this infamous traffic. The information (he ſays) was obtained from a gentleman who had made very accurate inquiries into this ſubject.

The ſmouch for mixing with black teas is made of the leaves of the aſh. When gathered, they are firſt dried in the ſun, then baked: they are next put upon a floor, and trod upon until the leaves are ſmall, then ſifted and ſteeped in copperas with ſheeps dung; after which, being dried on a floor, they are fit for uſe. There is alſo another mode: When the leaves are gathered, they are boiled in a copper with copperas and ſheeps dung; when the liquor is ſtrained off, they are baked and trod upon, until the leaves are ſmall, after which they are fit for uſe. The quantity manufactured at a ſmall village, and within eight or ten miles thereof, cannot be aſcertained, but is ſuppoſed to be about 20 tons in a year. One man acknowledges to have made 600 weight in every week for ſix months together. The fine is ſold at 4 l. 4 s. *per* cwt. equal to 9d. *per* lb. The coarſe is ſold at 2 l. 2 s. *per* cwt. equal to 4½d. *per* lb. Elder buds are manufactured in ſome places to repreſent fine teas.

For the honour of human nature, we hope ſuch a traffic as this is not very common; but if it be, thoſe concerned in it deſerve exemplary puniſhment. The only way (Mr Twining ſays) to eſcape this adulterated tea, is never to purchaſe from thoſe who offer their teas to ſale at lower prices than genuine teas can be afforded; but to purchaſe them only from perſons of character.

addition to its value; for whatever affords rational pleaſure to the mind, will always contribute to bodily health.

In this country teas are generally divided into three kinds of green, and five of bohea: The former are, 1. Imperial or bloom tea, with a large looſe leaf, light green colour, and a faint delicate ſmell. 2. Hyſon, ſo called from the name of the merchant who firſt imported it; the leaves of which are cloſely curled and ſmall, of a green colour, verging to a blue: And, 3. Singlo tea, from the name of the place where it is cultivated. The boheas are, 1. Souchong, which imparts a yellow green colour by infuſion. 2. Camho, ſo called from the place where it is made; a fragrant tea, with a violet ſmell: its infuſion pale. 3. Congo, which has a larger leaf than the following, and its infuſion ſomewhat deeper, reſembling common bohea in the colour of the leaf. 4. Pekoe tea; this is known by the appearance of ſmall white flowers mixed with it. 5. Common bohea, whoſe leaves are of one colour. There are other varieties, particularly a kind of green tea, done up in roundiſh balls, called *gun-powder tea*.

Tea-Tree of New Zealand, is a ſpecies of myrtle, of which an infuſion was drunk by Captain Cook's people in their voyages round the world. Its leaves were finely aromatic, aſtringent, and had a particular pleaſant flavour at the firſt infuſion; but this went off at the next filling up of the tea-pot, and a great degree of bitterneſs was then extracted; for which reaſon it was never ſuffered to be twice infuſed. In a fine ſoil in thick foreſts this tree grows to a conſiderable ſize; ſometimes 30 or 40 feet in height, and one foot in diameter. On a hilly and dry expoſure it degenerates into a ſhrub of five or ſix inches; but its uſual ſize is about eight or ten feet high, and three inches in diameter. In that caſe its ſtem is irregular and unequal, dividing very ſoon into branches, which riſe at acute angles, and only bear leaves and flowers at top. The flowers are white, and very ornamental to the whole plant.

Mr White, in his Journal of a Voyage to New South Wales, mentions a ſhrub which he calls a *tea-tree*, merely from its being uſed by the convicts as a ſuccedaneum for tea; for he had not ſeen the flower, nor did he know to what genus it belonged. It is a creeping kind of a vine, running to a great extent along the ground; the ſtalk ſlender; the leaf not ſo large as the common bay leaf; the taſte ſweet, exactly like the liquorice root of the ſhops.

TEACHERS, perſons employed in conducting the education of the young.

"We will venture to ſay, that there is no claſs of men to whom a nation is ſo much indebted as to thoſe employed in inſtructing the young: For if it be education that forms the only diſtinction between the civilized and the ſavage, much certainly is due to thoſe who devote themſelves to the office of inſtruction. It muſt be the duty therefore of every ſtate to take care that proper encouragement be given to thoſe who undertake this office. There ought to be ſuch a ſalary as would render it an object of ambition to men of abilities and learning, or at leaſt as would keep the teacher reſpectable. In Scotland, the office of a ſchoolmaſter was formerly much more lucrative than at preſent, and moſt of that claſs had received liberal education; and this is the reaſon why the common people in Scotland have been famous, even to a proverb, for their learning. But at preſent the ſalary of a country ſchoolmaſter, independent of fees for ſcholars, is not greater than a ploughman can earn, being ſeldom more than L. 8 : 6 ; 8, the conſequence of which is, that this, which is in fact an honourable, becauſe an uſeful profeſſion, is now ſinking into contempt. It is no longer an object to a man of learning; and we muſt ſoon be ſatisfied with ſchoolmaſters that can read, write, and caſt accounts, a little better, than the loweſt of the people, or who from ſome natural deformity are unable to exerciſe a trade. And what in this caſe muſt become of the minds of the common people? They muſt be totally uncultivated.

"We have obſerved a great difference between the cultivation of the common people in one part of Scotland compared with another; and we have found, that wherever a ſchoolmaſter is looked upon as a mean profeſſion, there is ſcarcely a duly qualified perſon to be found to undertake the office; and in thoſe places the common people are lamentably ignorant. In other places again, where the ſchoolmaſter is conſidered as one of the principal perſons in the pariſh, there men of a liberal education, young divines, and preachers, do not think themſelves diſgraced by exerciſing this profeſſion; and there the common people ſhow a degree of acuteneſs, knowledge, and obſervation, and poſſeſs ſuch poliſhed manners, as raiſe them very high above thoſe of their own rank in other parts of the country.

"Many and keen have been the debates about a reform of government of late years; but little attention has been paid to the formation of the minds of the common people, who conſtitute the greater part of the nation; of courſe they are ready to join the ſtandard of every ſeditious demagogue who ſounds the alarm of oppreſſion; and ſhould they at length be rouſed, their cruelty and barbarity, like the common people of France, would be exactly in proportion to their ignorance and want of principle.

"We are willing to hope, then, that the government and the monied men of the nation, who alone have property to loſe and money to beſtow, will at length find it to be their intereſt to patronize ſchoolmaſters."

TEAL, in ornithology. See ANAS.

TEARS, a lymph or aqueous humour, which is limpid, and a little ſaltiſh: it is ſeparated from the arterial blood by the lachrymal glands and ſmall glandulous grains on the inſide of the eyelids.

TEASELS, a plant cultivated in the weſt of England for the uſe of clothiers. See DIPSACUS.

TEBETH, the tenth month of the Jewiſh eccleſiaſtical year, and fourth of the civil. It anſwers to our month of December.

TECKLENBURG, a town of Germany, in the circle of Weſtphalia, capital of a county of the ſame name, with a caſtle built on a hill. It was bought by the king of Pruſſia in 1707. E. Long. 8. 2. N. Lat. 52. 20.

TECHNICAL, expreſſes ſomewhat relating to arts or ſciences: in this ſenſe we ſay technical terms. It is alſo particularly applied to a kind of verſes wherein are contained the rules or precepts of any art, thus digeſted to help the memory to retain them; an example whereof may be ſeen in the article MEMORY.

TECTONA, in botany; a genus of plants belonging to the claſs of *pentandria*, and order of *monogynia*. The ſtigma is dentate; the fruit a dry ſpongy plum within an inflated calyx; and the nucleus is trilocular. There is only one ſpecies, the *grandis*, Indian oak, or teak wood, which is a native of India.

TE DEUM, the name of a celebrated hymn, uſed in the Chriſtian church, and ſo called becauſe it begins with theſe words, *Te Deum laudamus*, We praiſe thee, O God. It is ſung in the Romiſh church with great pomp and ſolemnity upon the gaining of a victory, or other happy event; and is believed to be the compoſition of St AMBROSE biſhop of *Milan*.

TEES, a river which riſes on the confines of Cumberland,

land, and running eaſtward, divides the county of Durham from Yorkſhire, and falls into the German ſea below Stockton.

TEETH, the bones placed in the jaws for chewing food, that it may be the more eaſily digeſted in the ſtomach. The anatomical ſtructure of theſe has already been deſcribed under Anatomy and Comparative Anatomy. The diſeaſes to which they are liable, as well as the moſt ſucceſsful remedies for removing them, are fully detailed under Medicine and Surgery, to which we refer the reader.

Much attention has been paid to the beauty and preſervation of the teeth among moſt nations. The Romans rubbed and waſhed them with great care; and when they loſt them, ſupplied their place with artificial teeth made of ivory; and ſometimes, when looſe, bound them with gold. Ligatures of wire have been found to hurt the natural teeth with which the artificial are connected: whereas ſilken twiſt cannot affect them to any conſiderable degree for ſeveral years.

Guilleman gives us the compoſition of a paſte for making artificial teeth, which ſhall never grow yellow: the compoſition is white wax granulated, and melted with a little gum elemi, adding powder of white maſtich, coral and pearl.

When ſeveral teeth are out in the ſame place, it is beſt to make a ſet, or the number wanted, out of one piece, all adhering together, which may be faſtened to the two next of the ſound or natural teeth. And even a whole ſet of artificial teeth may be made for one or both jaws, ſo well fitted to admit of the neceſſary motions, and ſo conveniently retained in the proper ſituation by means of ſprings, that they will anſwer every purpoſe of natural teeth, and may be taken out, cleaned and replaced, by the patient himſelf with great eaſe.

The common trick of mountebanks and other ſuch practitioners, is to uſe various waſhes for the teeth, the ſudden effects of which, in cleaning and whitening the teeth, ſurpriſe and pleaſe people; but the effects are very pernicious. All the ſtrong acid ſpirits will do this. As good a mixture as any thing can be, on this occaſion, is the following: take plantane-water an ounce, honey of roſes two drams, muriatic acid ten drops; mix the whole together, and rub the teeth with a piece of linen rag dipped in this every day till they are whitened. The mouth ought to be well waſhed with cold water after the uſe of this or any other acid liquor; and indeed the beſt of all teeth-waſhes is cold water, with or without a little ſalt; the conſtant uſe of this will keep them clean and white, and prevent them from aching.

After all the numerous cures which have been propoſed for preventing the toothach, we will venture to recommend the keeping the teeth clean as the moſt efficacious, and avoiding every kind of hot food, eſpecially hot liquids, as tea, &c. They who are conſtantly uſing powders generally deſtroy their teeth altogether, as the valetudinarian does his health.

TEETHING in children. See Medicine.

TEFF, a kind of grain, ſown all over Abyſſinia, from which is made the bread commonly uſed throughout the country. We have no deſcription of this plant but from Mr Bruce, who ſays that it is herbaceous; and that from a number of weak leaves ſurrounding the root proceeds a ſtalk of about 28 inches in length, not perfectly ſtraight, ſmooth but jointed or knotted at particular diſtances. This ſtalk is not much thicker than that of a carnation or jellyflower. About eight inches from the top, a head is formed of a number of ſmall branches, upon which it carries the fruit and flowers; the latter of which is ſmall, of a crimſon colour, and ſcarcely perceptible by the naked eye but from the oppoſition of that colour. The piſtil is divided into two, ſeemingly attached to the germ of the fruit, and has at each end ſmall capillaments forming a bruſh. The ſtamina are three in number; two on the lower ſide of the piſtil, and one on the upper. Theſe are each of them crowned with two oval ſtigmata, at firſt green, but after crimſon. The fruit is formed in a capſula, conſiſting of two conical hollow leaves, which, when cloſed, ſeem to compoſe a ſmall conical pod, pointed at the top. The fruit or ſeed is oblong, and is not ſo large as the head of the ſmalleſt pin; yet it is very prolific, and produces theſe ſeeds in ſuch quantity as to yield a very abundant crop in the quantity of meal.

Our author, from the ſimilarity of the names, conjectures it to be the *tipha* mentioned, but not deſcribed, by Pliny: but this conjecture, which he acknowledges to be unſupported, is of very little importance.

There are three kinds of meal made from teff, of which the beſt (he ſays) is as white as flour, exceedingly light, and eaſily digeſted; the ſecond is of a browner colour; and the laſt, which is the food of ſoldiers and ſervants, is nearly black. This variety he imagines to ariſe entirely from the difference of ſoils in which the ſeeds are ſown, and the different degrees of moiſture to which the plant is expoſed when growing. The manner of making the meal or flour into bread is by taking a broad earthen jar, and having made a lump of it with water, they put it into the earthen jar at ſome diſtance from the fire, where it remains till it begins to ferment or turn ſour; they then bake it into cakes of a circular form, and about two feet in diameter: it is of a ſpongy ſoft quality, and not a diſagreeable ſouriſh taſte. Two of theſe cakes a-day, and a coarſe cotton cloth once a-year, are the wages of a common ſervant.

At their banquets of raw meat, the fleſh being cut in ſmall bits, is wrapt up in pieces of this bread, with a proportion of foſſil ſalt and Cayenne pepper. Before the company ſits down to eat, a number of theſe cakes of different qualities are placed one upon the other, in the ſame manner as our plates, and the principal people ſitting firſt down, eat the white teff; the ſecond or coarſer ſort ſerves the ſecond rate people that ſucceed them, and the third is for the ſervants. Every man, when he has done, dries or wipes his fingers upon the bread which he is to leave for his ſucceſſor, for they have no towels; and this is one of the moſt beaſtly cuſtoms among them.

Of this teff bread the natives make a liquor, by a proceſs which our author deſcribes in the following words: The bread, when well toaſted, is broken into ſmall pieces, which are put into a large jar, and have warm water poured upon them. It is then ſet by the fire, and frequently ſtirred for ſeveral days, the mouth of the jar being cloſe covered. After being allowed to ſettle three or four days, it acquires a ſouriſh taſte, and is what they call *bouza*, or the common beer of the country. The bouza in Atbara is made in the ſame manner, only inſtead of teff, cakes of barley-meal are employed. Both are very bad liquors, but the worſt is that made of barley.

TEFFLIS, or Tifflis, a town of Aſia, in Georgia, one of the ſeven nations between the Black Sea and the Caſpian. It is the capital of that country, the place of reſidence of its ſovereign, and is called by the inhabitants *Thilis-Cabar*, "warm town," from the warm baths in its neighbourhood. Though its circumference does not exceed two Engliſh miles, it contains 20,000 inhabitants, of which more than one half are Armenians; the remainder are principally Georgians, with ſome Tartars. According to Major Rennel, it has 20 Armenian and 15 Greek churches, and three metſheds. But Mr Coxe, on the authority of Profeſſor

Guldenſtaedt, ſtates the places of worſhip to be one Roman Catholic, 13 Greek, and ſeven Armenian churches. There are ſome magnificent caravanſeras, bazars, and palaces in the city, but no moſques; for the Georgians, though living under a Mohammedan government, have always riſen up in arms as often as any attempts have been made to erect ſuch places of Mohammedan worſhip. Many of the Romiſh miſſionaries live here in diſguiſe under the denomination of phyſicians, ſurgeons, and chemiſts; and the great cures which they perform procure them much eſteem, though they are ſometimes expoſed to the inſults of the people when they attempt to make any proſelytes to their church. All the houſes are of ſtone, with flat roofs, which ſerve, according to the cuſtom of the Eaſt, as walks for the women. They are neatly built; the rooms are wainſcotted, and the floors ſpread with carpets. The ſtreets ſeldom exceed ſeven feet in breadth; and ſome are ſo narrow as ſcarcely to allow room for a man on horſeback: they are conſequently very filthy.

Tefflis is a place of conſiderable trade, eſpecially in furs, which are conveyed hence to Conſtantinople by the way of Erzerum. As for the ſilks of this country, they are bought up on the ſpot by the Armenians, and conveyed to Smyrna and other ports of the Mediterranean; but the greateſt part is firſt ſent to Erzerum to be manufactured, the Georgians being very ignorant and unſkilful in that reſpect. From hence, likewiſe, great quantities of a root called *boya* is ſent to Erzerum and Indoſtan for the uſe of the linen dyers. Here is likewiſe a foundery, at which are caſt a few cannon, mortars, and balls, all of which are very inferior to thoſe of the Turks. The gunpowder made here is very good. The Armenians have likewiſe eſtabliſhed in this town all the manufactures carried on by their countrymen in Perſia: the moſt flouriſhing is that of printed linens. Tefflis is ſeated on the river Kur, at the foot of a mountain; and on the ſouth ſide of it ſtands a large caſtle or fortreſs, built by the Turks in 1576, when they made themſelves maſters of the city and country, under the command of the famous Muſtapha Pacha. It is 125 miles weſt of Terki. E. Long. 63. 3. N. Lat. 41. 59.

TEGERHY, a principal town in Fezzan, in Africa, about 80 miles ſouth-weſt of the capital. It collects from its lands little other produce than dates and Indian corn. In this, as in every town in Fezzan, a market for butcher-meat, corn, fruit, and vegetables, is regularly held. Mutton and goat's fleſh are ſold by the quarter without weighing; the uſual price is from 32 to 40 grains of gold-duſt, or four or five ſhillings Engliſh money. The fleſh of the camel, which is much more highly valued, is commonly ſold at a dearer rate, and is divided into ſmaller lots. Agriculture and paſturage ſeem to be the principal occupations.

TEGUMENT, any thing that ſurrounds or covers another.

TEIND in Scots law. See LAW, N° clxx.

Commiſſion of TEINDS. See COMMISSION.

TEINTS, and SEMITEINTS, in painting, denote the ſeveral colours uſed in a picture, conſidered as more or leſs high, bright, deep, thin, or weakened and diminiſhed, &c. to give the proper relievo, ſoftneſs, or diſtance, &c. of the ſeveral objects.

TELEGRAPH (derived from τηλε and γραφω), is the name very properly given to an inſtrument, by means of which information may be almoſt inſtantaneouſly conveyed to a conſiderable diſtance.

The telegraph, though it has been generally known and uſed by the moderns only for a few years, is by no means a modern invention. There is reaſon to believe that amongſt the Greeks there was ſome ſort of telegraph in uſe. The burning of Troy was certainly known in Greece very ſoon after it happened, and before any perſon had returned from thence. Now that was altogether ſo tedious a piece of buſineſs, that conjecture never could have ſupplied the place of information. A Greek play begins with a ſcene, in which a watchman deſcends from the top of a tower in Greece, and gives the information that Troy was taken. "I have been looking out theſe ten years (ſays he) to ſee when that would happen, and this night it is done." Of the antiquity of a mode of conveying intelligence quickly to a great diſtance, this is certainly a proof.

The Chineſe, when they ſend couriers on the great canal, or when any great man travels there, make ſignals by fire from one day's journey to another, to have every thing prepared; and moſt of the barbarous nations uſed formerly to give the alarm of war by fires lighted on the hills or riſing grounds.

Polybius calls the different inſtruments uſed by the ancients for communicating information πυρσειαι *pyrſiæ*, becauſe the ſignals were always made by means of fire. At firſt they communicated information of events merely by torches; but this method was of little uſe, becauſe it was neceſſary before-hand to fix the meaning of every particular ſignal. Now as events are exceedingly various, it was impoſſible to expreſs the greater number of them by any premeditated contrivance. It was eaſy, for inſtance, to expreſs by ſignals that a fleet had arrived at ſuch a place, becauſe this had been foreſeen, and ſignals accordingly had been agreed upon to denote it; but an unexpected revolt, a murder, and ſuch accidents, as happen but too often, and require an immediate remedy, could not be communicated by ſuch ſignals; becauſe to foreſee them was impoſſible.

Polybius, book x. chap. 40.

Æneas, a contemporary of Ariſtotle, who wrote a treatiſe on the duties of a general, endeavoured to correct thoſe imperfections, but by no means ſucceeded. "Thoſe (ſays he) who would give ſignals to one another upon affairs of importance, muſt firſt prepare two veſſels of earth, exactly equal in breadth and depth; and they need be but four feet and a half deep, and a foot and a half wide. They then muſt take pieces of cork, proportioned to the mouth of theſe veſſels, but not quite ſo wide, that they may be let down with eaſe to the bottom of theſe veſſels. They next fix in the middle of this cork a ſtick, which muſt be of equal ſize in both theſe veſſels. This ſtick muſt be divided exactly and diſtinctly, by ſpaces of three inches each, in order that ſuch events as generally happen in war may be writ on them. For example, on one of theſe ſpaces the following words may be writ: 'A BODY OF HORSE ARE MARCHED INTO THE COUNTRY.' On another, 'A BODY OF INFANTRY, heavily armed, are arrived hither.' On a third, 'INFANTRY LIGHTLY ARMED.' On a fourth, 'HORSE AND FOOT.' On another, 'SHIPS,' then 'PROVISIONS;' and ſo on till all the events which may probably happen in the war that is carrying on are writ down in theſe intervals.

"This being done, each of the two veſſels muſt have a little tube or cock of equal bigneſs, to let out the water in equal proportion. Then the two veſſels muſt be filled with water; the pieces of cork, with their ſticks thruſt through them, muſt be laid upon them, and the cocks muſt be opened. Now, it is plain, that as theſe veſſels are equal, the corks will ſink, and the ſticks deſcend lower in the veſſels, in proportion as they empty themſelves. But to be more certain of this exactneſs, it will be proper to make the experiment firſt, and to examine whether all things correſpond and agree together, by an uniform execution on both ſides. When they are well aſſured of this, the two veſſels muſt be carried to the two places where the ſignals are to be made and obſerved: water is poured in, and the corks and ſticks are put in the veſſels. When any of the events which are written on the ſticks ſhall happen, a torch or other light is raiſed, which muſt be held aloft till ſuch time as another is raiſed by the party to whom it is directed. (This firſt ſignal is only to give notice that both parties are ready and attentive.) Then the torch or other light muſt be taken away, and the cocks ſet open. When the interval, that is, that part of the ſtick where the event of which notice is to be given or written, ſhall be fallen to a level with the veſſels, then the man who gives the ſignal lifts up his torch; and on the other ſide, the correſpondent ſignal-maker immediately turns the cock of his veſſel, and looks at what is writ on that part of the ſtick which touches the mouth of the veſſel: on which occaſion, if every thing has been executed exactly and equally on both ſides, both will read the ſame thing."

This method was defective, becauſe it could not convey any other intelligence except what was written on the ſticks, and even that not particularly enough. With regard to all unforeſeen events, it was quite uſeleſs.

olybius, bid.

A new method was invented by Cleoxenus (others ſay by Democlitus), and very much improved by Polybius, as he himſelf informs us. He deſcribes this method as follows: Take the letters of the (Greek) alphabet, and divide them into five parts, each of which will conſiſt of five letters, except the laſt diviſion, which will have only four. Let theſe be fixed on a board in five columns. The man who is to give the ſignals is then to begin by holding up two torches, which he is to keep aloft till the other party has alſo ſhown two. This is only to ſhow that both ſides are ready. Theſe firſt torches are then withdrawn. Both parties are provided with boards, on which the letters are diſpoſed as formerly deſcribed. The perſon then who gives the ſignal is to hold up torches on the left to point out to the other party from what column he ſhall take the letters as they are pointed out to him. If it is to be from the firſt column, he holds up one torch; if from the ſecond, two; and ſo on for the others. He is then to hold up torches on the right, to denote the particular letter of the column that is to be taken. All this muſt have been agreed on before-hand. The man who gives the ſignals muſt have an inſtrument (διοπτραν), conſiſting of two tubes, and ſo placed as that, by looking through one of them, he can ſee only the right ſide, and through the other only the left, of him who is to anſwer. The board muſt be ſet up near this inſtrument; and the ſtation on the right and left muſt be ſurrounded with a wall (παραπεφραχθαι) ten feet broad, and about the height of a man, that the torches raiſed above it may give a clear and ſtrong light, and that when taken down they may be completely concealed. Let us now ſuppoſe that this information is to be communicated—*A number of the auxiliaries, about a hundred, have gone over to the enemy.* In the firſt place, words muſt be choſen that will convey the information in the feweſt letters poſſible; as *A hundred Cretans have deſerted,* Κρητες εκατον αφ' ημων ηυτομολησαν. Having written down this ſentence, it is conveyed in this manner. The firſt letter is a κ, which is in the ſecond column; two torches are therefore to be raiſed on the left hand to inform the perſon who receives the ſignals to look into that particular column. Then five torches are to be held up on the right, to mark the letter *k*, which is the laſt in the column. Then four torches are to be held up on the left to point out the ρ *(r)*, which is in the fourth column, and two on the right to ſhow that it is the ſecond letter of that column. The other letters are pointed out in the ſame manner.—Such was the *pyrſia* or telegraph recommended by Polybius.

But neither this nor any other method mentioned by the ancients ſeems ever to have been brought into general uſe; nor does it appear that the moderns had thought of ſuch a machine as a *telegraph* till the year 1663, when the Marquis of Worceſter, in his CENTURY OF INVENTIONS, affirmed that he had diſcovered "a method by which, at a window, as far as eye can diſcover black from white, a man may hold diſcourſe with his correſpondent, without noiſe made or notice taken; being according to occaſion given or means afforded, *ex re nata*, and no need of proviſion before hand; though much better if foreſeen, and courſe taken by mutual conſent of parties." This could be done only by means of a telegraph, which in the next ſentence is declared to have been rendered ſo perfect, that by means of it the correſpondence could be carried on "by night as well as by day, though as dark as pitch is black."

About 40 years afterwards M. Amontons propoſed a new telegraph. His method was this: Let there be people placed in ſeveral ſtations, at ſuch a diſtance from one another, that by the help of a teleſcope a man in one ſtation may ſee a ſignal made in the next before him; he muſt immediately make the ſame ſignal, that it may be ſeen by perſons in the ſtation next after him, who are to communicate it to thoſe in the following ſtation, and ſo on. Theſe ſignals may be as letters of the alphabet, or as a cipher, underſtood only by the two perſons who are in the diſtant places, and not by thoſe who make the ſignals. The perſon in the ſecond ſtation making the ſignal to the perſon in the third the very moment he ſees it in the firſt, the news may be carried to the greateſt diſtance in as little time as is neceſſary to make the ſignals in the firſt ſtation. The diſtance of the ſeveral ſtations, which muſt be as few as poſſible, is meaſured by the reach of a teleſcope. Amontons tried this method in a ſmall tract of land before ſeveral perſons of the higheſt rank at the court of France.

It was not, however, till the French revolution that the telegraph was applied to uſeful purpoſes. Whether M. Chappe, who is ſaid to have invented the telegraph firſt uſed by the French about the end of 1793, knew any thing of Amontons's invention or not, it is impoſſible to ſay; but his telegraph was conſtructed on principles nearly ſimilar. The manner of uſing this telegraph was as follows: At the firſt ſtation, which was on the roof of the palace of the Louvre at Paris, M. Chappe, the inventor, received in writing, from the committee of public welfare, the words to be ſent to Liſle, near which the French army at that time was. An upright poſt was erected on the Louvre, at the top of which were two tranſverſe arms, moveable in all directions by a ſingle piece of mechaniſm, and with inconceivable rapidity. He invented a number of poſitions for theſe arms, which ſtood as ſigns for the letters of the alphabet; and theſe, for the greater celerity and ſimplicity, he reduced in number as much as poſſible. The grammarian will eaſily conceive that ſixteen ſigns may amply ſupply all the letters of the alphabet, ſince ſome letters may be omitted not only without detriment but with advantage. Theſe ſigns, as they were arbitrary, could be changed every week; ſo that the ſign of B for one day might be the ſign of M the next; and it was only neceſſary that the perſons at the extremities ſhould know the key. The intermediate operators were only inſtructed generally in theſe ſixteen ſignals; which were ſo diſtinct, ſo marked, ſo different the one from the other, that they were eaſily remembered. The conſtruction of the machine was ſuch, that each ſignal was uniformly given in preciſely the ſame manner at all times: It did not depend on the operator's manual ſkill; and the poſition of the arm could never, for any one ſignal, be a degree higher or a degree lower, its movement being regulated mechanically.

M. Chappe having received at the Louvre the ſentence to be conveyed, gave a known ſignal to the ſecond ſtation, which was Mont Martre, to prepare. At each ſtation there was a watch tower, where teleſcopes were fixed, and the perſon on watch gave the ſignal of preparation which he had received, and this communicated ſucceſſively through all the line, which brought them all into a ſtate of readineſs. The perſon at Mont Martre then received, letter by letter, the ſentence from the Louvre, which he repeated with his own machine; and this was again repeated from the next height, with inconceivable rapidity, to the final ſtation at Liſle.

English Review. June 1796. The firſt deſcription of the telegraph was brought from Paris to Frankfort on the Maine by a former member of the parliament of Bourdeaux, who had ſeen that which was erected on the mountain of Belville. As given by Dr Hutton from ſome of the Engliſh papers, it is as follows. AA is a beam or maſt of wood placed upright on a riſing ground (fig. 1. Plate DII.), which is about 15 or 16 feet high. BB is a beam or balance moving upon the centre AA. This balance-beam may be placed vertically or horizontally, or any how inclined, by means of ſtrong cords, which are fixed to the wheel D, on the edge of which is a double groove to receive the two cords. This balance is about 11 or 12 feet long, and nine inches broad, having at the ends two pieces of wood CC, which likewiſe turn upon angles by means of four other cords that paſs through the axis of the main balance, otherwiſe the balance would derange the cords; the pieces C are each about three feet long, and may be placed either to the right or left, ſtraight or ſquare, with the balance-beam. By means of theſe three the combination of movement is very extenſive, remarkably ſimple, and eaſy to perform. Below is a ſmall wooden gouge or hut, in which a perſon is employed to obſerve the movements of the machine. In the mountain neareſt to this another perſon is to repeat theſe movements, and a third to write them down. The time taken up for each movement is 20 ſeconds; of which the motion alone is four ſeconds, the other 16 the machine is ſtationary. Two working models of this inſtrument were executed at Frankfort, and ſent by Mr W. Playfair to the Duke of York; and hence the plan and alphabet of the machine came to England.

Various experiments were in conſequence tried upon telegraphs in that country; and one was ſoon after ſet up by government in a chain of ſtations from the admiralty-office to the ſea-coaſt. It conſiſts of ſix octagonal boards, each of which is poiſed upon an axis in a frame, in ſuch a manner that it can be either placed vertically, ſo as to appear with its full ſize to the obſerver at the neareſt ſtation, as in fig. 2. or it becomes inviſible to him by being placed horizontally, as in fig. 3. ſo that the narrow edge alone is expoſed, which narrow edge is from a diſtance inviſible. Fig. 2. is a repreſentation of this telegraph, with the parts all ſhut, and the machine ready to work. T, in the officer's cabin, is the teleſcope pointed to the next ſtation. Fig. 3. is a repreſentation of the machine not at work, and with the ports all open. The opening of the firſt port (fig. 2.) expreſſes *a*, the ſecond *b*, the third *c*, the fourth *d*, the fifth *e*, and the ſixth *f*, &c.

Six boards make 36 changes, by the moſt plain and ſimple mode of working; and they will make many more if more were neceſſary: but as the real ſuperiority of the telegraph over all other modes of making ſignals conſiſts in its making letters, we do not think that more changes than the letters of the alphabet, and the ten arithmetical ciphers, are neceſſary; but, on the contrary, that thoſe who work the telegraphs ſhould avoid communicating by words or ſigns agreed upon to expreſs ſentences; for that is the ſure method never to become expert at ſending unexpected intelligence accurately.

This telegraph is without doubt made up of the beſt number of combinations poſſible; five boards would be inſufficient, and ſeven would be uſeleſs. It has been objected to it, however, that its form is too clumſy to admit of its being raiſed to any conſiderable height above the building on which it ſtands; and that it cannot be made to change its direction, and conſequently cannot be ſeen but from one particular point.

Several other telegraphs have been propoſed to remedy theſe defects, and perhaps others to which the inſtrument is ſtill liable. The dial plate of a clock would make an excellent telegraph, as it might exhibit 134 ſigns ſo as to be viſible at a great diſtance. A telegraph on this principle, with only ſix diviſions inſtead of twelve, would be ſimple and cheap, and might be raiſed 20 or 30 feet high above the building without any difficulty; it might be ſupported on one poſt, and therefore turn round, and the contraſt of colours would always be the ſame.

Supplement for 1794. A very ingenious improvement of the telegraph has been propoſed in the Gentleman's Magazine. It conſiſts of a ſemicircle to be properly elevated, and fixed perpendicularly on a ſtrong ſtand. The radius 12 feet; the ſemicircle conſequently ſomewhat more than 36. This to be divided into 24 parts. Each of theſe will therefore compriſe a ſpace of 18 inches, and an arch of 7° 30′ on the circumference. Theſe 24 diviſions to be occupied by as many circular apertures of ſix inches diameter; which will leave a clear ſpace of ſix inches on each ſide between the apertures. Theſe apertures, beginning from the left, to denote the letters of the alphabet, omitting K, J conſonant, V, X, and Q, as uſeleſs for this purpoſe. There are then 21 letters. The four other ſpaces are reſerved for ſignals. The inſtrument to have an index moveable by a windlaſs on the centre of the ſemicircle, and having two tops, according as it is to be uſed in the day or night; one, a circular top of lacquered iron or copper, of equal diameter with the apertures (and which conſequently will eclipſe any of them againſt which it reſts); the other, a ſpear or arrow-ſhaped top, black and highly poliſhed, which, in ſtanding before any of the apertures in the day-time, will be diſtinctly viſible. In the night, the apertures to be reduced by a diaphragm fitting cloſe to each, ſo as to leave an aperture of not more than two inches diameter. The diaphragm to be of well-poliſhed tin; the inner rim lacquered black half an inch. All the apertures to be illuminated, when the inſtrument is uſed in the night-time, by ſmall lamps; to which, if neceſſary, according to circumſtances, convex lenſes may be added, fitted into each diaphragm, by which the light may be powerfully concentrated and increaſed. Over each aperture one of the five priſmatic colours leaſt likely to be miſtaken (the remaining two being leſs diſtinguiſhable, and not wanted, are beſt omitted) to be painted; and, in their natural order, on a width of eighteen inches and a depth of four, red, orange, yellow, green, blue; or, ſtill to heighten the contraſt, and render immediately ſucceſſive apertures more diſtinguiſhable, red, green, orange, blue, yellow. The whole inner circle beneath and between the apertures to be painted black.

When the inſtrument is to be uſed, the index to be ſet to the ſignal apertures on the right. All the apertures to be covered or dark when it begins to be uſed, except that which is to give the ſignal. A ſignal gun to be fired to appriſe the obſerver. If the index is ſet to the firſt aperture, it will denote that words are to be expreſſed; if to the ſecond, that figures; if to the third, that the figures ceaſe; and that the intelligence is carried on in words. When figures are to be expreſſed, the alternate apertures from the left are taken in their order, to denote from 1 to 10 incluſively;

ſively; the ſecond from the right denotes 100; the fifth 1000. This order, and theſe intervals, are taken to prevent any confuſion in ſo peculiarly important an article of the intelligence to be conveyed.

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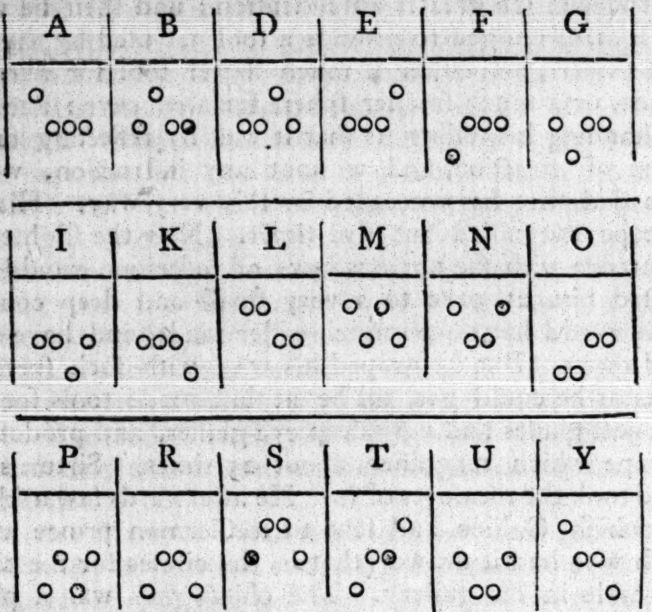
Perhaps, however none of the telegraphs hitherto offered to the public exceeds the following, either in ſimplicity, cheapneſs, or facility in working, and it might perhaps, with a few trifling additions, be made exceedingly diſtinct. It is thus deſcribed in the Repertory of Arts and Manufactures: For a nocturnal telegraph, let there be four large patent reflectors, lying on the ſame plane, parallel to the horizon, placed on the top of an obſervatory. Let each of theſe reflectors be capable, by means of two winches, either of elevation or depreſſion to a certain degree. By elevating or depreſſing one or two of the reflectors, eighteen very diſtinct arrangements may be produced, as the following ſcheme will explain (A).



For the ſake of example, the above arrangements are made to anſwer to the moſt neceſſary letters of the alphabet; but alterations may be made at will, and a greater number of changes produced, without any addition to the reflectors. In the firſt obſervatory there need only be a ſet of *ſingle* reflectors; but in the others each reflector ſhould be double, ſo as to face both the preceding and ſubſequent obſervatory; and each obſervatory ſhould be furniſhed with two teleſcopes. The proper diameter of the reflectors, and their diſtance from each other, will be aſcertained by experience.

To convert this machine into a diurnal telegraph, nothing more is neceſſary than to inſert, in the place of the reflectors, gilt balls, or any other conſpicuous bodies.

Were telegraphs brought to ſo great a degree of perfection, that they could convey information ſpeedily and diſtinctly; were they ſo much ſimplified, that they could be conſtructed and maintained at little expence—the advantages which would reſult from their uſe are almoſt inconceivable. Not to ſpeak of the ſpeed with which information could be communicated and orders given in time of war, by means of which misfortunes might be prevented or inſtantly repaired, difficulties removed, and diſputes precluded, and by means of which the whole country could be prepared in an inſtant to oppoſe an invading enemy; it might be uſed by commercial men to convey a commiſſion cheaper and ſpeedier than an expreſs can travel. The capitals of diſtant nations might be united by chains of poſts, and the ſettling of thoſe diſputes which at preſent take up months or years might then be accompliſhed in as many hours. An eſtabliſhment of telegraphs might then be made like that of the poſt; and inſtead of being an expence, it would produce a revenue. Until telegraphs are employed to convey information that occurs very frequently, the perſons who are ſtationed to work them will never become expert, and conſequently will neither be expeditious nor accurate, though, with practice, there is no doubt but they will attain both in a degree of perfection of which we can as yet have but little conception.

TELEMACHUS, the ſon of Ulyſſes and Penelope, was ſtill in the cradle when his father went with the reſt of the Greeks to the Trojan war. At the end of this celebrated war, Telemachus, anxious to ſee his father, went to ſeek him; and as the place of his reſidence, and the cauſe of his long abſence, were then unknown, he viſited the court of Menelaus and Neſtor to obtain information. He afterwards returned to Ithaca, where the ſuitors of his mother Penelope had conſpired to murder him, but he avoided their ſnares; and by means of Minerva he diſcovered his father, who had arrived in the iſland two days before him, and was then in the houſe of Eumæus. With this faithful ſervant and Ulyſſes Telemachus concerted how to deliver his mother from the importunities of her ſuitors, and it was effected with great ſucceſs. After the death of his father, Telemachus went to the iſland of Ææa, where he married Circe, or, according to others, Caſſiphone the daughter of Circe, by whom he had a ſon called *Latinus*. He ſome time after had the misfortune to kill his mother-in-law Circe, and fled to Italy, where he founded Cluſium. Telemachus was accompanied in his viſit to Neſtor and Menelaus by the goddeſs of wiſdom under the form of Mentor. It is ſaid that, when a child, Telemachus fell into the ſea, and that a dolphin brought him ſafe to ſhore, after he had remained ſome time under water. From this circumſtance Ulyſſes had the figure of a dolphin engraved on the ſeal which he wore on his ring.

Lectures on Rhetoric and the Belles Lettres.

From theſe ſtories, collected from Homer and the other poets of antiquity, the celebrated Fenelon archbiſhop of Cambray took the idea of his well-known *Adventures of Telemachus*; which, though not compoſed in verſe, is juſtly intitled to be eſteemed a poem. "The plan of the work (ſays Dr Blair) is in general well contrived; and is deficient neither in epic grandeur nor unity of object. The author has entered with much felicity into the ſpirit and ideas of the ancient poets, particularly into the ancient mythology, which retains more dignity, and makes a better figure in his hands than in thoſe of any other modern poet. His deſcriptions are rich and beautiful; eſpecially of the ſofter and calmer ſcenes, for which the genius of Fenelon was beſt ſuited; ſuch as the incidents of paſtoral life, the pleaſures of virtue, or a country flouriſhing in peace. There is an inimitable ſweetneſs and tenderneſs in ſeveral of the pictures of this kind which he has given:" and his meaſured proſe, which is remarkably harmonious, gives the ſtyle nearly as much elevation as the French language is capable of ſupporting even in regular verſe.

According to the ſame eminent critic, "the beſt executed part of the work is the firſt ſix books, in which Telemachus recounts his adventures to Calypſo. The narration throughout them is lively and intereſting. Afterwards, eſpecially in the laſt twelve books, it becomes more tedious and languid; and in the warlike adventures which are attempted,

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(A) Each reflector, after every arrangement, muſt be reſtored to its place.

Telephium, Teleſcope.

tempted, there is a great defect of vigour. The chief objection againſt this work being claſſed with epic poems, ariſes from the minute details of virtuous policy, into which the author in ſome places enters; and from the diſcourſes and inſtructions of Mentor, which recur upon us too often, and too much in the ſtrain of common-place morality. Though theſe were well ſuited to the main deſign of the author, which was to form the mind of a young prince, yet they ſeem not congruous to the nature of epic poetry; the object of which is to improve us by means of actions, characters, and ſentiments, rather than by delivering profeſſed and formal inſtruction."

TELEPHIUM, TRUE ORPINE, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *trigynia;* and in the natural ſyſtem ranging under the 54th order, *Miſcellaneæ*. The calyx is pentaphyllous; there are five petals, which are inſerted into the receptacle; the capſule is unilocular and trivalvular. There are two ſpecies, the *imperati* and *oppoſitifolia*.

TELESCOPE, an optical inſtrument for viewing diſtant objects; ſo named by compounding the Greek words τηλε *far off*, and σκοπειν *to look at* or *contemplate*. This name is commonly appropriated to the larger ſizes of the inſtrument, while the ſmaller are called PERSPECTIVE-GLASSES, SPY-GLASSES, OPERA-GLASSES. A particular kind, which is thought to be much brighter than the reſt, is called a NIGHT-GLASS.

To what has been ſaid already with reſpect to the inventor of this moſt noble and uſeful inſtrument in the article OPTICS, we may add the two following claims.

Mr Leonhard Digges, a gentleman of the laſt century of great and various knowledge, poſitively aſſerts in his *Stratoticos*, and in another work, that his father, a military gentleman, had an inſtrument which he uſed in the field, by which he could bring diſtant objects near, and could know a man at the diſtance of three miles. He ſays, that when his father was at home he had often looked through it, and could diſtinguiſh the waving of the trees on the oppoſite ſide of the Severn. Mr Digges reſided in the neighbourhood of Briſtol.

Francis Fontana, in his *Celeſtial Obſervations*, publiſhed at Naples in 1646, ſays, that he was aſſured by a Mr Hardy, advocate of the parliament of Paris, a perſon of great learning and undoubted integrity, that on the death of his father, there was found among his things an old tube, by which diſtant objects were diſtinctly ſeen; and that it was of a date long prior to the teleſcope lately invented, and had been kept by him as a ſecret.

It is not at all improbable, that curious people, handling ſpectacle glaſſes, of which there were by this time great varieties, both convex and concave, and amuſing themſelves with their magnifying power and the ſingular effects which they produced in the appearances of things, might ſometimes chance ſo to place them as to produce diſtinct and enlarged viſion. We know perfectly, from the table and ſcheme which Sirturus has given us of the tools or diſhes in which the ſpectacle-makers faſhioned their glaſſes, that they had convex lenſes formed to ſpheres of 24 inches diameter, and of 11 inferior ſizes. He has given us a ſcheme of a ſet which he got leave to meaſure belonging to a ſpectacle-maker of the name of *Rogette* at Corunna in Spain; and he ſays that this man had tools of the ſame ſizes for concave glaſſes. It alſo appears, that it was a general practice (of which we do not know the preciſe purpoſe) to uſe a convex and concave glaſs together. If any perſon ſhould chance to put together a 24-inch convex and a 12-inch concave (wrought on both ſides) at the diſtance of 6 inches, he would have diſtinct viſion, and the object would appear of double ſize. Concaves of 6 inches were not uncommon, and one ſuch combined with the convex of 24, at the diſtance of 9 inches, would have diſtinct viſion, and objects would be quadrupled in diameter. When ſuch a thing occurred, it was natural to keep it as a curioſity, although the *rationale* of its operation was not in the leaſt underſtood. We doubt not but that this happened much oftener than in theſe two inſtances. The chief wonder is, that it was not frequent, and taken notice of ſome writer. It is pretty plain that Galileo's firſt teleſcope was of this kind, made up of ſuch ſpectacle-glaſſes as he could procure; for it magnified only three times in diameter: a thing eaſily procured by ſuch glaſſes as he could find with every ſpectacle-maker. And he could not but obſerve, in his trials of their glaſſes, that the deeper concaves and flatter convexes he employed, he produced the greater amplification; and then he would find himſelf obliged to provide a tool not uſed by the ſpectacle-makers, viz. either a much flatter tool for a convex ſurface, or a much ſmaller ſphere for a concave: and, notwithſtanding his telling us that it was by reflecting on the nature of refraction, and without any inſtruction, we are perſuaded that he proceeded in this very way. His next teleſcope magnified but five times. Now the ſlighteſt acquaintance with the obvious laws of refraction would have directed him at once to a very ſmall and deep concave, which would have been much eaſier made, and have magnified more. But he groped his way with ſuch ſpectacle-glaſſes as he could get, till he at laſt made tools for very flat object-glaſſes and very deep eye-glaſſes, and produced a teleſcope which magnified about 25 times. Sirturus ſaw it, and took the meaſures of it. He afterwards ſaw a ſcheme of it which Galileo had ſent to a German prince at Inſpruch who had it drawn (that is, the circles for the tools) on a table in his gallery. The object-glaſs was a plano-convex, a portion of a ſphere, of 24 inches diameter; the eye-glaſs was a double concave of 2 inches diameter: the focal diſtances were therefore 24 inches and 1 inch nearly. This muſt have been a very lucky operation, for Sirturus ſays it was the beſt teleſcope he had ſeen; and we know that it requires the very beſt work to produce this magnifying power with ſuch ſmall ſpheres. Teleſcopes continued to be made in this way for many years; and Galileo, though keenly engaged in the obſervation of Jupiter's ſatellites, being candidate for the prize held out by the Dutch for the diſcovery of the longitude, and therefore much intereſted in the advantage which a convex eye-glaſs would have given him, never made them of any other form. Kepler publiſhed his Dioptrics in 1611; in which he tells us, all that he or others had diſcovered of the law of refraction, viz. that in very ſmall obliquities of incidence, the angle of refraction was nearly $\frac{2}{3}$d of the angle of incidence. This was indeed enough to have pointed out with ſufficient exactneſs, the conſtruction of every optical inſtrument that we are even now poſſeſſed of; for this proportionality of the angles of incidence and refraction is aſſumed in the conſtruction of the optical figure for all of them; and the deviation from it is ſtill conſidered as the *refinement* of the art, and was not brought to any rule till 50 years after by Huyghens, and called by him ABERRATION. Yet even the ſagacious Kepler ſeems not to have ſeen the advantage of any other conſtruction of the teleſcope; he juſt ſeems to acknowledge the poſſibility of it: and we are ſurpriſed to ſee writers giving him as the author of the aſtronomical teleſcope, or even as hinting as its conſtruction. It is true, in the laſt propoſition he ſhows how a teleſcope may be made *apparently* with a convex eye-glaſs: but this is only a frivolous

Teleſcope.

fancy; for the eye-glaſs is directed to be made convex externally, and a very deep concave on the inſide; ſo that it is, in fact, a meniſcus with the concavity prevalent. In the 86th propoſition, he indeed ſhows that it is poſſible ſo to place a convex glaſs behind another convex glaſs, that an eye ſhall ſee objects diſtinct, magnified, and inverted; and he ſpeaks very ſagaciouſly on the ſubject. After having ſaid that an eye placed behind the point of union of the firſt glaſs will ſee an object inverted, he ſhows that a ſmall part only will be ſeen; and then he ſhows that a convex glaſs, duly proportioned and properly placed, will ſhow more of it. But in ſhowing this, he ſpeaks in a way which ſhows evidently that he had formed no diſtinct notions of the manner in which this effect would be produced, only ſaying vaguely that the convergency of the ſecond glaſs would counteract the divergency beyond the focus of the firſt. Had he conceived the matter with any tolerable diſtinctneſs, after ſeeing the great advantage of taking in a field greater in almoſt any proportion, he would have eagerly catched at the thought, and enlarged on the immenſe improvement. Had he but drawn one figure of the progreſs of the rays through two convex glaſſes, ſuch as fig. 12. of Pl. CCCLXIV. the whole would have been open to his view.

This ſtep, ſo eaſy and ſo important, was reſerved for Father Scheiner, as has been already obſerved in the article Optics; and the conſtruction of this author, together with that of Janſen, are the models on which all refracting teleſcopes are now conſtructed; and in all that relates to their magnifying power, brightneſs, and field of viſion, they may be conſtructed on Kepler's principle, that the angles of refraction are in a certain given proportion to the angles of incidence.

But after Huyghens had applied his elegant geometry to the diſcovery of Snellius, viz. the proportonality, not of the angles, but of the ſines, and had aſcertained the aberrations from the foci of infinitely ſlender pencils, the reaſons were clearly pointed out why there were ſuch narrow limits affixed by nature to the performance of optical inſtruments, in conſequence of the indiſtinctneſs of viſion which reſulted from conſtructions where the magnifying power, the quantity of light, or the field of viſion, were extended beyond certain moderate bounds. The theory of aberrations, which that moſt excellent geometer eſtabliſhed, has enabled us to diminiſh this indiſtinctneſs ariſing from any of theſe cauſes; and this diminution is the ſole aim of all the different conſtructions which have been contrived ſince the days of Galileo and Scheiner.

The deſcription which has been already given of the various conſtructions of teleſcopes in the article Optics, is ſufficient for inſtructing the reader in the general principles of their conſtruction, and with moderate attention will ſhow the manner in which the rays of light proceed, in order to enſure the different circumſtances of amplification, brightneſs, and extent of field, and even diſtinctneſs of viſion, in as far as this depends on the proper intervals between the glaſſes. But it is inſufficient for giving us a knowledge of the improvements which are aimed at in the different departures from the original conſtructions of Galileo and Scheiner, the advantage of the double eye-glaſs of Huyghens, and the quintuple eye-glaſs of Dolland: ſtill more is it inſufficient for ſhowing us why the higheſt degrees of amplification and moſt extenſive field cannot be obtained by the mere proportion of the focal diſtances of the glaſſes, as Kepler had taught. In ſhort, without the Huyghenian doctrine of aberrations, neither can the curious reader learn the limits of their performance, nor the artiſt learn why one teleſcope is better than another, or in what manner to proceed to make a teleſcope differing in any particular from thoſe which he ſervilely copies.

Although all the improvements in the conſtruction of teleſcopes ſince the publication of Huyghens's Dioptrics have been the productions of Britain, and although Dr Smith of Cambridge has given the moſt elegant and perſpicuous account of this ſcience that has yet appeared, we do not recollect a performance in the Engliſh language (except the Optics of Emerſon) which will carry the reader beyond the mere ſchoolboy elements of the ſcience, or enable a perſon of mathematical ſkill to underſtand or improve the conſtruction of optical inſtruments. The laſt work on this ſubject of any extent (Dr Prieſtley's Hiſtory of Viſion) is merely a parlour book for the amuſement of half-taught dilettanti, but is totally deficient in the mathematical part, although it is here that the ſcience of optics has her chief claim to preeminence, and to the name of a DISCIPLINA ACCURATA. But this would have been *ultra crepidam*; and the author would in all probability have made as poor a figure here as he has done in his attempts to degrade his ſpecies in his Commentaries on the *Vibratiunculæ* of Hartley; motions which neither the author nor his amplificator were able to underſtand or explain. We truſt that our readers, jealous as we are of every thing that ſinks us in the ſcale of nature's works, will pardon this tranſient ejaculation of ſpleen, when our thoughts are called to a ſyſtem which, of *abſolute and unavoidable neceſſity*, makes the DIVINE MIND nothing but a quivering of *that matter* of which it is the AUTHOR and unerring DIRECTOR. *Sed miſſum faciamus.*

We think therefore that we ſhall do the public ſome ſervice, by giving ſuch an account of this *higher branch* of optical ſcience as will at leaſt tend to the complete underſtanding of this noble inſtrument, by which our conceptions of the extent of almighty power, and wiſdom, and beneficence, are ſo wonderfully enlarged. In the proſecution of this we hope that many general rules will emerge, by which artiſts who are not mathematicians may be enabled to conſtruct optical inſtruments with intelligence, and avoid the many blunders and defects which reſult from mere ſervile imitation.

The general aim in the conſtruction of a teleſcope is, to form, by means of mirrors or lenſes, an image of the diſtant object, as large, as bright, and as extenſive as is poſſible, conſiſtently with diſtinctneſs; and then to view the image with a magnifying glaſs in any convenient manner. This gives us an arrangement of our ſubject. We ſhall firſt ſhow the principles of conſtruction of the object glaſs or mirror, ſo as that it ſhall form an image of the diſtant object with theſe qualities; and then ſhow how to conſtruct the magnifying glaſs or eye-piece, ſo as to preſerve them unimpaired.

This indiſtinctneſs which we wiſh to avoid ariſes from two cauſes; the ſpherical figures of the refracting and reflecting ſurfaces, and the different refrangibility of the differently coloured rays of light. The firſt may be called the SPHERICAL and the ſecond the CHROMATIC indiſtinctneſs; and the deviations from the foci, determined by the elementary theorem (Optics, p. 289), may be called the SPHERICAL and the CHROMATIC aberrations.

The limits of a Work like this will not permit us to give any more of the doctrine of aberrations than is abſolutely neceſſary for the conſtruction of achromatic teleſcopes; and we muſt refer the reader for a general view of the whole to Euler's *Dioptrics*, and other works of that kind. Dr Smith has given as much as was neceſſary for the compariſon of the merits of different glaſſes of ſimilar conſtruction, and this in a very plain and elegant manner.

We ſhall begin with the aberration of colour, becauſe it is the moſt ſimple.

Plate DII.

Let white or compounded light fall perpendicularly on the flat ſide PQ (fig. 1.) of a plano-convex lens PVQ, whoſe axis is CV and vertex V. The white ray *p* P falling on the extremity of the lens is diſperſed by refraction at the point P of the ſpherical ſurface, and the red ray goes to the point *r* of the axis, and the violet ray to the point *v*. In like manner the white ray *q* Q is diſperſed by refraction at Q, the red ray going to *r*, and the violet to *v*. The red ray P *r* croſſes the violet ray Q *v* in a point D, and Q *r* croſſes P *v* in a point E; and the whole light refracted and diſperſed by the circumference, whoſe diameter is PQ, paſſes through the circular area, whoſe diameter is DE. Suppoſing that the lens is of ſuch a form that it would collect red rays, refracted by its whole ſurface in the point *r*, and violet in the point *v*; then it is evident that the whole light which occupies the ſurface of the lens will paſs through this little circle, whoſe diameter is DE. Therefore white light iſſuing from a point ſo diſtant that the rays may be conſidered as parallel, will not be collected in another point or focus, but will be diſperſed over the ſurface of that little circle; which is therefore called the *circle of chromatic diſperſion;* and the radiant point will be repreſented by this circle. The neighbouring points are in like manner repreſented by circles; and theſe circles encroaching on and mixing with each other, muſt occaſion hazineſs or confuſion, and render the picture indiſtinct. This indiſtinctneſs will be greater in the proportion of the number of circles which are in this manner mixed together. This will be in the proportion of the room that is for them; that is, in proportion to the area of the circle, or in the duplicate proportion of its diameter. Our firſt buſineſs therefore is, to obtain meaſures of this diameter, and to mark the connection between it and the aperture and focal diſtance of the lens.

Let i be to r as the ſine of incidence in glaſs to the ſine of refraction of the red rays; and let i be to v as the ſine of incidence to the ſine of refraction of the violet rays. Then we ſay, that when the aperture PQ is moderate, $v-r : v+r-2i = DE : PQ$, very nearly. For let DE, which is evidently perpendicular to Vr, meet the parallel incident rays in K and L and the radii of the ſpherical ſurface in G and H. It is plain that GKP is equal to the angle of incidence on the poſterior or ſpherical ſurface of the lens; and GPr and GPv are the angles of refraction of the red and the violet rays; and that GK, GD, and GE, are very nearly as the ſines of thoſe angles, becauſe the angles are ſuppoſed to be ſmall. We may therefore inſtitute this proportion $DE : KD = v-r : r-i$; then, by doubling the conſequents $DE : 2KD = v-r : 2r-2i$. Alſo $DE : 2KD + DE = v-r : 2r-2i+v-r, = v-r : r+v-2i$. But $2KD + DE$ is equal to KL or PQ. Therefore we have $DE : PQ = v-r : r+v-2i$. *Q. E. D.*

Cor. 1. Sir Iſaac Newton, by moſt accurate obſervation, found, that in common glaſs the ſines of refraction of the red and violet rays were 77 and 78 where the ſine of incidence was 50. Hence it follows, that $v-r$ is to $v+r-2i$ as 1 to 55; and that the diameter of the ſmalleſt circle of diſperſion is $\frac{1}{55}$th part of that of the lens.

2. In like manner may be determined the circle of diſperſion that will comprehend the rays of any particular colour or ſet of colours. Thus all the orange and yellow will paſs through a circle whoſe diameter is $\frac{1}{260}$th of that of the lens.

3. In different ſurfaces, or plano-convex lenſes, the angles of aberration rPv are as the breadth PQ directly, and as the focal diſtance VF inverſely; becauſe any angle DPE is as its ſubtenſe DE directly and radius DP inverſely. *N. B.* we call VF the focal diſtance, becauſe at this diſtance, or at the point F, the light is moſt of all conſtipated. If we examine the focal diſtance by holding the lens to the ſun, we judge it to be where the light is drawn into the ſmalleſt ſpot.

When we reflect that a lens of 5½ inches in diameter has a circle of diſperſion $\frac{1}{10}$th of an inch in diameter, we are ſurpriſed that it produces any picture of an object that can be diſtinguiſhed. We ſhould not expect greater diſtinctneſs from ſuch a lens than would be produced in a camera obſcura without a lens, by ſimply admitting the light through a hole of $\frac{1}{10}$th of an inch in diameter. This, we know, would be very hazy and confuſed. But when we remark the ſuperior vivacity of the yellow and orange light in compariſon with the reſt, we may believe that the effect produced by the confuſion of the other colours will be much leſs ſenſible. But a ſtronger reaſon is, that the light is much denſer in the middle of the circle of diſperſion, and is exceedingly faint towards the margin. This, however, muſt not be taken for granted; and we muſt know diſtinctly the manner in which the light of different colours is diſtributed over the circle of chromatic diſperſion, before we pretend to pronounce on the immenſe difference between the indiſtinctneſs ariſing from colour and that ariſing from the ſpherical figure. We think this the more neceſſary, becauſe the illuſtrious diſcoverer of the chromatic aberration has made a great miſtake in the compariſon, becauſe he did not conſider the diſtribution of the light in the circle of ſpherical diſperſion. It is therefore proper to inveſtigate the chromatic diſtribution of the light with the ſame care that we beſtowed on the ſpherical diſperſion in Optics, nº 251. &c.; and we ſhall then ſee that the ſuperiority of the reflecting teleſcope is incomparably leſs than Newton imagined it to be.

Therefore let EB (fig. 2.) repreſent a plano-convex lens, of which C is the centre and Cr the axis. Let us ſuppoſe it to have no ſpherical aberration, but to collect rays occupying its whole ſurface to ſingle points in the axis. Let a beam of white or compounded light fall perpendicularly on its plane ſurface. The rays will be ſo refracted by its curved ſurface, that the extreme red rays will be collected at r, the extreme violet rays at w, and thoſe of intermediate refrangibility at intermediate points, o, y, g, b, p, v, of the line rw, which is nearly $\frac{1}{28}$th of rC. The extreme red and violet rays will croſs each other at A and D; and AD will be a ſection or diameter of the circle of chromatic diſperſion, and will be about $\frac{1}{55}$th of EB. We may ſuppoſe wr to be biſected in b, becauſe wb is to br very nearly in the ratio of equality (for $rb : rC = bA : cE, = bA : cB, = wb : wC$). The line rw will be a kind of priſmatic ſpectrum, red from r to o, orange-coloured from o to y, yellow from y to g, green from g to b, blue from b to p, purple from p to v, and violet from v to w.

The light in its compound ſtate muſt be ſuppoſed uniformly denſe as it falls upon the lens; and the ſame muſt be ſaid of the rays of any particular colour. Newton ſuppoſes alſo, that when a white ray, ſuch as eE, is diſperſed into its component coloured rays by refraction at E, it is uniformly ſpread over the angle DEA. This ſuppoſition is indeed gratuitous; but we have no argument to the contrary, and may therefore conſider it as juſt. The conſequence is, that each point w, v, p, b, &c. of the ſpectrum is not only equally luminous, but alſo illuminates uniformly its correſponding portion of AD: that is to ſay, the coating (ſo to term it) of any particular colour, ſuch as purple, from the point p, is uniformly denſe in every part of AD on which it falls. In like manner, the colouring of yellow, intercepted by a part of AD in its paſſage to the point y, is uniformly denſe in all its parts. But the denſity of the different colours in AD is extremely different: for ſince the radiation in w is equally denſe with that in p, the denſity of the violet colouring, which radiates from w, and is ſpread over the whole of AD, muſt be much leſs than the denſity of the purple colouring, which radiates from *p*, and occupies only a part of AD round the circle *b*. Theſe denſities muſt be very nearly in the inverſe proportion of wb^2 to pb^2.

Hence we ſee, that the central point *b* will be very intenſely illuminated by the blue radiating from *p b* and the green intercepted from *b g*. It will be more faintly illuminated by the purple radiating from *v p*, and the yellow intercepted from *g y;* and ſtill more faintly by the violet from *w v*, and the orange and red intercepted from *y r*. The whole colouring will be a white, tending a little to yellowneſs. The accurate proportion of theſe colourings may be computed from our knowledge of the poſition of the points *o*, *y*, *g*, &c. But this is of little moment. It is of more conſequence to be able to determine the proportion of the total intenſity of the light in *b* to its intenſity in any other point I.

For this purpoſe draw *r* I R, I *w* W, meeting the lens in R and W. The point I receives none of the light which paſſes through the ſpace RW: for it is evident that *b* I : CR = *b* A : CE, = 1 : 55, and that CR = CW; and therefore, ſince all the light incident on EB paſſes through AB, all the light incident on RW paſſes through I *i* (*b i* being made = *b* I). Draw *o* I O, *y* I Y, *g* I G, I *p* P, I *v* V. It is plain, that I receives red light from RO, orange from OY, yellow from YG, green from GE, a little blue from BP, purple from PV, and violent from VW. It therefore wants ſome of the green and of the blue.

That we may judge of the intenſity of theſe colours at I, ſuppoſe the lens covered with paper pierced with a ſmall hole at G. The green light only will paſs through I; the other colours will paſs between I and *b*, or between I and A, according as they are more or leſs refrangible than the particular green at I. This particular colour converges to *g*, and therefore will illuminate a ſmall ſpot round I, where it will be as much denſer than it is at G as this ſpot is ſmaller than the hole at G. The natural denſity at G, therefore, will be to the increaſed denſity at I, as $g\text{I}^2$ to $g\text{G}^2$, or as gb^2 to $g\text{C}^2$, or as $b\text{I}^2$ to CG^2. In like manner, the natural denſity of the purple coming to I through an equal hole at P will be to the increaſed denſity at I as $b\text{I}^2$ to CP^2. And thus it appears, that the intenſity of the differently coloured illuminations of *any* point of the circle of diſperſion, is inverſely proportional to the ſquare of the diſtance from the centre of the lens to the point of its ſurface through which the colouring light comes to this point of the circle of diſperſion. This circumſtance will give us a very eaſy, and, we think, an elegant ſolution of the queſtion.

Biſect CE in F, and draw FL perpendicular to CE, making it equal to CF. Through the point L deſcribe the hyperbola KLN of the ſecond order, that is, having the ordinates EK, FL, RN, &c. inverſely proportional to the ſquares of the abſciſſæ CE, CF, CR, &c.; ſo that FL : RN $= \frac{1}{\text{CF}^2} : \frac{1}{\text{CR}^2}$, or $= \text{CR}^2 : \text{CF}^2$, &c. It is evident that theſe ordinates are proportional to the denſities of the ſeverally coloured lights which go from them to any points whatever of the circle of diſperſion.

Now the total denſity of the light at I depends both on the denſity of each particular colour and on the number of colours which fall on it. The ordinates of this hyperbola determine the firſt; and the ſpace ER meaſures the number of colours which fall on I, becauſe it receives light from the whole of ER, and of its equal BW. Therefore, if ordinates be drawn from any point of ER, their ſum will be as the whole light which goes to I; that is, the total denſity of the light at I will be proportional to the area NREK. Now it is known that CE × EK is equal to the infinitely extended area lying beyond EK; and CR × RN is equal to the infinitely extended area lying beyond RN. Therefore the area NREK is equal to CR × RN — CE × EK. But RN and EK are reſpectively equal to $\frac{\text{CF}^3}{\text{CR}^2}$ and $\frac{\text{CF}^3}{\text{CE}^2}$. Therefore the denſity at I is proportional to $\text{CF}^3 \times \left(\frac{\text{CR}}{\text{CR}^2} - \frac{\text{CE}}{\text{CE}^2}\right)$, $= \text{CF}^3 \times \left(\frac{1}{\text{CR}} - \frac{1}{\text{CE}}\right)$, $= \text{CF}^3 \times \frac{\text{CE}-\text{CR}}{\text{CE}\times\text{CR}}$, $= \text{CF}^3 \times \frac{\text{ER}}{\text{CE}\times\text{CR}}$, $= \frac{\text{CF}^3}{\text{CE}} \times \frac{\text{ER}}{\text{CR}}$. But becauſe CF is $\frac{1}{2}$ of CE, $\frac{\text{CF}^3}{\text{CE}}$ is $= \frac{\text{CF}^3}{2\text{CF}}$, $= \frac{\text{CF}^2}{2}$, a conſtant quantity. Therefore the denſity of the light at I is proportional to $\frac{\text{ER}}{\text{CR}}$, or to $\frac{\text{AI}}{b\text{I}}$, becauſe the points R and I are ſimilarly ſituated in EC and A*b*.

Farther, if the ſemi-aperture CE of the lens be called 1, $\frac{\text{CF}^2}{2}$ is $= \frac{1}{8}$, and the denſity at I is $= \frac{\text{AI}}{8b\text{I}}$.

Here it is proper to obſerve, that ſince the point R has the ſame ſituation in the diameter EB that the point I has in the diameter AD of the circle of diſperſion, the circle deſcribed on EB may be conceived as the magnified repreſentation of the circle of diſperſion. The point F, for inſtance, repreſents the point *f* in the circle of diſperſion, which biſects the radius *b* A; and *f* receives no light from any part of the lens which is nearer the centre than F, being illuminated only by the light which comes through EF and its oppoſite BF′. The ſame may be ſaid of every other point.

In like manner, the denſity of the light in *f*, the middle between *b* and A, is meaſured by $\frac{\text{EF}}{\text{CF}}$, which is $= \frac{\text{EF}}{\text{EF}}$, or 1. This makes the denſity at this point a proper ſtandard of compariſon. The denſity there is to the denſity at I as 1 to $\frac{\text{AI}}{b\text{I}}$, or as *b*I to AI; and this is the ſimpleſt mode of compariſon. The denſity half way from the centre of the circle of diſperſion is to the denſity at any point I as *b* I to IA.

Laſtly, through L deſcribe the common rectangular hyperbola *k* L *n*, meeting the ordinates of the former in *k*, L, and *n*: and draw *k h* parallel to EC, cutting the ordinates in *g*, *f*, *r*, &c. Then CR : CE = E *k* : R *n*, and CR : CE — CR = E *k* : R *n* — E *k*, or CR : RE = E *k* : *r n*, and *b* I : IA = E *k* : *r n*. And thus we have a very ſimple expreſſion of the denſity in any point of the circle of diſperſion. Let the point be anywhere, as at I. Divide the lens in R as AD is divided in I, and then *r n* is as the denſity in I.

Theſe two meaſures were given by Newton; the firſt in his *Treatiſe de Mundi Syſtemate*, and the laſt in his *Optics*; but both without demonſtration.

If the hyperbola *k* L *n* be made to revolve round the axis CQ, it will generate a ſolid ſpindle, which will meaſure the whole quantity of light which paſſes through different portions of the circle of diſperſion. Thus the ſolid produced by the revolution of L *k f* will meaſure all the light which occupies the outer part of the circle of diſperſion lying without the middle of the radius. This ſpace is $\frac{3}{4}$ths of the whole circle; but the quantity of light is but $\frac{1}{4}$th of the whole.

A ſtill more ſimple expreſſion of the whole quantity of light paſſing through different portions of the circle of chromatic diſperſion may now be obtained as follows:

It has been demonſtrated, that the denſity of the light at I is

I is as $\frac{AI}{bI}$, or as $\frac{ER}{CR}$. Suppoſe the figure to turn round the axis. I or R deſcribe circumferences of circles; and the whole light paſſing through this circumference is as the circumference, or as the radius, and as the denſity jointly. It is therefore as $\frac{ER}{CR} \times CR$, that is, as ER. Draw any ſtraight line E m, cutting RN in s, and any other ordinate FL in x Rs. The whole light which illuminates the circumference deſcribed by I is to the whole light which illuminates the centre b as ER to EC, or as Rs to Cm. In like manner, the whole light which illuminates the circumference deſcribed by the point f in the circle of diſperſion is to the whole light which illuminates the centre b, as Fx to Cm. The lines Cm, RS, Fx, are therefore proportional to the whole light which illuminates the correſponding circumferences in the circle of diſperſion. Therefore the whole light which falls on the circle whoſe radius is b I, will be repreſented by the trapezium in CRS; and the whole light which falls on the ring deſcribed by IA, will be repreſented by the triangle EsR; and ſo of any other portions.

By conſidering the figure, we ſee that the diſtribution of the light is exceedingly unequal. Round the margin it has no ſenſible denſity; while its denſity in the very centre is incomparably greater than in any other point, being expreſſed by the aſymptote of a hyperbola. Alſo the circle deſcribed with the radius $\frac{Ab}{2}$ contains $\frac{3}{4}$ths of the whole light. No wonder then that the confuſion cauſed by the mixture of theſe circles of diſperſion is leſs than one ſhould expect; beſides, it is evident that the moſt lively or impreſſive colours occupy the middle of the ſpectrum, and are there much denſer than the reſt. The margin is covered with an illumination of deep red and violet, neither of which colours are brilliant. The margin will be of a dark claret colour. The centre revives all the colours, but in a proportion of intenſity greatly different from that in the common priſmatic ſpectrum, becauſe the radiant points L, p, b, g, &c. by which it is illuminated, are at ſuch different diſtances from it. It will be white; but we apprehend not a pure white, being greatly overcharged with the middle colours.

Theſe conſiderations ſhow that the coloured fringes, which are obſerved to border very luminous objects ſeen on a dark ground through optical inſtruments, do not proceed from the object-glaſs of a teleſcope or microſcope, but from an improper conſtruction of the eye-glaſſes. The chromatic diſperſion would produce fringes of a different colour, when they produce any at all, and the colours would be differently diſpoſed. But this diſperſion by the object-glaſs can hardly produce any fringes: its effect is a general and almoſt uniform mixture of circles all over the field, which produces an uniform hazineſs, as if the object were viewed at an improper diſtance, or out of its focus, as we vulgarly expreſs it.

We may at preſent form a good gueſs at the limit which this cauſe puts to the performance of a teleſcope. A point of a very diſtant object is repreſented, in the picture formed by the object-glaſs, by a little circle, whoſe diameter is at leaſt $\frac{1}{100}$th of the aperture of the object-glaſs, making a very full allowance for the ſuperior brilliancy and denſity of the central light. We look at this picture with a magnifying eye-glaſs. This magnifies the picture of the point. If it amplify it to a ſuch a degree as to make it an object individually diſtinguiſhable, the confuſion is then ſenſible. Now this can be computed. An object ſubtending one minute of a degree is diſtinguiſhed by the dulleſt eye, even although it be a dark object on a bright ground. Let us therefore ſuppoſe a teleſcope, the object-glaſs of which is of ſix feet focal diſtance, and one inch aperture. The diameter of the circle of chromatic diſperſion will be $\frac{1}{100}$th of an inch, which ſubtends at the centre of the object-glaſs an angle of about $9\frac{1}{2}$ ſeconds. This, when magnified ſix times by an eye-glaſs, would become a diſtinguiſhable object; and a teleſcope of this length would be indiſtinct if it magnified more than ſix times, if a point were thus ſpread out into a ſpot of uniform intenſity. But the ſpot is much leſs intenſe about its margin. It is found experimentally that a piece of engraving, having fine croſs hatches, is not ſenſibly indiſtinct till brought ſo far from the limits of perfectly diſtinct viſion, that this indiſtinctneſs amounts to 6′ or 5′ in breadth.—Therefore ſuch a teleſcope will be ſenſibly diſtinct when it magnifies 36 times; and this is very agreeable to experience.

We come, in the ſecond place, to the more arduous taſk of aſcertaining the error ariſing from the ſpherical figure of the ſurfaces employed in optical inſtruments.—Suffice it to ſay before we begin, that although geometers have exhibited other forms of lenſes which are totally exempt from this error, they cannot be executed by the artiſt; and we are therefore reſtricted to the employment of ſpherical ſurfaces.

Of all the determinations which have been given of ſpherical aberration, that by Dr Smith, in his Optics, which is an improvement of the fundamental theorem of that moſt elegant geometer Huyghens, is the moſt perſpicuous and palpable. Some others are more conciſe, and much better fitted for after uſe, and will therefore be employed by us in the proſecution of this article. But they do not keep in view the optical facts, giving the mind a picture of the progreſs of the rays, which it can contemplate and diſcover amidſt many modifying circumſtances. By ingenious ſubſtitutions of analytical ſymbols, the inveſtigation is rendered expeditious, conciſe, and certain; but theſe are not immediate ſymbols of things, but of operations of the mind; objects ſufficiently ſubtile of themſelves, and having no need of ſubſtitutions to make us loſe ſight of the real ſubject; and thus our occupation degenerates into a proceſs almoſt without ideas. We ſhall therefore ſet out with Dr Smith's fundamental Theorem.

1. *In Reflections.*

Let AVB (fig. 3.) be a concave ſpherical mirror, of which C is the centre, V the vertex, CV the axis, and F the focus of an infinitely ſlender pencil of parallel rays paſſing through the centre. Let the ray a A, parallel to the axis, be reflected in AG, croſſing the central ray CV in f. Let AP be the ſine of the ſemi-aperture AV, AD its tangent, and CD its ſecant.

The aberration Ff from the principal focus of central rays is equal to $\frac{1}{2}$ of the exceſs VD of the ſecant above the radius, or very near equal to $\frac{1}{2}$ of VP, the verſed ſine of the ſemi-aperture.

For becauſe AD is perpendicular to CA, the points C, A, D, are in a circle, of which CD is the diameter; and becauſe Af is equal to Cf, by reaſon of the equality of the angles fAC, fCA, and CAa, f is the centre of the circle through C, A, D, and fD is $= \frac{1}{2}$ CD. But FC is $= \frac{1}{2}$ CV. Therefore Ff is $\frac{1}{2}$ of VD.

But becauſe DV : VP = DC : VC, and DC is very little greater than VC when the aperture AB is moderate, DV is very little greater than VP, and Ff is very nearly equal to $\frac{1}{2}$ of VP.

Cor. 1. The longitudinal aberration is $= \frac{AV^2}{4\,CV}$, for PV is very nearly $= \frac{AV^2}{2\,CV}$.

Cor. 2. The lateral aberration FG is $= \frac{AV^3}{2CV^2}$. For $FG : Ff = AP : Pf, = AV : \frac{1}{2} CV$ nearly, and therefore $FG = \frac{AV^3}{4CV} \times \frac{2}{CV} = \frac{AV^3}{2CV^2}$.

2. *In Refractions.*

Let AVB (fig. 4. A or B) be a ſpherical ſurface ſeparating two refracting ſubſtances, C the centre, V the vertex, AV the ſemi aperture, AP its ſine, PV its verſed ſine, and F the focus of parallel rays infinitely near to the axis. Let the extreme ray *a* A, parallel to the axis, be refracted into AG, croſſing CF in *f*, which is therefore the focus of extreme parallel rays.

The rectangle of the ſine of incidence, by the difference of the ſines of incidence and refraction, is to the ſquare of the ſine of refraction, as the verſed ſine of the ſemi-aperture is to the longitudinal abberration of the extreme rays.

Call the ſine of incidence *i*, the ſine of refraction *r*, and their difference *d*.

Join CA, and about the centre *f* deſcribe the arch AD.

The angle ACV is equal to the angle of incidence, and CA *f* is the angle of refraction. Then, ſince the ſine of incidence is to the ſine of refraction as VF to CF, or as A *f* to C*f*, that is, as D *f* to C*f*, we have

$CF : FV = Cf : fD$

by converſion $CF : CV = Cf : CD$

altern. conver. $CF - Cf : CV - CD = CF : CV$

or - $Ff : VD = CF : CV, = r : d.$

Now $PV = \frac{AP^2}{CP + CV}, = \frac{AP^2}{2CV}$ nearly, and $PD = \frac{AP^2}{fP + fV} = \frac{AP^2}{2fV}$ nearly, $= \frac{AP^2}{2FV}$ nearly. Therefore $PV : PD = FV : CV$, and $DV : PV = CF : FV$ nearly.

we had above $Ff : VD = r : d;$

and now - $VD : PV = CF : FV, = r : i;$

therefore - $Ff : PV = r^2 : di,$

and $Ff = \frac{r^2}{di} \times PV$. *Q. E. D.*

The aberration will be different according as the refraction is made towards or from the perpendicular; that is, according as *r* is leſs or greater than *i*. They are in the ratio of $\frac{r^2}{di}$ to $\frac{i^2}{dr}$, or of r^3 to i^3. The abberration therefore is always much diminiſhed when the refraction is made from a rare into a denſe medium. The proportion of the ſines for air and glaſs is nearly that of 3 to 2. When the light is refracted into the glaſs, the aberration is nearly $\frac{4}{3}$ of PV; and when the light paſſes out of glaſs into air, it is about $\frac{9}{2}$ of PV.

Cor. 1. $Ff = \frac{r^2}{di} \times \frac{AP^2}{2CV}$ nearly, and it is alſo $= \frac{r^2}{d^2} \times \frac{AP^2}{2FV}$, becauſe $PV = \frac{AP^2}{2CV}$ nearly, and $i : d = FV : CV$.

Cor. 2. Becauſe $fP : PA = Ff : FG$
or $FV : AV = Ff : FG$ nearly,

we have FG, the lateral aberration, $= Ff \times \frac{AV}{FV}, = \frac{r^2}{d^2} \times \frac{AV^3}{2FV^2}, = \frac{r^2}{i^2} \times \frac{AV^3}{2CV^2}$.

Cor. 3. Becauſe the angle F·A*f* is proportional to $\frac{FG}{FV}$ very nearly, we have the angular aberration $FAf = \frac{r^2}{d^2} \times \frac{AV^3}{2FV^3} = \frac{r^2}{i^2} \times \frac{AV^3}{2CV^3}$.

In general, the longitudinal aberrations from the focus of central parallel rays are as the ſquares of the apertures directly, and as the focal diſtances inverſely; and the lateral aberrations are as the cubes of the apertures directly, and the ſquares of the focal diſtances inverſely; and the angular aberrations are as the cubes of the aperture directly, and the cubes of the focal diſtances inverſely.

The reader muſt have obſerved, that to ſimplify the inveſtigation, ſome ſmall errors are admitted. PV and PD are not in the exact proportion that we aſſumed them, nor is D *f* equal to FV. But in the ſmall apertures which ſuffice for optical inſtruments, theſe errors may be diſregarded.

This ſpherical aberration produces an indiſtinctneſs of viſion, in the ſame manner as the chromatic aberration does, *viz.* by ſpreading out every mathematical point of the object into a little ſpot in its picture; which ſpots, by mixing with each other, confuſe the whole. We muſt now determine the diameter of the circle of diffuſion, as we did in the caſe of chromatic diſperſion.

Plate DIII.

Let a ray $\beta\,\alpha$ (fig. 5.) be refracted on the other ſide of the axis, into $\alpha H \phi$, cutting AfG in H, and draw the perpendicular EH. Call AV *a*, $\alpha V\ \alpha$, V *f* (or VF, or $V\phi$, which in this compariſon may be taken as equal) $= f$, $Ff = b$, and $fE = \phi x$.

$AV^2 : \alpha V^2 = Ff : F\phi$ (already demonſtrated) and $F\phi = \frac{\alpha^2}{a^2} b$, and $Ff - F\phi$, (or $f\phi$) $= b - \frac{\alpha^2}{a^2} b, = \frac{a^2 b - \alpha^2 b}{a^2}, = \frac{b}{a^2} \times \overline{a^2 - \alpha^2}, = \frac{b}{a^2} \times \overline{a + \alpha} \times \overline{a - \alpha}$. Alſo $Pf : PA = fE : EH$, or $f : a = x : \frac{ax}{f}, = EH$. And $P\pi : P\phi = EH : E\phi$, or $\alpha : f = \frac{ax}{f} : \frac{ax}{\alpha}, = E\phi$. Therefore $f\phi = \frac{ax}{\alpha} + x, = \frac{\overline{a + \alpha}\,x}{\alpha}, = \frac{x}{\alpha} \times \overline{a + \alpha}$. Therefore $\frac{x}{\alpha} \times \overline{a + \alpha} = \frac{b}{a^2} \times \overline{a + \alpha} \times \overline{a - \alpha}$, and $\frac{x}{\alpha} = \frac{b}{a^2} \times \overline{a - \alpha}$, and $x = \frac{b}{a^2} \times \alpha\,(a - \alpha)$. Therefore *x* is greateſt when $\alpha \times \overline{a - \alpha}$ is greateſt; that is, when $\alpha = \frac{1}{2} a$. Therefore EH is greateſt when $P\pi$ is equal to the half of AP. When this is the caſe, we have at the ſame time $\frac{b}{a^2} \times \alpha\,(a - \alpha) = \frac{b}{a^2} \times \frac{1}{4} a^2$, and $x = \frac{1}{4} b$, or $EH = \frac{1}{4} FG$. That is, the diameter of the circle of aberration through which the whole of the refracted light muſt paſs, is $\frac{1}{4}$ of the diameter of the circle of aberration at the focus of parallel central rays. In the chromatic aberration it was $\frac{1}{2}$; ſo that in this reſpect the ſpherical aberration does not create ſo great confuſion as the chromatic.

We are now able to compare them, ſince we have now the meaſure of both the circles of aberration.

It has not been found poſſible to give more than four inches of aperture to an object glaſs of 100 feet focal diſtance, ſo as to preſerve ſufficient diſtinctneſs. If we compute the diameter of the circle EH correſponding to this aperture, we ſhall find it not much to exceed $\frac{1}{120,000}$ of an inch. If we reſtrict the circle of chromatic diſperſion to $\frac{1}{250}$ of the aperture, which is hardly the fifth part of the whole diſperſion in it, it is $\frac{1}{62\frac{1}{2}}$ of an inch, and is about 1900 times greater than the other.

The circle of ſpherical abberration of a plano-convex lens, with the plane ſide next the diſtant object, is equal to the circle of chromatic diſperſion when the ſemi-aperture is about 15°: For we ſaw formerly that EH is $\frac{1}{4}$ of FG, and that FG is $= \frac{r^2}{i^2} \frac{AP^3}{2AC^2}$, and therefore $EG = \frac{r^2}{i^2} \times \frac{AP^3}{8AC^2}$. This being made $= \frac{AP}{55}$, gives us $AP = \sqrt{\frac{8i^2 AC^2}{55r^2}}$, which is nearly $\frac{AC}{4}$, and correſponds to an aperture of 30° diameter, if r be to i as 3 to 2.

Sir Iſaac Newton was therefore well entitled to ſay, that it was quite needleſs to attempt figures which ſhould have leſs aberration than ſpherical ones, while the confuſion produced by the chromatic diſperſion remained uncorrected. Since the indiſtinctneſs is as the ſquares of the diameters of the circles of aberration, the diſproportion is quite beyond our imagination, even when Newton has made ſuch a liberal allowance to the chromatic diſperſion. But it muſt be acknowledged, that he has not attended to the diſtribution of the light in the circle of ſpherical aberration, and has haſtily ſuppoſed it to be like the diſtribution of the coloured light, indefinitely rare in the margin, and denſer in the centre.

We are indebted to Father Boſcovich for the elegant determination of this diſtribution, which we have given in the article OPTICS. From this it appears, that the light in the margin of the circle of ſpherical aberration, inſtead of being incomparably rarer than in the ſpaces between it and the centre, is incomparably denſer. The indiſtinctneſs therefore produced by the interſection of theſe luminous circumferences is vaſtly great, and increaſes the whole indiſtinctneſs exceedingly. By a groſs calculation which we made, it appears to be increaſed at leaſt 500 times. The proportional indiſtinctneſs therefore, inſtead of being 1900^2 to 1, is only $\frac{1900^2}{500}$, or nearly 7220 to 1; a proportion ſtill ſufficently great to warrant Newton's preference of the reflecting teleſcope of his invention. And we may now obſerve, that the reflecting teleſcope has even a great advantage over a refracting one of the ſame focal diſtance with reſpect to its ſpherical aberration: For we have ſeen (*Cor.* 2.) that the lateral aberration is $\frac{r^2}{i^2} \frac{AV^3}{2CV^2}$. This for a plano-convex glaſs is nearly $\frac{9}{4} \frac{AV^3}{2CV^2}$. And the diameter of the circle of aberration is one-fourth of this, or $\frac{9}{16} \times \frac{AV^3}{2CV^2}$. In like manner, the lateral aberration of a concave mirror is $\frac{AV^3}{2CV^2}$; and the diameter of the circle of diſperſion is $\frac{AV^3}{8CV^2}$; and therefore if the ſurfaces were portions of the ſame ſphere, the diameter of the circle of aberration of refracted rays would be to that of the circle of aberration of reflected rays as $\frac{9}{16}$ to $\frac{1}{4}$, or as 9 to 4. But when the refracting and reflecting ſurfaces, in the poſition here conſidered, have the ſame focal diſtance, the radius of the refracting ſurface is four times that of the reflecting ſurface. The proportion of the diameters of the circles of ſpherical aberration is that of 9×4^2 to 4, or of 144 to 4, or 36 to 1. The diſtinctneſs therefore of the reflector is 36 × 36, or 1296 times greater than that of a plano-convex lens (placed with the plane ſide next the diſtant object) of the ſame breadth and focal diſtance, and will therefore admit of a much greater magnifying power. This compariſon is indeed made in circumſtances moſt favourable to the reflector, becauſe this is the very worſt poſition of a plano-convex lens. But we have not as yet learned the aberration in any other poſition. In another poſition the refraction and conſequent aberration of both ſurfaces are complicated.

Before we proceed to the conſideration of this very difficult ſubject, we may deduce from what has been already demonſtrated ſeveral general rules and maxims in the conſtruction of teleſcopes, which will explain (to ſuch readers as do not wiſh to enter more deeply into the ſubject), and juſtify the proportion which long practice of the beſt artiſts has ſanctioned.

Indiſtinctneſs proceeds from the commixture of the circles of aberration on the retina of the eye: For any one *ſenſible* point of the retina, being the centre of a circle of aberration, will at once be affected by the admixture of the rays of as many different pencils of light as there are ſenſible points in the area of that circle, and will convey to the mind a mixed ſenſation of as many viſible points of the object. This number will be as the area of the circle of aberrations, whatever be the ſize of a ſenſible point of the retina. Now in viſion with teleſcopes, the diameter of the circle of aberration on the retina is as the *apparent* magnitude of the diameter of the correſponding circle in the focus of the eye-glaſs; that is, as the angle ſubtended by this diameter at the centre of the eye-glaſs; that is, as the diameter itſelf directly, and as the focal diſtance of the eye-glaſs inverſely. And the area of that circle on the retina is as the area of the circle in the focus of the eye-glaſs directly, and as the ſquare of the focal diſtance of the eye-glaſs inverſely. And this is the meaſure of the apparent indiſtinctneſs.

Cor. In all ſorts of teleſcopes, and alſo in compound microſcopes, an object is ſeen equally diſtinct when the focal diſtance of the eye-glaſſes are proportional to the diameters of the circles of aberration in the focus of the object-glaſs.

Here we do not conſider the trifling alteration which well conſtructed eye-glaſſes may add to the indiſtinctneſs of the firſt image.

In refracting teleſcopes, the apparent indiſtinctneſs is as the area of the object-glaſs directly, and as the ſquare of the focal diſtance of the eye-glaſs inverſely. For it has been ſhown, that the area of the circle of diſperſion is as the area of the object-glaſs, and that the ſpherical aberration is inſignificant when compared with this.

Therefore, to make reflecting teleſcopes equally diſtinct, the diameter of the object-glaſs muſt be proportional to the focal diſtance of the eye-glaſs.

But in reflecting teleſcopes, the indiſtinctneſs is as the ſixth power of the aperture of the object-glaſs directly, and as the fourth power of the focal diſtance of the object-glaſs and ſquare of the focal diſtance of the eye-glaſs inverſely. This is evident from the dimenſions of the circle of aberration, which was found proportional to $\frac{AV^3}{CV^2}$.

Therefore, to have them equally diſtinct, the cubes of the apertures muſt be proportional to the ſquares of the focal diſtance multiplied by the focal diſtance of the eye-glaſs.

By theſe rules, and a ſtandard teleſcope of approved goodneſs, an artiſt can always proportion the parts of any inſtrument he wiſhes to conſtruct. Mr Huyghens made one, of which the object-glaſs had 30 feet focal diſtance and three inches diameter. The eye-glaſs had 3,3 inches focal diſtance. And its performance was found ſuperior to any which he had ſeen; nor did this appear owing to any chance goodneſs of the object-glaſs, becauſe he found others equally good which were conſtructed on ſimilar proportions. This has therefore been adopted as a ſtandard.

It does not at firſt appear how there can be any difficulty in this matter, becauſe we can always diminiſh the aperture of the object-glaſs, or ſpeculum till the circle of aberration is as ſmall as we pleaſe. But by diminiſhing this aperture, we diminiſh the light in the duplicate ratio of the aperture. Whatever be the aperture, the brightneſs is diminiſhed by the magnifying power, which ſpreads the light over a greater ſurface in the bottom of the eye. The apparent brightneſs muſt be as the ſquare of the aperture of the teleſcope directly, and the ſquare of the amplification of the diameter of an object inverſely. Objects therefore will be ſeen equally bright if the apertures of the teleſcopes be as the focal diſtances of the object-glaſſes directly, and the focal diſtances of the ſingle eye-glaſs (or eye-glaſs equivalent to the eye-piece) inverſely. Therefore, to have teleſcopes equally diſtinct and equally bright, we muſt combine theſe proportions with the former. It is needleſs to go farther into this ſubject, becauſe the conſtruction of refracting teleſcopes has been ſo materially changed by the correction of the chromatic aberration, that there can hardly be given any proportion between the object-glaſs and eye-glaſſes. Every thing now depends on the degree in which we can correct the aberrations of the object-glaſs. We have been able ſo far to diminiſh the chromatic aberration, that we can give very great apertures without its becoming ſenſible. But this is attended with ſo great an increaſe of the aberration of figure, that this laſt becomes a ſenſible quality. A lens which has 30° for its ſemi-aperture, has a circle of aberration equal to its chromatic aberration. Fortunately we can derive from the very method of contrary refractions, which we employ for removing the chromatic aberration, a correction of the other. We are indebted for this contrivance alſo to the illuſtrious Newton.

We call this Newton's contrivance, becauſe he was the firſt who propoſed a conſtruction of an object-glaſs in which the aberration was corrected by the contrary aberrations of glaſs and water.

Huyghens had indeed ſuppoſed, that our all-wiſe Creator had employed in the eyes of animals many refractions in place of one, in order to make the viſion more diſtinct; and the invidious detractors from Newton's fame have catched at this vague conjecture as an indication of his knowledge of the poſſibility of deſtroying the aberration of figure by contrary refractions. But this is very ill-founded. Huyghens has acquired ſufficient reputation by his theory of aberrations. The ſcope of his writing in the paſſage alluded to, is to ſhow that, by dividing any intended refraction into parts, and producing a certain convergence to or divergence from the axis of an optical inſtrument by means of two or three lenſes inſtead of one, we diminiſh the aberrations four or nine times. This conjecture about the eye was therefore in the natural train of his thoughts. But he did not think of deſtroying the aberration altogether by oppoſite refractions. Newton, in 1669, ſays, that opticians need not trouble themſelves about giving figures to their glaſſes other than ſpherical. If this figure were all the obſtacle to the improvement of teleſcopes, he could ſhow them a conſtruction of an object-glaſs having ſpherical ſurfaces where the aberration is deſtroyed; and accordingly gives the conſtruction of one compoſed of glaſs and water, in which this is done completely by means of contrary refractions.

The general principle is this: When the radiant point R (fig. 5. B), or focus of incident rays, and its conjugate focus F of refracted central rays, are on oppoſite ſides of the refracting ſurface or lens V, the conjugate focus *f* of marginal rays is nearer to R than F is. But when the focus of incident rays R′ lies on the ſame ſide with its conjugate focus F′ for central rays, R′*f*′ is greater than R′ F′.

Now fig. 5. C repreſents the contrivance for deſtroying the colour produced at F, the principal focus of the convex lens V, of crown glaſs, by means of the contrary refraction of the concave lens *v* of flint glaſs. The incident parallel rays are made to converge to F by the firſt lens. This convergence is diminiſhed, but not entirely deſtroyed, by the concave lens *v*, and the focus is formed in F. F and F′ therefore are conjugate foci of the concave lens. If F be the focus of V for central rays, the marginal rays will be collected at ſome point *f* nearer to the lens. If F be now conſidered as the focus of light incident on the centre of *v*, and F′ be the conjugate focus, the marginal ray *p* F would be refracted to ſome point *f*′ lying beyond F′. Therefore the marginal ray *p f* may be refracted to F′, if the aberration of the concave be properly adjuſted to that of the convex.

This brings us to the moſt difficult part of our ſubject, the compounded aberrations of different ſurfaces. Our limits will not give us room for treating this in the ſame elementary and perſpicuous manner that we employed for a ſingle ſurface. We muſt try to do it in a compendious way, which will admit at once the different ſurfaces and the different refractive powers of different ſubſtances. This muſt naturally render the proceſs more complicated; but we hope to treat the ſubject in a way eaſily comprehended by any perſon moderately acquainted with common algebra; and we truſt that our attempt will be favourably received by an indulgent public, as it is (as far as we know) the only diſſertation in our language on the conſtruction of achromatic inſtruments. We cannot but expreſs our ſurpriſe at this indifference about an invention which has done ſo much honour to Britain, and which now conſtitutes a very lucrative branch of its manufacture. Its artiſts infinitely ſurpaſs all the performances of foreigners in this branch, and ſupply the markets of Europe without any competition; yet it is from the writings on the continent that they derive their ſcientific inſtruction, and particularly from the diſſertations of Clairaut, who has wonderfully ſimplified the analyſis of optical propoſitions. We ſhall freely borrow from him, and from the writings of Abbé Boſcovich, who has conſiderably improved the firſt views of Clairaut. We recommend the originals to the curious reader. Clairaut's diſſertations are to be found in the Memoirs of the Academy of Paris, 1756, &c.; thoſe of Boſcovich in the Memoirs of the Academy of Bologna, and in his five volumes of *Opuſcula*, publiſhed at Baſſano in 1785. To theſe may be added D'Alembert and Euler. The only thing in our language is the tranſlation of a very inperfect work by Schærfer.

Lemma I. In the right-angled triangle MXS (fig. 6), of which one ſide MX is very ſmall in compariſon of either of the others; the exceſs of the hypothenuſe MS, above the ſide XS, is very nearly equal to $\frac{MX^2}{2MS}$ or to $\frac{MX^2}{2XS}$. For if about the centre S, with the radius SM, we deſcribe the ſemicircle AMO, we have $AX \times XO = MX^2$. Now $AX = MS - SX$, and XO, is nearly equal to 2MS or 2XS; on the other hand, MS is nearly equal to $XS + \frac{MX^2}{2XS}$; and in like manner MG is nearly equal to $\frac{MX^2}{2XG} + XG$, and MH is nearly equal to $\frac{MX^2}{2XH} + XH$.

Prop. I. Let the ray *m* M, incident on the ſpherical ſurface AM, converge to G; that is, let G be the focus of incident rays. It is required to find the focus F of refracted rays?

Let m expreſs the ratio of the ſine of incidence and refraction; that is, let m be to 1 as the ſine of incidence to the ſine of refraction in the ſubſtance of the ſphere.

Then - MG : GS = ſin. MSH : ſin. SMG,
and - m : 1 = ſin. SMG : ſin. SMH;
therefore $m \times$ MG : GS = ſin. MSH : ſin. SMH.
Now S, MSH : S, SMH = MH : HS. Therefore, finally,
m. MG : GS = MH : HS.

Now let MS, the radius of the refracting ſurface, be called a. Let AG, the diſtance of the focus of incident rays from the ſurface, be called r. And let AH, the focal diſtance of refracted rays, be called x. Laſtly, let the ſine MX of the ſemi-aperture be called e. Obſerve, too, that a, r, x, are to be conſidered as poſitive quantities, when AS, AG, AH, lie from the ſurface in the direction in which the light is ſuppoſed to move. If therefore the refracting ſurface be concave, that is, having the centre on that ſide from which the light comes; or if the incident rays are divergent, or the refracted rays are divergent; then a, r, x, are negative quantities.

It is plain that HS $= x - a$; GS $= r - a$; alſo AX $= \frac{e^2}{2a}$ nearly. HX $= a - \frac{e^2}{2a}$. GX $= r - \frac{e^2}{2a}$. Now add to HX and to GX their differences from MH and MG, which (by the Lemma) are $\frac{e^2}{2x}$ and $\frac{e^2}{2r}$. We get MH $= x - \frac{e^2}{2a} + \frac{e^2}{2x}$, and MG $= r - \frac{e^2}{2a} + \frac{e^2}{2r}$. In order to ſhorten our notation, make $k = \frac{1}{a} - \frac{1}{r}$. This will make MG $= r - \frac{ke^2}{2}$.

Now ſubſtitute theſe values in the final analogy at the top of this column, viz. MH : HS = m. MG : GS; it becomes $x - \frac{e^2}{2a} + \frac{e^2}{2x} : x - a = mr - \frac{mke^2}{2} : r - a$ (or $a\,r\,k$), becauſe $k = \frac{r-a}{ar}$, and $a\,r\,k = r - a$. Now multiply the extreme and mean terms of this analogy. It is evident that it muſt give us an equation which will give us a value of x or AH, the quantity ſought.

But this equation is quadratic. We may avoid the ſolution by an approximation which is ſufficiently accurate, by ſubſtituting for x in the fraction $\frac{e^2}{2x}$ (which is very ſmall in all caſes of optical inſtruments), an approximate value very eaſily obtained, and very near the truth. This is the focal diſtance of an infinitely ſlender pencil of rays converging to G. This we know by the common optical theorem to be $\frac{amr}{\overline{m-1}\,r \pm a}$. Let this be called φ; if we ſubſtitute k in place of $\frac{1}{a} - \frac{1}{r}$, this value of φ becomes $= \frac{am}{m-ak}$.

This gives us, by the by, an eaſily remembered expreſſion (and beautifully ſimple) of the refracted focus of an infinitely ſlender pencil, correſponding to any diſtance r of the radiant point. For ſince $\varphi = \frac{am}{m-ak}$, $\frac{1}{\varphi}$ muſt be $= \frac{m-ak}{am}, = \frac{m}{am} - \frac{ak}{am}, = \frac{1}{a} - \frac{k}{m}$. We may even expreſs it more ſimply, by expanding k, and it becomes $\frac{1}{\varphi} = \frac{1}{a} - \frac{1}{ma} - \frac{1}{mr}$.

Now put this value of $\frac{1}{\varphi}$ in place of the $\frac{1}{x}$ in the analogy employed above. The firſt term of the analogy becomes $x - \frac{e^2}{2a} + \frac{e^2}{2a} - \frac{ke^2}{2m}$, or $x - \frac{ke^2}{2m}$. The analogy now becomes $x - \frac{ke^2}{2m} : x\,a = mr - \frac{mke^2}{2} : ark$. Hence we obtain the linear equation $mrx - \frac{mke^2x}{2} - mra + \frac{mkae^2}{2} = arkx - \frac{arke^2}{2m}$; from which we finally deduce

$$x = \frac{mra - \frac{1}{2}make^2 - \frac{ark^2e^2}{2m}}{mr - ark - \frac{1}{2}mke^2}$$

We may ſimplify this greatly by attending to the elementary theorem in fluxions, that the fraction $\frac{x+\dot{x}}{y+\dot{y}}$ differs from the fraction $\frac{x}{y}$ by the quantity $\frac{y\dot{x} - x\dot{y}}{y^2}$; this being the fluxion of $\frac{x}{y}$. Therefore $\frac{x+\dot{x}}{y+\dot{y}} = \frac{x}{y} + \frac{y\dot{x} - x\dot{y}}{y^2}$. Now the preceding formula is nearly in this ſituation. It may be written thus; $\frac{mra \quad \left(-\frac{1}{2}make^2 - \frac{ark^2e^2}{2m}\right)}{mr - ark \quad - mke^2}$, when the laſt terms of the numerator and denominator are very ſmall in compariſon with the firſt, and may be conſidered as the $\dot{x}$ and $\dot{y}$, while mra is the x, and $mr - ark$ is the y. Treating it in this way, it may be ſtated thus:

$$x = \frac{mra}{mr - ark} + \frac{(mra)\frac{1}{2}mke^2 - (mr - ark)\left(\frac{1}{2}mkae^2 + \frac{ark^2e^2}{2m}\right)}{r^2(m-ak)^2}$$

$$\text{or } x = \frac{mra}{r(m-ak)} + \frac{(mra)mk - (mr - ark)\left(mka + \frac{ark^2}{m}\right)}{r^2(m-ak)^2} \times \tfrac{1}{2}e^2.$$

The firſt term $\frac{mra}{r(m-ak)}$, or $\frac{ma}{m-ak}$, is evidently $= \varphi$, the focal diſtance of an infinitely ſlender pencil. Therefore the aberration is expreſſed by the ſecond term, which we muſt endeavour to ſimplify.

If we now perform the multiplications indicated by $-(mr - ark) \times \left(mka - \frac{ark^2}{m}\right)$, it is plain that $-mr \times mka$ deſtroys the firſt term $mra \times mk$ of the numerator of our ſmall fraction, and there remains of this numerator $\left(ma^2rk^2 - ar^2k^2 + \frac{a^2r^2k^3}{m}\right)\frac{1}{2}e^2$, which is equal to $m^2a^2 \left(\frac{rk^2}{m} - \frac{r^2k^2}{m^2a} + \frac{r^2k^3}{m^3}\right)\frac{1}{2}e^2$.

The denominator was $r^2(m-ak)^2$, and the fraction now becomes $\frac{m^2a^2}{(m-ak)^2}\left(\frac{k^2}{mr} - \frac{k^2}{m^2a} + \frac{k^3}{m^3}\right)\frac{1}{2}e^2$, which is evidently $= \varphi^2\left(\frac{k^2}{mr} - \frac{k^2}{m^2a} + \frac{k^3}{m^3}\right)\frac{e^2}{2}$. Now recollect that $k = \frac{1}{a} - \frac{1}{r}$. Therefore $\frac{k^3}{m^2} = \frac{k^2}{m^2}\left(\frac{1}{a} - \frac{1}{r}\right) = \frac{k^2}{m^2a} - \frac{k^2}{m^2r}$. Therefore, inſtead of $-\frac{k^2}{m^2a}$, write $\frac{-k^3}{m^2} - \frac{k^2}{m^2r}$, and we get the fraction $\varphi^2\left(\frac{k^3}{m^3} - \frac{k^3}{m^2} - \frac{k^2}{m^2r} + \frac{k^2}{mr}\right)\frac{e^2}{2} = \varphi^2\left(\frac{k^3}{m} - \frac{mk^3}{m^3} - \right.$

$m\,k^2$

$\frac{m\,k^2}{m^3 r} + \frac{m^2 k^2}{m^3 r}\Big) \frac{e^2}{2}$, which is equal to $\varphi^2\,\frac{1-m}{m^3}\left(k^3 - \frac{mk^2}{r}\right)\frac{e^2}{2}$, and finally to $-\varphi^2\,\frac{m-1}{m^3}\left(k^3 - \frac{mk^2}{r}\right)\frac{e^2}{2}$.

Therefore the focal diſtance of refracted rays is $x = \varphi - \varphi^2\,\frac{m-1}{m^3}\left(k^3 - \frac{m\,k^2}{r}\right)\frac{e^2}{2}$.

This conſiſts of two parts. The firſt φ is the focal diſtance of an infinitely ſlender pencil of central rays, and the other $-\varphi^2\,\frac{m-1}{m^3}\left(k^3 - \frac{mk^2}{r}\right)\frac{e^2}{2}$ is the aberration ariſing from the ſpherical figure of the refracting ſurface.

Our formula has thus at laſt put on a very ſimple form, and is vaſtly preferable to Dr Smith's for practice.

This aberration is evidently proportional to the ſquare of the ſemi-aperture, and to the ſquare of the diſtance φ: but, in order to obtain this ſimplicity, ſeveral quantities were neglected. The aſſumption of the equality of AX to $\frac{e^2}{2a}$ is the firſt ſource of error. A much more accurate value of it would have been $\frac{2ae^2}{4a^2+e^2}$, for it is really $= \frac{e^2}{2a - \mathrm{AX}}$. If for AX we ſubſtitute its approximated value $\frac{e^2}{2a}$, we ſhould have $\mathrm{AX} = \frac{e^2}{2a - \frac{e^2}{2a}}, = \frac{2ae^2}{4a^2 - e^2}$. To have uſed this value would not have much complicated the calculus; but it did not occur to us till we had finiſhed the inveſtigation, and it would have required the whole to be changed. The operation in page 346. col. 2. par. 2. is another ſource of error. But theſe errors are very inconſiderable when the aperture is moderate. They increaſe for the moſt part with an increaſe of aperture, but not in the proportion of any regular function of it; ſo that we cannot improve the formula by any manageable proceſs, and muſt be contented with it. The errors are preciſely the ſame with thoſe of Dr Smith's theorem, and indeed with thoſe of any that we have ſeen, which are not vaſtly more complicated.

As this is to be frequently combined with ſubſequent operations, we ſhorten the expreſſion by putting θ for $\frac{m-1}{m^3}\left(k^3 - \frac{m\,k^2}{r}\right)\frac{e^2}{2}$. Then $\varphi^2\,\theta$ will expreſs the aberration of the firſt refraction from the focal diſtance of an infinitely ſlender pencil; and now the focal diſtance of refracted rays is $f = \varphi - \varphi^2\,\theta$.

If the incident rays are parallel, r becomes infinite, and $\theta = \frac{m-1}{m^3}\,k^3\,\frac{e^2}{2}$. But in this caſe k becomes $= \frac{1}{a}$, and $\frac{1}{\varphi} = \frac{m-1}{ma}$, and $\varphi = \frac{ma}{m-1}$, and $\varphi^2\,\theta$ becomes $\frac{m^2 a^2}{(m-1)^2} \times \frac{m-1}{m^3} \times \frac{1}{a^3} \times \frac{e^2}{2}, = \frac{e^2}{2(m-1)ma}$. This is the aberration of extreme parallel rays.

We muſt now add the refraction of another ſurface.

Lemma 2. If the focal diſtance AG be changed by a ſmall quantity Gg, the focal diſtance AH will alſo be changed by a ſmall quantity Hh, and we ſhall have

$$m \cdot \mathrm{AG}^2 : \mathrm{AH}^2 = \mathrm{G}g : \mathrm{H}h.$$

Draw Mg, Mh, and the perpendiculars Gi, Hk. Then, becauſe the ſines of the angles of incidence are in a conſtant ratio to the ſines of the angles of refraction, and the increments of theſe ſmall angles are proportional to the increments of the ſines, theſe increments of the angles are in the ſame conſtant ratio. Therefore,

We have the angle CMg to HMh as m to 1

Now $\mathrm{G}g : \mathrm{G}i = \mathrm{AG} : \mathrm{AM}$,
and $\mathrm{G}i : hk = m \cdot \mathrm{AG} : \mathrm{HA}$,
and $hk : \mathrm{H}h = \mathrm{MA} : \mathrm{AH}$:
therefore $\mathrm{G}g : \mathrm{H}h = m \cdot \mathrm{AG}^2 : \mathrm{AH}^2$.

The eaſieſt and moſt perſpicuous method for obtaining the aberration of rays twice refracted, will be to conſider the firſt refraction as not having any aberration, and determine the aberration of the ſecond refraction. Then conceive the focus of the firſt refraction as ſhifted by the aberration. This will produce a change in the focal diſtance of the ſecond refraction, which may be determined by this Lemma.

Prop. II. Let AM, BN (fig. 7.) be two ſpherical ſurfaces, including a refracting ſubſtance, and having their centres C and c in the line AG. Let the ray aA paſs through the centres, which it will do without refraction. Let another ray mM, tending to G, be refracted by the firſt ſurface into MH, cutting the ſecond ſurface in N, where it is farther refracted into NI. It is required to determine the focal diſtance BI?

It is plain that the ſine of incidence on the ſecond ſurface is to the ſine of refraction into the ſurrounding air as 1 to m. Alſo BI may be determined in relation to BH, by means of BH, Nx, Bc, and $\frac{1}{m}$, in the ſame way that AH was determined in relation to AG, by means of AG, MX, AC, and m.

Let the radius of the ſecond ſurface be b, and let e ſtill expreſs the ſemi-aperture, (becauſe it hardly differs from Nx). Alſo let α be the thickneſs of the lens. Then obſerve, that the focal diſtance of the rays refracted by the firſt ſurface, (neglecting the thickneſs of the lens and the aberration of the firſt ſurface, is the diſtance of the radiant point for the ſecond refraction, or is the focal diſtance of rays incident on the ſecond ſurface. In place of r therefore we muſt take φ; and as we made $k = \frac{1}{a} - \frac{1}{r}$, in order to abbreviate the calculus, let us now make $l = \frac{1}{b} - \frac{1}{\varphi}$; and make $\frac{1}{f} = \frac{1}{b} - ml$, as we made $\frac{1}{\varphi} = \frac{1}{a} - \frac{k}{m}$. Laſtly, in place of $\theta = \frac{m-1}{m^3}\left(k^3 - \frac{m\,k^2}{r}\right)\frac{e^2}{2}$, make $\theta' = \left(\frac{1}{m} - 1\right)m^3\left(l^3 - \frac{l^2}{m\varphi}\right)\frac{e^2}{2}, = -\frac{m-1}{m}\left(m^3 l^3 - \frac{m^2 l^2}{\varphi}\right)\frac{e^2}{2}$.

Thus we have got an expreſſion ſimilar to the other; and the focal diſtance BI, after two refractions, becomes $\mathrm{BI} = f - f^2\,\theta'$.

But this is on the ſuppoſition that BH is equal to φ, whereas it is really $\varphi - \varphi^2\,\theta - \alpha$. This muſt occaſion a change in the value juſt now obtained of BI. The ſource of the change is twofold. 1ſt, Becauſe, in the value $\frac{1}{b} - \frac{1}{\varphi}$, we muſt put $\frac{1}{b} - \frac{1}{\varphi - \varphi^2\,\theta - \alpha}$, and becauſe we muſt do the ſame in the fraction $\frac{m^2 l^2}{\varphi}$. In the ſecond place, when the value of BH is diminiſhed by the quantity $\varphi^2\,\theta + \alpha$, BI will ſuffer a change in the proportion determined by the 2d Lemma. The firſt difference may ſafely be neglected, becauſe the value of θ is very ſmall, by reaſon of the coefficient $\frac{e^2}{2}$ being very ſmall, and alſo becauſe the variation bears a very ſmall ratio to the quantity itſelf, when the true value of φ

differs but little from that of the quantity for which it is employed. The chief change in BI is that which is determined by the lemma. Therefore take from BI the variation of BH, multiplied by $\frac{m\,\mathrm{BI}^2}{\mathrm{BH}^2}$, which is very nearly $= \frac{mf^2}{\varphi^2}$. The product of this multiplication is $mf^2\,\theta + \frac{mf^2\,\alpha}{\varphi^2}$. This being taken from f, leaves us for the value of BI $f - \frac{f^2\,m\,\alpha}{\varphi^2} - f^2\,(m\,\theta + \theta')$.

In this value f is the focal diſtance of an infinitely ſlender pencil of rays twice refracted by a lens having no thickneſs, $\alpha\frac{mf^2}{\varphi}$ is the ſhortening occaſioned by the thickneſs, and $f^2\,(m\,\theta + \theta')$ is the effect of the two aberrations ariſing from the aperture.

It will be convenient, for ſeveral collateral purpoſes, to exterminate from theſe formula the quantities k, l, and φ. For this purpoſe make $\frac{1}{n} = \frac{1}{a} - \frac{1}{b}$. We have already $k = \frac{1}{a} - \frac{1}{r}$; and $\frac{1}{\varphi} = \frac{1}{a} - \frac{1}{ma} + \frac{1}{mr}$; and $l = \frac{1}{b} - \frac{1}{\varphi}, = \frac{1}{b} - \frac{1}{a} + \frac{1}{ma} - \frac{1}{mr}$. Now for $\frac{1}{b} - \frac{1}{a}$ write $-\frac{1}{n}$, and we get $l = \frac{1}{ma} - \frac{1}{mr} - \frac{1}{n}$. Therefore $\frac{1}{f} = \frac{1}{b} - ml$ (by conſtruction, page 347. Prop. II.) becomes $= \frac{1}{b} - \frac{1}{a} + \frac{1}{r} + \frac{m}{n}, = \frac{m}{n} + \frac{1}{r} - \frac{1}{n}, = \frac{m-1}{n} + \frac{1}{r}$.

This laſt value of $\frac{1}{f}$ (the reciprocal of the focus of a ſlender pencil twice refracted), viz. $\frac{m-1}{n} + \frac{1}{r}$, is the ſimpleſt that can be imagined, and makes n as a ſubſtitute for $\frac{1}{a} - \frac{1}{b}$; a moſt uſeful ſymbol, as we ſhall frequently find in the ſequel. It alſo gives a very ſimple expreſſion of the focal diſtance of parallel rays, which we may call the principal focal diſtance of the lens, and diſtinguiſh it in future by the ſymbol p; for the expreſſion $\frac{1}{f} = \frac{m-1}{n} + \frac{1}{r}$, becomes $\frac{1}{p} = \frac{m-1}{n}$ when the incident light is parallel. And this gives us another very ſimple and uſeful meaſure of f; for $\frac{1}{f}$ becomes $= \frac{1}{p} + \frac{1}{r}$. Theſe equations $\frac{1}{f} = \frac{m-1}{n} + \frac{1}{r}$, $\frac{1}{p} = \frac{m-1}{n}$, and $\frac{1}{f} = \frac{1}{p} + \frac{1}{r}$, deſerve therefore to be made very familiar to the mind.

We may alſo take notice of another property of n. It is half the radius of an iſoſceles lens, which is equivalent to the lens whoſe radii are a and b: for ſuppoſe the lens to be iſoſceles, that is, $a = b$; then $n = \frac{1}{a} - \frac{1}{a}$. Now the ſecond a is negative if the firſt be poſitive, or poſitive if the firſt be negative. Therefore $\frac{1}{a} - \frac{1}{b} = \frac{1+b}{a^2} = \frac{a+a}{a^2} = \frac{2}{a}$, and $\frac{1}{n} = \frac{2}{a}$, and $n = \frac{a}{2}$. Now the focal diſtance of this lens is $\frac{m-1}{n}$, and ſo is that of the other, and they are equivalent.

But, to proceed with our inveſtigation, recollect that we had $\theta = \frac{m-1}{m^3}\left(k^3 - \frac{mk^2}{r}\right)\frac{e^2}{2}$. Therefore $m\,\theta = \frac{m-1}{m}\left(\frac{k^3}{m} - \frac{k^2}{r}\right)\frac{e^2}{2}$. And θ' was $= \frac{m-1}{m}\left(-m^3\,l^3 + \frac{ml^2}{\varphi}\right)\frac{e^2}{2}$. Therefore $m\,\theta + \theta'$, the aberration (neglecting the thickneſs of the lens) is $f^2\,\frac{m-1}{m}\left(\frac{k^3}{m} - \frac{k^2}{r} - m^3\,l^3 + \frac{m\,l^2}{\varphi}\right)\frac{e^2}{2}$.

If we now write for k, l, and φ, their values as determined above, performing all the neceſſary multiplications, and arrange the terms in ſuch a manner as to collect in one ſum the coefficients of a, n, and r, we ſhall find 4 terms for the value of $m\,\theta$, and 10 for the value of θ'. The 4 are deſtroyed by as many with contrary ſigns in the value of θ', and there remain 6 terms to expreſs the value of $m\,\theta + \theta'$, which we ſhall expreſs by one ſymbol q; and the equation ſtands thus:

$$q = \frac{m-1}{m}\left(\frac{m^3}{n^3} - \frac{2m^2+m}{an^2} + \frac{m+2}{a^2n} + \frac{3m^2+m}{rn^2} - \frac{4m+4}{arn} + \frac{3m+2}{r^2n}\right)\frac{e^2}{2}.$$

The focal diſtance therefore of rays twice refracted, reckoned from the laſt ſurface, or BI, corrected for aberration, and for the thickneſs of the lens, is $f - f^2\frac{m\alpha}{\varphi^2} - f^2\,q$, conſiſting of three parts, viz. f, the focal diſtance of central rays; $f^2\frac{m\alpha}{\varphi^2}$, the correction for the thickneſs of the lens; and $f^2\,q$, the aberration.

The formula in the 2d par. of this col. appears very complex, but is of very eaſy management, requiring only the preparation of the ſimple numbers which form the numerators of the fractions included in the parentheſis. When the incident rays are parallel, the terms vaniſh which have r in the denominator, ſo that only the three firſt terms are uſed.

We might here point out the caſes which reduce the aberration expreſſed in the formula laſt referred to, to nothing; but as they can ſcarcely occur in the object-glaſs of a teleſcope, we omit it for the preſent, and proceed to the combination of two or more lenſes.

Lemma 3. If AG be changed by a ſmall quantity Gg, BI ſuffers a change Ii, and Gg : Ii = AG^2 : BI^2. For it is well known that the ſmall angles GMg and INi are equal; and therefore their ſubtenſes Gk, In are proportional to MG, NI, or to AG, AI nearly, when the aperture is moderate. Therefore we have (nearly)

$$\mathrm{G}k : \mathrm{I}n : \mathrm{AG} : \mathrm{BI}$$
$$\mathrm{I}n : \mathrm{I}i = \mathrm{AM} : \mathrm{BI}$$
$$\mathrm{G}g : \mathrm{G}k = \mathrm{AG} : \mathrm{AM}$$
$$\text{Therefore } \mathrm{G}g : \mathrm{I}i = \mathrm{AG}^2 : \mathrm{BI}^2$$

Prop. III. To determine the focal diſtance of rays refracted by two lenſes placed near to each other on a common axis.

Let AM, BN (fig. 8.) be the ſurfaces of the firſt lens, and CO, DP be the ſurfaces of the ſecond, and let β be the thickneſs of the ſecond lens, and δ the interval between them. Let the radius of the anterior ſurface of the ſecond lens be a', and the radius of its poſterior ſurface be b'. Let m' be to 1 as the ſine of incidence to the ſine of refraction in the ſubſtance of the ſecond lens. Laſtly, let p' be the principal focal diſtance of the ſecond lens. Let the extreme or marginal ray meet the axis in L after paſſing thro' both lenſes, ſo that DL is the ultimate focal diſtance, reckoned from the laſt ſurface.

It is plain that DL may be determined by means of a', b', m', p', and CI, in the ſame manner that BI was determined by means of a, b, m, p, and AG.

The value of BI is $f - m\alpha\frac{f^2}{\varphi^2} - f^2 q$. Take from this the interval δ, and we have CI $= f - m\alpha\frac{f^2}{\varphi^2} - \delta - f^2 q$. Let the ſmall part $- m\alpha\frac{f^2}{\varphi^2} - \delta - f^2 q$ be neglected for the preſent, and let CI be ſuppoſed $= f$. As we formed φ, f, and q, by means of a, b, m, n, and r, let us now form φ', f', and q', for the ſecond lens, by means of a', b', m', n', $\left(= \frac{1}{a'} - \frac{1}{b'}\right)$, and r'. φ' will be the focal diſtance of a ſlender pencil refracted by the firſt ſurface, f will be the focal diſtance of this pencil after two refractions, and q' will be the coefficient of the aberration, neglecting the thickneſs and interval of the lenſes.

Proceeding in this way, DL will be $= f' - m\beta\frac{f'^2}{\varphi'} - f'^2 q$. But becauſe CI is really leſs than f, by the quantity $m\alpha\frac{f^2}{\varphi'^2} + \delta + f^2 q'$, we muſt (by Lemma 3.) ſubtract the product of this quantity, multiplied by $\frac{\text{DL}}{\text{BI}^2}$, (which is nearly $\frac{f'^2}{f^2}$), from $f' - m\beta\frac{f'^2}{\varphi'^2} - f'^2 q'$.

By this proceſs we ſhall have

$$\text{DL} = f' - f'^2\left(\frac{m\alpha}{\varphi^2} + \frac{\delta}{f^2} + \frac{m'\beta}{\varphi'^2}\right) - f'^2 (q + q').$$

The firſt term f' of this value of DI is the focal diſtance of a ſlender pencil of central rays refracted by both lenſes, neglecting their thickneſs and diſtance; the ſecond term, $-f'^2\left(\frac{m\alpha}{\varphi^2} + \frac{\delta}{f^2} + \frac{m'\beta}{\varphi'^2}\right)$ is the correction neceſſary for theſe circumſtances; and the third term, $-f'^2 (q + q')$, is the correction for the aperture $2e$. And it is evident that q' is a formula preciſely ſimilar to q, containing the ſame number of terms, and differing only by the m', a', n', and r', employed in place of m, a, n, and r.

It is alſo evident, that if there be a third lens, we ſhall obtain its focal diſtance by a proceſs preciſely ſimilar to that by which we obtained DL; and ſo on for any number of lenſes.

Thus have we obtained formulæ by which the foci of rays are determined in the moſt general terms; and in ſuch a manner as ſhall point out the connection of the curvatures, thickneſſes, and diſtances of the lenſes, with their ſpherical aberrations, and with the final aberration of the compound lens, and give the aberrations in ſeparate ſymbols, ſo that we can treat them by themſelves, and ſubject them to any conditions which may enable us to correct one of them by another.

We alſo ſee in general, that the correction for the thickneſs and diſtance of the lenſes are exhibited in terms which involve only the focal diſtances of central rays, and have very little influence on the aberrations, and ſtill leſs on the ratio of the aberrations of the different lenſes. This is a moſt convenient circumſtance; for we may neglect them while we are determining q and q', and in determining the ratio of the focal diſtances of the ſeveral lenſes, on which the correction of the chromatic aberration chiefly depends. Therefore, in the conſtruction of a compound lens for uniting the different colours, we may neglect this correction for the thickneſs and diſtance till the end of the proceſs. When we apply it, we ſhall find that it chiefly affects the final focal diſtance, making it ſomewhat longer, but has hardly any influence either on the chromatic or ſpherical aberration. We do not heſitate to ſay, that the final formulæ here given are abundantly accurate, while they are vaſtly more manageable than thoſe employed by Euler or D'Alembert. We have calculated trigonometrically the progreſs of the rays through one of the glaſſes, which will be given as an example, giving it a very extravagant aperture, that the errors of the formulæ might be very remarkable. We found the real aberration exceed the aberration aſſigned by the formula by no more than $\frac{1}{50}$th part, a difference which is quite inſignificant. The proceſs here given derives its ſimplicity from the frequent occurrence of harmonic proportions in all optical theorems. This enabled Mr Clairaut to employ the reciprocals of the radii and diſtances with ſo much ſimplicity and generality.

We conſider it as another advantage of Mr Clairaut's method, that it gives, by the way, formulæ for the more ordinary queſtions in optics, which are of wonderful ſimplicity, and moſt eaſily remembered. The chief problems in the elementary conſtruction of optical inſtruments relate to the focal diſtances of central rays. This determines the focal diſtances and arrangement of the glaſſes. All the reſt may be called the refinement of optics; teaching us how to avoid or correct the indiſtinctneſs, the colours, and the diſtortions, which are produced in the images formed by theſe ſimple conſtructions. We ſhall mention a few of theſe formulæ which occur in our proceſs, and tend greatly to abbreviate it when managed by an experienced analyſt.

Let m be to 1 as the ſine of incidence to the ſine of refraction; let a and b be the radii of the anterior and poſterior ſurfaces of a lens; let r be the diſtance of the radiant point, or the focus of incident central rays, and f the diſtance of the conjugate focus; and let p be the principal focal diſtance of the lens, or the focal diſtance of parallel rays. Make $\frac{1}{n}$ equal to $\frac{1}{a} - \frac{1}{b}$; let the ſame letters a', b', r', &c. expreſs the ſame things for a ſecond lens; and a'', b'', r'', &c. expreſs them for a third; and ſo on. Then we have $\frac{1}{f} = \frac{m-1}{n} + \frac{1}{r}$; $\frac{1}{f'} = \frac{m'-1}{n'} + \frac{1}{r'}$; $\frac{1}{f''} = \frac{m''-1}{n''} + \frac{1}{r''}$, &c.

Therefore when the incident light is parallel, and r infinite, we have $\frac{1}{p} = \frac{m-1}{n}$; $\frac{1}{p'} = \frac{m'-1}{n'}$; $\frac{1}{p''} = \frac{m''-1}{n''}$, &c.

And when ſeveral lenſes are contiguous, ſo that their intervals may be neglected, and therefore $\frac{1}{f}$, belonging to the firſt lens, becomes $\frac{1}{r}$, belonging to the ſecond, we have

$$1.\ \frac{1}{r'} = \frac{1}{f}, = \frac{m-1}{n} + \frac{1}{r}, = \frac{1}{p} + \frac{1}{r}.$$

$$2.\ \frac{1}{r''} = \frac{1}{f'}, = \frac{m'-1}{n'} + \frac{m-1}{n} + \frac{1}{r}, = \frac{1}{p'} + \frac{1}{p} + \frac{1}{r}.$$

$$3.\ \frac{1}{f''} = \frac{m''-1}{n''} + \frac{m'-1}{n} + \frac{m-1}{n} + \frac{1}{r}, = \frac{1}{p''} + \frac{1}{p'} + \frac{1}{p} + \frac{1}{r}.$$

Nothing can be more eaſily remembered than theſe formulæ, how numerous ſo ever the glaſſes may be.

Having thus obtained the neceſſary analyſis and formula, it now remains to apply them to the conſtruction of achromatic lenſes; in which it fortunately happens, that the employment of ſeveral ſurfaces, in order to produce the union of the differently refrangible rays, enables us at the ſame time to employ them for correcting each other's ſpherical aberration.

In the article OPTICS we gave a general notion of the principle on which we may proceed in our endeavours to unite the differently refrangible rays. A white or compounded ray is ſeparated by refraction into its component coloured rays, and they are diffuſed over a ſmall angular ſpace. Thus it appears, that the glaſs uſed by Sir Iſaac

Newton in his experiments diffuſed a white ray which was incident on its poſterior ſurface in an angle of 30°, in ſuch a manner that the extreme red ray emerged into air, making an angle of 50° 21⅓′ with the perpendicular; the extreme violet ray emerged in an angle of 51° 15⅓′; and the ray which was in the confines of green and blue, emerged in an angle of 50° 48⅓′. If the ſine of the angle 30° of incidence be called 0,5, which it really is, the ſine of the emergence of the red ray will be 0,77; that of the violet ray will be 0,78; and that of the intermediate ray will be 0,77½, an exact mean between the two extremes. This ray may therefore be called the mean refrangible ray, and the ratio of 77½ to 50, or of 1,55 to 1, will very properly expreſs the mean refraction of this glaſs; and we have for this glaſs $m = 1{,}55$. The ſine of refraction, being meaſured on a ſcale, of which the ſine of incidence occupies 100 parts, will be 154 for the red ray, 155 for the mean ray, and 156 for the violet ray. This number, or its ratio to unity, is commonly taken to repreſent the refractive power of the glaſs. There is ſome impropriety in this, unleſs we conſider ratios as meaſured by their logarithms: for if m be 1, the ſubſtance does not refract at all. The refractive power can be properly meaſured only by the refraction which it produces; that is, by the change which it makes in the direction of the light, or the angle contained between the incident and refracted rays. If two ſubſtances produce ſuch deviations always in one proportion, we ſhould then ſay that their refractive powers are in that proportion. This is not true in any ſubſtances; but the ſines of the angles, contained between the refracted ray and the perpendicular are always in one proportion when the angle of incidence in both ſubſtances is the ſame. This being a cogniſable function of the real refraction, has therefore been aſſumed as the only convenient meaſure of the refractive powers. Although it is not ſtrictly juſt, it anſwers extremely well in the moſt uſual caſes in optical inſtruments: the refractions are moderate; and the ſines are very nearly as the angles contained between the rays and the perpendicular; and the real angles of refraction, or deflections of the rays, are almoſt exactly proportional to $m - 1$. The moſt natural and obvious meaſure of the refractive powers would therefore be $m - 1$. But this would embarraſs ſome very frequent calculations; and we therefore find it beſt, on the whole, to take m itſelf for the meaſure of the refractive power.

The ſeparation of the red, violet, and intervening rays, has been called *diſperſion;* and although this ariſes merely from a difference of the refractive power in reſpect of the different rays, it is convenient to diſtinguiſh this particular modification of the refractive power by a name, and we call it the DISPERSIVE POWER of the refracting ſubſtance.

It is ſuſceptible of degrees; for a piece of flint-glaſs will refract the light, ſo that when the ſine of refraction of the red ray is 77, the ſine of the refraction of the violet ray is nearly 78½; or if the ſine of refraction of the red ray, meaſured on a particular ſcale, is 1,54, the ſine of refraction of the violet ray is 1,57. The diſperſion of this ſubſtance, being meaſured by the difference of the extreme ſines of refraction, is greater than the diſperſion of the other glaſs, in the proportion of 3 to 2.

But this alone is not a ſufficient meaſure of the abſolute diſperſive power of a ſubſtance. Although the ratio of 1,54 to 1,56 remains conſtant, whatever the real magnitude of the refractions of common glaſs may be, and though we therefore ſay that its diſperſive power is conſtant, we know, that by increaſing the incidence and the refraction, the abſolute diſperſion is alſo increaſed. Another ſubſtance ſhows the ſame properties, and in a particular caſe may produce the ſame diſperſion; yet it has not for this ſole reaſon the ſame diſperſive power. If indeed the incidence and the refraction of the mean ray be alſo the ſame, the diſperſive power cannot be ſaid to differ; but if the incidence and the refraction of the mean ray be leſs, the diſperſive power muſt be conſidered as greater, though the actual diſperſion be the ſame; becauſe if we increaſe the incidence till it becomes equal to that in the common glaſs, the diſperſion will now be increaſed. The proper way of conceiving the diſperſion therefore is, to conſider it as a portion of the whole refraction; and if we find a ſubſtance making the ſame diſperſion with half the general refraction, we muſt ſay that the diſperſive quality is double; becauſe by making the refraction equal, the diſperſion will really be double.

If therefore we take $\dot{m}$ as a ſymbol of the ſeparation of the extreme rays from the middle ray, $\frac{\dot{m}}{m-1}$ is the natural meaſure of the diſperſive power. We ſhall expreſs this in the Leibnitzian notation, thus $\frac{dm}{m-1}$, that we may avoid the indiſtinctneſs which the Newtonian notation would occaſion when m is changed for m' or m''.

It is not unuſual for optical writers to take the whole ſeparation of the red and violet rays for the meaſure of the diſperſive power, and to compare this with the refracting power with reſpect to one of the extreme rays. But it is ſurely better to conſider the mean refraction as the meaſure of the refracting power: and the deviation of either of the extremes from this mean is a proper enough meaſure of the diſperſion, being always half of it. It is attended with this convenience, that being introduced into our computations as a quantity infinitely ſmall, and treated as ſuch for the eaſe of computation, while it is really a quantity of ſenſible magnitude; the errors ariſing from this ſuppoſition are diminiſhed greatly, by taking one half of the deviation and comparing it with the mean refraction. This method has, however, this inconvenience, that it does not exhibit at once the refractive power in all ſubſtances reſpecting any particular colour of light; for it is not the ray of any particular colour that ſuffers the mean refraction. In common glaſs it is the ray which is in the confines of the yellow and blue; in flint glaſs it is nearly the middle blue ray; and in other ſubſtances it is a different ray. Theſe circumſtances appear plainly in the different proportions of the colours of the priſmatic ſpectrum exhibited by different ſubſtances. This will be conſidered afterwards, being a great bar to the perfection of achromatic inſtruments.

The way in which an achromatic lens is conſtructed is, to make uſe of a contrary refraction of a ſecond lens to deſtroy the diſperſion or ſpherical aberration of the firſt.

The firſt purpoſe will be anſwered if $\frac{dm}{n}$ be equal to $-\frac{dm'}{n'}$. For, in order that the different coloured rays may be collected into one point by two lenſes, it is only neceſſary that $\frac{1}{f}$, the reciprocal of the focal diſtance of rays refracted by both, may be the ſame for the extreme and mean rays, that is, that $\frac{m + dm - 1}{n} + \frac{m' + dm' - 1}{n'} + \frac{1}{r}$ be of the ſame value with $\frac{m-1}{n} + \frac{m'-1}{n'} + \frac{1}{r}$; which muſt happen if $\frac{dm}{n} + \frac{dm'}{n'}$ be $= 0$, or $\frac{dm}{n} = -\frac{dm'}{n}$. This may be ſeen in another way, more comprehenſible by ſuch as are not verſant in theſe diſcuſſions. In order

der that the extreme colours which are ſeparated by the firſt lens may be rendered parallel by the ſecond; we have ſhown already that n and n' are proportional to the radii of the equivalent iſoſceles lenſes, being the halves of theſe radii. They are therefore (in theſe ſmall refractions) inverſely proportional to the angles formed by the ſurfaces at the edges of the lenſes. n' may therefore be taken for the angle of the firſt lens, and n for that of the ſecond. Now the ſmall refraction by a priſm, whoſe angle (alſo ſmall) is n', is $\overline{m-1} \times n'$. The diſperſive power being now ſubſtituted for the refractive power, we have for this refraction of the priſm $dm \times n'$. This muſt be deſtroyed by the oppoſite refraction of the other priſm $dm' \times n$. Therefore $dm \times n' = dm' \times n$, or $\frac{dm}{n} = -\frac{dm'}{n'}$. In like manner, this effect will be produced by three lenſes if $\frac{dm}{n} + \frac{dm'}{n'} + \frac{dm''}{n''}$ be $= 0$, &c.

Laſtly, the errors ariſing from the ſpherical figure, which we expreſſed by $-R^2 (q+q')$ will be corrected if $q+q'$ be $= 0$. We are therefore to diſcover the adjuſtments of the quantities employed in the preceding formulæ, which will inſure theſe conditions. It will render the proceſs more perſpicuous if we collect into one view the ſignifications of our various ſymbols, and the principal equations which we are to employ.

1. The ratios to unity of the ſines of mean incidence in the different media are - m, m', m''
2. The ratio of the differences of the ſines of the extremes - - - $\frac{dm}{dm'}, = u$.
3. The ratio $\frac{m-1}{m'-1}$ - - $= c$.
4. The radii of the ſurfaces - $a, b; a', b; a'', b''$.
5. The principal focal diſtances, or the focal diſtances of parallel central rays, - p, p', p''.
6. The focal diſtance of the compound lens P.
7. The diſtance of the radiant point, or of the focus of incident rays on each lens r, r', r''.
8. The focal diſtance of the rays refracted by each lens - - $f, f' f''$.
9. The focal diſtance of rays refracted by ths compound lens - - F.
10. The half breadth of the lens e.

Alſo the following ſubſidiary values:

1. $\frac{1}{n} = \frac{1}{a} - \frac{1}{b}$; $\frac{1}{n'} = \frac{1}{a'} - \frac{1}{b'}$; $\frac{1}{n''} = \frac{1}{a''} - \frac{1}{b''}$.

2. $q = \frac{m-1}{m}\left(\frac{m'^3}{n^3} - \frac{2m^2+m}{an^2} + \frac{m+2}{a^2 n} + \frac{3m^2+m}{rn^2} - \frac{4(m+1)}{arn} + \frac{3m+2}{r^2 n}\right)\frac{e^2}{2}$. And q' and q'' muſt be formed in the ſame manner from m', a', n', r'; and from m'', a'', n'', r'', as q is formed from m, a, n, r.

3. Alſo, becauſe in the caſe of an object-glaſs, r is infinitely great, the laſt term $\frac{1}{r}$ in all the values of $\frac{1}{f}, \frac{1}{f'}, \frac{1}{f''}, \frac{1}{r'}, \frac{1}{r''}$, will vaniſh, and we ſhall alſo have $F = P$.

Therefore in a double object-glaſs $\frac{1}{P} = \frac{m'-1}{n'} + \frac{m-1}{n}, = \frac{1}{p} + \frac{1}{p'}$.

And in a triple object-glaſs $\frac{1}{P} = \frac{m''-1}{n''} + \frac{m'-1}{n} + \frac{m-1}{n}, = \frac{1}{p''} + \frac{1}{p'} + \frac{1}{p}$.

Alſo, in a double object-glaſs, the correction of ſpherical aberration requires $q + q' = v$.

And a triple object-glaſs requires $q + q' + q'' = v$. For the whole error is multiplied by F^2, and by $\frac{1}{2}e^2$; and therefore the equation which corrects this error may be divided by $F^2 \frac{1}{2} e^2$.

This equation in the preceding column, 11th line from the bottom, giving the value of q, q', q'', may be much ſimplified as follows: In the firſt place, they may be divided by m, m', or m'', by applying them properly to the terms within the parentheſis, and expunging them from the denominator of the general factors $\frac{m-1}{m}, \frac{m'-1}{m'}, \frac{m''-1}{m''}$. This does not alter the values of q, q', and q''. In the ſecond place the whole equations may be afterwards divided by $m'-1$. This will give the values of $\frac{q}{m'-1}, \frac{q'}{m'-1}$, and $\frac{q''}{m'-1}$, which will ſtill be equal to nothing if $q + q' + q''$ be equal to nothing.

This diviſion reduces the general factor $\frac{m'-1}{m'}$ of q' to $\frac{1}{m'}$. And in the equation for q we obtain, in place of the general factor $\frac{m-1}{m}$, the factor $\frac{m-1}{m'-1}$, or c. This will alſo be the factor of the value of q'' when the third lens is of the ſame ſubſtance with the firſt, as is generally the caſe. And, in the third place, ſince the rays incident on the firſt lens are parallel, all the terms vaniſh from the value of q in which $\frac{1}{r}$ is found, and there remain only the three firſt, viz. $\frac{m^3}{n^3} - \frac{2m^2+m}{an^2} + \frac{m+2}{a^2 n}$.

Performing theſe operations, we have

$$\frac{q}{m'-1} = c\left(\frac{m^2}{n^3} - \frac{2m+1}{an^2} + \frac{m+2}{ma^2 n}\right)\frac{e^2}{2}$$

$$\frac{q'}{m'-1} = \left(\frac{m'^2}{n'^3} - \frac{2m'+1}{a'n'^2} + \frac{m'+2}{m'a'^2 n'} + \frac{3m'+1}{r'n'^2} - \frac{4(m'+1)}{m'a'r'n'} + \frac{3m'+2}{m'r'^2 n'}\right)\frac{e^2}{2}$$

$$\frac{q''}{m'-1} = c\left(\frac{m^2}{n''^3} - \frac{2m+1}{a''n''^2} + \frac{m+2}{m''a''^2 n''} + \frac{3m+1}{r''n''^2} + \frac{4(m+1)}{m''a''r''n''} + \frac{3m+2}{m''r''^2 n''}\right)\frac{e2}{2}$$

Let us now apply this inveſtigation to the conſtruction of an object-glaſs; and we ſhall begin with a double lens.

Conſtruction of a Double Achromatic Object-glaſs.

Here we have to determine four radii a, b, a', and b'. Make $n = 1$. This greatly ſimplifies the calculus, by exterminating it from all the denominators. This gives for the equation $\frac{dm}{n} + \frac{dm'}{n'} = 0$, the equation $dm + \frac{dm'}{n'} = 0$, or $dm = -\frac{dm'}{n'}$, and $\frac{1}{n'} = -\frac{dm}{dm'}, = -u$. Alſo we have r', the focal diſtance of the light incident on the ſecond lens, the ſame with the principal focal diſtance p of the firſt lens (neglecting the interval, if any). Now $\frac{1}{p} = \frac{m-1}{n}$, which in the preſent caſe is $= m - 1$. Alſo $\frac{1}{p'}$ is $= -u(m'-1)$, and $\frac{1}{P} = m - 1 - u(m'-1) = u'$.

Make theſe ſubſtitutions in the values of $\frac{q}{m-1}$ and $\frac{q'}{m'-1}$, and we obtain the following equation:

$$cm^2 - \frac{c(2m+1)}{a} + \frac{c(m+2)}{ma^2} - u^3m'^2 - \frac{u^2(2m'+1)}{a'} - \frac{u(m'+2)}{m'a'^2} + u^2(3m'+1)(m-1) + \frac{4u(m'+1)(m-1)}{m'a'} - \frac{u(3m'+2)(m-1)^2}{m'} = 0.$$

Arrange theſe terms in order, according as they are factors of $\frac{1}{a^2}$, $\frac{1}{a}$, $\frac{1}{a'^2}$, $\frac{1}{a'}$, or independent quantities. It puts on this form:

$$\frac{c(m+2)}{m} \times \frac{1}{a^2} - c'(2m+1) \times \frac{1}{a} - \frac{u(m'+2)}{m'} \times \frac{1}{a'^2} - \left(u^2(2m'+1) - \frac{4u(m'+1)(m-1)}{m'}\right) \times \frac{1}{a'} + cm^2 + u^2(3m'+1)(m-1) - u^3m'^2 - \frac{u(3m'+2)(m-1)^2}{m'} = 0.$$

Let A be the coefficient of $\frac{1}{a^2}$, B that of $\frac{1}{a}$, C that of $\frac{1}{a'^2}$, D that of $\frac{1}{a'}$, and E the ſum of the independent quantity; that is, let A be $= \frac{c(m+2)}{m}$, $B = c(2m+1)$, $C = \frac{u(m'+2)}{m'}$, $D = u^2(2m'+2) - \frac{4u(m'+1)(m-1)}{m'}$, and $E = cm^2 + u^2(3m'+1)(m-1) - u^3m'^2 - \frac{u(3m'+2)(m-1)^2}{m'}$.

Our final equation becomes

$$\frac{A}{a^2} - \frac{B}{a} - \frac{C}{a'^2} - \frac{D}{a'} + E = 0.$$

The coefficients of this equation and the independent quantity are all known, from our knowledge of m, m' dm, dm'; and we are to find the values of a and a', and from them and $n = 1$ to find the values of b and b'.

But it is evidently an indeterminate equation, becauſe there are two unknown quantities; ſo that there may be an infinity of ſolutions. It muſt be rendered determinate by means of ſome other conditions, to which it may be ſubjected. Theſe conditions muſt depend on ſome other circumſtances which may direct our choice.

One circumſtance occurs to us which we think of very great conſequence. In the paſſage of light from one ſubſtance to another, there is always a conſiderable portion reflected from the poſterior ſurface of the firſt and from the anterior ſurface of the laſt; and this reflection is more copious in proportion to the refraction. This loſs of light will therefore be diminiſhed by making the internal ſurfaces of the lenſes to coincide; that is, by making $b = a'$. This will be attended with another advantage. If we put between the glaſſes a ſubſtance of nearly the ſame refracting power, we ſhall not only completely prevent this loſs of light, but we ſhall greatly diminiſh the errors which ariſe from an imperfect poliſh of the ſurfaces. We have tried this, and find the effect very ſurpriſing. The lens being poliſhed immediately after the figure has been given it, and while it was almoſt impervious to light by reaſon of its roughneſs, which was ſtill ſenſible to the naked eye, performed as well as when finiſhed in the fineſt manner.

N. B. This condition, by taking away one refraction, obliges us to increaſe thoſe which remain, and therefore increaſes the ſpherical aberrations. And ſince our formulæ do not fully remove thoſe (by reaſon of the ſmall quantities neglected in the proceſs), it is uncertain whether this condition be the moſt eligible. We have, however, no direct argument to the contrary.

Let us ſee what determination this gives us.

In this caſe $\frac{1}{a'} = \frac{1}{b}, = \frac{1}{a} - 1$. For becauſe $\frac{1}{n} = \frac{1}{a} - \frac{1}{b}$ and $n = 1$, we have $1 + \frac{1}{b} = \frac{1}{a}$, and $\frac{1}{b} = \frac{1}{a} - 1$. Therefore $\frac{1}{a'^2} = \frac{1}{a^2} - \frac{2}{a} + 1$. Therefore in our final equation, put $\frac{1}{a^2} - \frac{2}{a} + 1$ in place of $\frac{1}{a'^2}$, and $\frac{1}{a} - 1$ in place of $\frac{1}{a'}$, and it becomes $\frac{A-C}{a^2} - \frac{B+D-2C}{a} + E + D - C = 0$.

Thus have we arrived at a common affected quadratic equation, where $\frac{1}{a}$ is the unknown quantity. It has the common form $px^2 + qx + r = 0$, where p is $= A - C$, q is equal to $2C - B - D$, r is equal to $E + D - C$, and x is equal to $\frac{1}{a}$.

Divide the equation by p, and we have $x^2 + \frac{q}{p}x + \frac{r}{p} = 0$. Make $s = \frac{q}{p}$ and $t = \frac{r}{p}$, and we have $x^2 + sx + t = 0$.

This gives us finally $\frac{1}{a'}$, or $x = -\frac{1}{2}s \pm \sqrt{\frac{1}{4}s^2 - t}$.

This value of $\frac{1}{a}$ is taken from a ſcale of which the unit is half the radius of the iſoſceles lens which is equivalent to the firſt lens, or has the ſame focal diſtance with it. We muſt then find (on the ſame ſcale) the value of b, *viz.* $\frac{1}{a} - 1$, which is alſo the value of a'. Having obtained a', we muſt find b' by means of the equation $\frac{1}{n'} = \frac{1}{a'} - \frac{1}{b'}$ and therefore $\frac{1}{b} = \frac{1}{a'} - \frac{1}{n'}$. But $\frac{1}{n'} = u$. Therefore $\frac{1}{b'} = \frac{1}{a'} + u, = \frac{1}{a} + u - 1$.

Thus is our object-glaſs conſtructed; and we muſt determine its focal diſtance, or its reciprocal $\frac{1}{P}$. This is $= m - 1 - u(m' - 1)$.

All theſe radii and diſtances are meaſured on a ſcale of which n is the unit. But it is more convenient to meaſure every thing by the focal diſtance of the compound object-glaſs. This gives us the proportion which all the diſtances bear to it. Therefore, calling P unity, in order to obtain $\frac{1}{a}$ on this ſcale, we have only to ſtate the analogy $m - 1 - u(m' - 1) : 1 = \frac{1}{a} : \frac{1}{A}$, and A is the radius of our firſt ſurface meaſured on a ſcale of which P is the unit.

If, in the formula which expreſſes the final equation for $\frac{1}{a}$, the value of t ſhould be poſitive, and greater than $\frac{1}{4}s^2$, the equation has imaginary roots; and it is not poſſible with the glaſſes employed, and the conditions aſſumed, to correct both the chromatic and ſpherical aberrations.

If t is negative and equal to $\frac{1}{4}s^2$, the radical part of the value is $= 0$, and $\frac{1}{a} = -\frac{1}{2}s$. But if it be negative or poſitive, but leſs than $\frac{1}{4}s^2$, the equation has two real roots, which will give two conſtructions. That is to be preferred which gives the ſmalleſt curvature of the ſurfaces; becauſe, ſince in our formulæ which determine the ſpherical aberration ſome quantities are neglected; theſe quantities are always

ways greater when a large arch (that is, an arch of many degrees) is employed. No radius ſhould be admitted which is much leſs than $\frac{1}{3}$ of the focal diſtance.

All this proceſs will be made plain and eaſy by an example.

Very careful experiments have ſhown, that in common crown-glaſs the ſine of incidence is to the ſine of refraction as 1,526 is to 1, and that in the generality of flint-glaſs it is as 1,604 to 1. Alſo that $\frac{dm}{dm'} = 0,6054 = u$. Therefore $m - 1 = 0,526$; $m' - 1 = 0,604$; $c = \frac{m - 1}{m' - 1'}, = 0,87086$. By theſe numbers we can compute the coefficients of our final equation. We ſhall find them as follows:

$$\begin{aligned} A &= 2,012 \\ B &= 3,529 \\ C &= 1,360 \\ D &= -0,526 \\ E &= 1,8659 \end{aligned}$$

The general equation (p. 352. l. 17.), when ſubjected to the aſſumed coincidence of the internal ſurfaces, is $\frac{A - C}{a^2} - \frac{B + D - 2C}{a} + E + D - C = 0$. $A - C$ is $= 0,652$; $B + D - 2C$ is $= 0,283$; and $E + D - C$ is $= -0,020$; and the equation with numerical coefficients is $\frac{0,652}{a^2} - \frac{0,283}{a} - 0,020 = 0$, which correſponds to the equation $px^2 + qx + r = 0$. We muſt now make $s = \frac{q}{p}, = \frac{0,283}{0,652}, = 0,434$, and $t = \frac{r}{p}, = \frac{0,02}{0,652}, = 0,0307$. This gives us the final quadratic equation $\frac{1}{a^2} - \frac{0,434}{a} - 0,0307 = 0$. To ſolve this, we have $-\frac{1}{2}s = 0,217$, and $\frac{1}{4}s^2 - 0,0471$. From this take t, which is $= -0,0307$ (that is, to 0,0471 add 0,0307), and we obtain 0,0778, the ſquare root of which is $= 0,2789$. Therefore, finally, $\frac{1}{a} = 0,2170 \pm 0,2789$, which is either 0,4959 or $-0,0619$. It is plain that the firſt muſt be preferred, becauſe the ſecond gives a negative radius, or makes the firſt ſurface of the crown-glaſs concave. Now as the convergence of the rays is to be produced by the crown-glaſs, the other ſurface muſt become very convex, and occaſion great errors in the computed aberration. We therefore retain 0,4959 for the value of $\frac{1}{a}$, and a is $= \frac{1}{0,4959}, = 2,0166$.

To obtain b, uſe the equation $\frac{1}{b} = \frac{1}{a} - 1$, which gives $\frac{1}{b} = -0,5041$, and therefore a convex ſurface. b is therefore $= \frac{1}{0,5041}, = 1,9837$.

a' is the ſame with b, and $\frac{1}{a'}, = -0,5041$.

To obtain b', uſe the equation $\frac{1}{b'} = \frac{1}{a'}, + u$. Now $u = 0,6054$, and $\frac{1}{a'}, = -0,5041$. The ſum of theſe is 0,1013; and ſince it is poſitive, the ſurface is concave. $b' = \frac{1}{,1013} = 9,872$.

Laſtly, $\frac{1}{P} = m - 1 - u\,(m' - 1) = 0,1603$, and $P = \frac{1}{0,1603}, = 0,2383$.

Now to obtain all the meaſures in terms of the focal diſtance P, we have only to divide the meaſures already found by 6,2383, and the quotients are the meaſures wanted.

$$\begin{aligned} \text{Therefore } a &= \frac{2,0166}{6,2383} = 0,32325 \\ b &= \frac{1,9837}{6,2383} = -0,31798 \\ a' &= \;\;\text{-}\;\;\;\text{-}\;\; = -0,31798 \\ b' &= \frac{9,872}{6,2383} = \;\;\; 1,5825 \\ P &= \;\;\;\text{-}\;\;\;\;\;\;\; 1. \end{aligned}$$

If it be intended that the focal diſtance of the object-glaſs ſhall be any number n of inches or feet, we have only to multiply each of the above radii by n, and we have their lengths in inches or feet.

Thus we have completed the inveſtigation of the conſtruction of a double object-glaſs. Although this was intricate, the final reſult is abundantly ſimple for practice, eſpecially with the aſſiſtance of logarithms. The only troubleſome thing is the preparation of the numerical coefficients A, B, C, D, E of the final equation. Strict attention muſt alſo be paid to the poſitive and negative ſigns of the quantities employed.

We might propoſe other conditions. Thus it is natural to prefer for the firſt or crown-glaſs lens ſuch a form as ſhall give it the ſmalleſt poſſible aberration. This will require a ſmall aberration of the flint-glaſs to correct it. But a little reflection will convince us that this form will not be good. The focal diſtance of the crown-glaſs muſt not exceed one-third of that of the compound glaſs; theſe two being nearly in the proportion of $dm' - dm$ to dm'. Therefore if this form be adopted, and a be made about $\frac{1}{6}$th of b, it will not exceed $\frac{1}{5}$th of P. Therefore, although we may produce a moſt accurate union of the central and marginal rays by oppoſite aberrations, there will be a conſiderable aberration of ſome rays which are between the centre and the margin.

It is abſolutely impoſſible to collect into one point the whole rays (though the very remoteſt rays are united with the central rays), except in a very particular caſe, which cannot obtain in an object-glaſs; and the ſmall quantities which are neglected in the formula which we have given for the ſpherical aberration, produce errors which do not follow any proportion of the aperture which can be expreſſed by an equation of a manageable form. When the aperture is very large, it is better not to correct the aberration for the whole aperture, but for about $\frac{5}{6}$ths of it. When the rays correſponding to this diſtance are made to coincide with the central rays by means of oppoſite aberrations, the rays which are beyond this diſtance will be united with ſome of thoſe which are nearer to the centre, and the whole diffuſion will be conſiderably diminiſhed. Dr Smith has illuſtrated this in a very perſpicuous manner in his theory of his Catoptric Microſcope.

But although we cannot adopt this form of an object-glaſs, there may be other conſiderations which may lead us to prefer ſome particular form of the crown-glaſs, or of the flint-glaſs. We ſhall therefore adapt our general equation $\frac{A}{a^2} - \frac{B}{a} - \frac{C}{a'^2} - \frac{D}{a'} + E = 0$ to this condition.

Therefore let b expreſs this ſelected ratio of the two radii of the crown-glaſs, making $\frac{a}{b} = b$ (remembering always that a is poſitive and b negative in the caſe of a double convex, and b is a negative number).

With this condition we have $\frac{1}{b} = \frac{b}{a}$. But when we make n the unit of our formula of aberration, $\frac{1}{b} = \frac{1}{a} - 1$. Therefore $1 = \frac{1}{a} - \frac{b}{a}$, and $\frac{1}{a} = \frac{1}{1-b}$. Now ſubſtitute this for $\frac{1}{a}$ in the general equation, and change all the ſigns (which ſtill preſerves it $= 0$), and we obtain

$$\frac{C}{a'^2} + \frac{D}{a} - E - \frac{A}{(1-b)^2} + \frac{B}{1-b} = 0.$$

By this equation we are to find $\frac{1}{a}$, or the radius of the anterior ſurface of the flint-glaſs. The equation is of this form $p x^2 + q x + r = 0$, and we muſt again make $s = \frac{q}{p}$, and $t = \frac{r}{p}$. Therefore $s = \frac{D}{C}$, and $t = \frac{1}{C} \times \left(\frac{B}{1-b} - \frac{A}{(1-b)^2} - E\right)$. Then, finally,

$$\frac{1}{a'}, = -\tfrac{1}{2} s \pm \sqrt{\tfrac{1}{4} s^2 - t}.$$

It may be worth while to take a particular caſe of this condition. Suppoſe the crown glaſs to be of equal convexities on both ſides. This has ſome advantages: We can tell with preciſion whether the curvatures are preciſely equal, by meaſuring the focal diſtance of rays reflected back from its poſterior ſurface. Theſe diſtances will be preciſely equal. Now it is of the utmoſt importance in the conſtruction of an object-glaſs which is to correct the ſpherical aberration, that the forms be preciſely ſuch as are required by our formulæ.

In this caſe of a lens equally convex on both ſides $\frac{1}{a}$ is $= -\frac{1}{b}, = \frac{1}{2}$. Subſtitute this value for $\frac{1}{a}$ in the general equation $\frac{A}{a^2} - \frac{B}{a} - \frac{C}{a'^2} - \frac{D}{a'} + E = 0$, and then $\frac{A}{a^2} = \frac{A}{4}$; $\frac{B}{a}$ becomes $\frac{B}{2}$. Now change all the ſigns, and we have $\frac{C}{a'^2} + \frac{D}{a'} - E - \frac{A}{4} + \frac{B}{2} = 0$, by which we are to find a'. This in numbers is $\frac{1{,}360}{a'^2} - \frac{0{,}526}{a'} - 0{,}6044 = 0$. Then $s = \frac{-0{,}526}{1{,}360}, = 0{,}3867$, and $t = \frac{-0{,}6044}{1{,}360}, = -0{,}4444$. Then $-\frac{1}{2} s = 0{,}1933$; $\frac{1}{4} s^2 = 0{,}0374$; and $\sqrt{\frac{1}{4} S^2 - t} = \pm 0{,}6941$; ſo that $\frac{1}{a'} = 0{,}1933 \pm 0{,}6941$. This gives two real roots, viz. 0,8874, and $-$ 0,5008. If we take the firſt, we ſhall have a convex anterior ſurface for the flint-glaſs, and conſequently a very deep concave for the poſterior ſurface. We therefore take the ſecond or negative root $-$ 0,5008.

We find $\frac{1}{b'}$, as before, by the equation $\frac{1}{b'} = \frac{1}{a'} + u, =$ 0,1046, which will give a large value of b'.

We had $\frac{1}{a} = \frac{1}{2}$

and $\frac{1}{b} = -\frac{1}{2}$

and $\frac{1}{P}$ is the ſame as in the former caſe, viz. 0,1603,

Having all theſe reciprocals, we may find a, b, a'', b', and P; and then dividing them by P, we obtain finally

$$\begin{aligned} a &= 0{,}3206 \\ b &= -0{,}3206 \\ a' &= -0{,}3201 \\ b' &= 1{,}533 \\ P &= 1, \end{aligned}$$

By comparing this object-glaſs with the former, we may remark, that diminiſhing a a little increaſes b, and in this reſpect improves the lens. It indeed has diminiſhed b', but this being already conſiderable, no inconvenience attends this diminution. But we learn, at the ſame time, that the advantage *muſt* be very ſmall; for we cannot diminiſh a much more, without making it as ſmall as the ſmalleſt radius of the object-glaſs. This proportion is therefore very near the maximum, or beſt poſſible; and we know that in ſuch caſes, even conſiderable changes in the radii will make but ſmall changes in the reſult: for theſe reaſons we are diſpoſed to give a ſtrong preference to the firſt conſtruction, on account of the other advantages which we ſhowed to attend it.

As another example, we may take a caſe which is very nearly the general practice of the London artiſts. The radius of curvature for the anterior ſurface of the convex crown-glaſs is $\frac{5}{6}$ths of the radius of the poſterior ſurface, ſo that $b = \frac{5}{6}$. This being introduced into the determinate equation, gives

$$\begin{aligned} a &= 0{,}2938 & a' &= -0{,}3443 \\ b &= -0{,}3526 & b &= 1{,}1474 \end{aligned}$$

As another condition, we may ſuppoſe that the ſecond or flint-glaſs is of a determined form.

This caſe is ſolved much in the ſame manner as the former. Taking b to repreſent the ratio of a' and b', we have $\frac{1}{a'} = \frac{1}{1-b}$. This value being ſubſtituted in the general equation $\frac{A}{a^2} - \frac{B}{a} - \frac{C}{a'^2} - \frac{D}{a} + E = 0$, gives us $\frac{A}{a^2} - \frac{B}{a} + E - \frac{C}{(1-b)^2} - \frac{D}{1-b} = 0$. This gives for the final equation $x^2 + s x + t = 0$, $s = \frac{B}{A}$, and $t = \frac{1}{A} \times \left(E - \frac{C}{(1-b)^2} - \frac{D}{1-b}\right)$ and $\frac{1}{a} = -\frac{1}{2} s \pm \sqrt{\frac{1}{4} s^2 - t}$.

We might here take the particular caſe of the flint-glaſs being equally concave on both ſides. Then, becauſe $\frac{1}{u'} = -u$, and in the caſe of equal concavities $\frac{2}{a'} = \frac{1}{n'}, = -u$, it is ſufficient to put $-\frac{1}{2} u$ for $\frac{1}{a'}$. This being done, the equation becomes $\frac{A}{a} - \frac{B}{a} \frac{C u^2}{4} + \frac{D u}{2} + E = 0$. This gives $s = \frac{B}{A}$, and $t = \frac{1}{A} \times \left(\frac{4 D u - 2 C u^2}{8} + E\right)$.

We imagine that theſe caſes are ſufficient for ſhowing the management of the general equation; and the example of the numerical ſolution of the firſt caſe affords inſtances of the only niceties which occur in the proceſs, viz. the proper employment of the poſitive and negative quantities.

We have oftener than once obſerved, that the formula is not perfectly accurate, and that in very large apertures errors will remain. It is proper therefore, when we have obtained the form of a compound object glaſs, to calculate trigonometrically the progreſs of the light through it; and if we find a conſiderable abberration, either chromatic or ſpherical, remaining, we muſt make ſuch changes in the curvatures as will correct them. We have done this for the firſt example; and we find, that if the focal diſtance of the compound object-glaſs be 100 inches, there remains of the ſpherical aberration nearly $\frac{1}{60}$ of an inch, and the aberration of colour is over corrected above $\frac{1}{9}$th of an inch. The firſt aberration has been diminiſhed about 6 times, and the other about 30 times. Both of the remaining errors will be diminiſhed by increaſing the radius of the inner ſurfaces. This will diminiſh the aberration of the crown-glaſs, and will diminiſh the diſperſion of the flint more than that of the crown. But indeed the remaining error is hardly worth our notice.

It is evident to any perſon converſant with optical diſcuſſions, that we ſhall improve the correction of the ſpherical aberration by diminiſhing the refractions. If we employ two lenſes for producing the convergency of the rays to a real focus, we ſhall reduce the aberration to $\frac{1}{4}$th. Therefore a better achromatic glaſs will be formed of three lenſes, two of which are convex and of crown-glaſs. The refraction being thus divided between them, the aberrations are leſſened. There is no occaſion to employ two concave lenſes of flint-glaſs; there is even an advantage in uſing one. The aberration being conſiderable, leſs of it will ſerve for correcting the aberration of the crown-glaſs, and therefore ſuch a form may be ſelected as has little aberration. Some light is indeed loſt by theſe two additional ſurfaces: but this is much more than compenſated by the greater apertures which we can venture to give when the curvature of the ſurface is ſo much diminiſhed. We proceed therefore to

The Conſtruction of a Triple Achromatic Object-glaſs

It is plain that there are more conditions to be aſſumed before we can render this a determinate problem, and that the inveſtigation muſt be more intricate. At the ſame time, it muſt give us a much greater variety of conſtructions, in conſequence of our having more conditions neceſſary for giving the equation this determinate form. Our limits will not allow us to give a full account of all that may be done in this method. We ſhall therefore content ourſelves with giving one caſe, which will ſufficiently point out the method of proceeding. We ſhall then give the reſults in ſome other eligible caſes, as rules to artiſts by which they may conſtruct ſuch glaſſes.

Let the firſt and ſecond glaſſes be of equal curvatures on both ſides; the firſt being a double convex of crown-glaſs, and the ſecond a double concave of flint-glaſs.

Still making n the unit of our calculus, we have in the firſt place $a = -b, = -a', = b'$. Therefore $\frac{1}{a'} - \frac{1}{b'} = -\left(\frac{1}{a} - \frac{1}{b}\right)$, or $\frac{1}{n'} = -\frac{1}{n} = -1$. Therefore the equation $\frac{dm}{n} + \frac{dm'}{n'} + \frac{dm''}{n'} = 0$ becomes $u - 1 + \frac{u}{n''} = 0$, or $\frac{1}{n''} = \frac{1}{u} - 1$. Let us call this value u'.

We have $\frac{1}{p} = m - 1$; $\frac{1}{p'} = -(m' - 1)$; $\frac{1}{p''} = u'(m-1)$; $\frac{1}{P} = \frac{1}{p} + \frac{1}{p'} + \frac{1}{p''}, = m - m' + u'(m-1)$.

And if we make $m' - m = C'$, we ſhall have $\frac{1}{P} = -C, + u'(m-1)$. Alſo $\frac{1}{r'} = m - 1$; $\frac{1}{r''} = m - 1 - (m'-1), = m - m', = -C'$.

The equality of the two curvatures of each lens gives $\frac{1}{a} = \frac{1}{2n}$. Therefore $\frac{1}{a} = -\frac{1}{b}, = -\frac{1}{a'}, = \frac{1}{b'}, = \frac{1}{2}$; and $\frac{1}{b''} = \frac{1}{a''} - \frac{1}{n''}, = \frac{1}{a''} - u'$.

Subſtituting theſe values in the equation (p. 351. col. 2. par. 5.), we obtain the three formulæ,

$$1. \quad cm^2 - \tfrac{1}{2}c(2m+1) + \frac{c(m+2)}{4m}$$

$$2. -m'2 + \tfrac{1}{2}(2m'+1) - \frac{m'+2}{4m'} + (3m'+1)(m-1) - \frac{2(m'+1)(m-1)}{m'} - \frac{(3m'+2)(m-1)^2}{m'}$$

$$3. \; cu'3m^2 - \frac{cu'^2(2m+1)}{a''} + \frac{cu'(m+2)}{ma''^2} - cc'u'^2(3m+1) + \frac{4cc'u'(m+1)}{ma''} + \frac{cc'^2u'(3m+2)}{m} = 0.$$

Now arrange theſe quantities according as they are coefficients of $\frac{1}{a''^2}$ and of $\frac{1}{a''}$, or independent quantities. Let the coefficient of $\frac{1}{a''^2}$ be A, that of $\frac{1}{a''}$ be B, and the independent quantity be C, we have

$$A = \frac{cu'(m+2)}{m}; \; B = cu'^2(2m+1) - \frac{4cc'u'(m+1)}{m},$$

and

$$C = cm^2 + \frac{c(m+2)}{4m} + \tfrac{1}{2}(2m'+1) + (3m'+1)(m-1) + cu'^3m^2 + \frac{cc'^2u'(3m+2)}{m} - \tfrac{1}{2}c(2m+1) - m'^2 - \frac{m'+2}{4m} - \frac{2(m'+1)(m-1)}{m'} - \frac{(3m'+2)(m-1)^2}{m'} - cc'u'^2(3m+1).$$

Our equation now becomes $\frac{A}{a''^2} - \frac{B}{a''} + C = 0$.

This reduced to numbers, by computing the values of the coefficients, is $\frac{1,312}{a''^2} - \frac{1,207}{a''} - 0,3257 = 0$.

This, divided by 1,312, gives $s = -0,92$; and $t = -0,2482$; $-\frac{1}{2}s = 0,46$; $\frac{1}{4}s^2 = 0,2116$; and $\sqrt{\frac{1}{4}s^2 - t} = \pm 0,6781$.

And, finally, $\frac{1}{a''} = 0,46 \pm 0,6781$.

This has two roots, viz. 0,2181 and − 1,1381. The laſt would give a very ſmall radius, and is therefore rejected.

Now, proceeding with this value of $\frac{1}{a''}$ and the $\frac{1}{n''}$, we get the other radius b'', and then, by means of u', we get the other radius which is common to the four ſurfaces. Then, by $\frac{1}{P} = \frac{1}{p''} - c'$, we get the value of P.

The radii being all on the ſcale of which n is the unit, they muſt be divided by P to obtain their value on the ſcale which has P for its unit. This will give us

$$a = -b, = -a', = b', = 0{,}530$$
$$a'' = 1{,}215$$
$$b'' = -0{,}3046$$
$$P = 1.$$

This is not a very good form, becauſe the laſt ſurface has too great curvature.

We thought it worth while to compute the curvatures for a caſe where the internal ſurfaces of the lenſes coincide, in order to obtain the advantages mentioned on a former occaſion. The form is as follows:

The middle lens is a double concave of flint-glaſs; the laſt lens is of crown-glaſs, and has equal curvatures on both ſides. The following table contains the dimenſions of the glaſſes for a variety of focal diſtances. The firſt column contains the focal diſtances in inches; the ſecond contains the radii of the firſt ſurface in inches; the third contains the radii of the poſterior ſurface of the firſt lens and anterior ſurface of the ſecond; and the fourth column has the radii of the three remaining ſurfaces.

P	a	b, a'	b', a'', b''
12	9,25	6,17	12,75
24	18,33	12,25	25,5
36	27,33	18,25	38,17
48	36,42	24,33	50,92
60	45,42	30,33	63,58
72	54,5	36,42	76,33
84	63,5	42,5	89,
96	72,6	48,5	101,75
108	81,7	54,58	114,42
120	90,7	60,58	127,17

We have had an opportunity of trying glaſſes of this conſtruction, and found them equal to any of the ſame length, although executed by an artiſt by no means excellent in his profeſſion as a glaſs-grinder. This very circumſtance gave us the opportunity of ſeeing the good effects of interpoſing a tranſparent ſubſtance between the glaſſes. We put ſome clear turpentine varniſh between them, which completely prevented all reflection from the internal ſurfaces. Accordingly theſe teleſcopes were ſurpriſingly bright; and although the roughneſs left by the firſt grinding was very perceptible by the naked eye before the glaſſes were put together, yet when joined in this manner it entirely diſappeared, even when the glaſſes were viewed with a deep magnifier.

The aperture of an object glaſs of this conſtruction of 30 inches focal diſtance was $3\frac{1}{5}$th inches, which is conſiderably more than any of Mr Dollond's that we have ſeen.

If we ſhould think it of advantage to make all the three lenſes iſoſceles, that is, equally curved on both ſurfaces, the general equation will give the following radii:

$$a = +0{,}639 \qquad a' = -0{,}5285 \qquad a'' = +0{,}6413$$
$$b = -0{,}639 \qquad b' = +0{,}5285 \qquad b'' = -0{,}6413$$

This ſeems a good form, having large radii.

Should we chooſe to have the two crown-glaſs lenſes iſoſceles and equal, we muſt make

$$a = +0{,}6412 \qquad a' = -0{,}5227 \qquad a'' = +0{,}6412$$
$$b = -0{,}6412 \qquad b' = +0{,}5367 \qquad b'' = -0{,}6412$$

This form hardly differs from the laſt.

Our readers will recollect that all theſe forms proceed on certain meaſures of the refractive and diſperſive powers of the ſubſtances employed, which are expreſſed by m, m', $d\,m$, and $d\,m'$: and we may be aſſured that the formulæ are ſufficiently exact, by the compariſon (which we have made in one of the caſes) of the reſult of the formula and the trigonometrical calculation of the progreſs of the rays. The error was but $\frac{1}{60}$th of the whole, ten times leſs than another error, which unavoidably remains, and will be conſidered preſently. Theſe meaſures of refraction and diſperſion were carefully taken; but there is great diverſity, particularly in the flint-glaſs. We are well informed that the manufacture of this article has conſiderably changed of late years, and that it is in general leſs refractive and leſs diſperſive than formerly. This muſt evidently make a change in the forms of achromatic glaſſes. The proportion of the focal diſtance of the crown-glaſſes to that of the flint muſt be increaſed, and this will occaſion a change in the curvatures, which ſhall correct the ſpherical aberration. We examined with great care a parcel of flint-glaſs which an artiſt of Edinburgh got lately for the purpoſe of making achromatic object-glaſſes, and alſo ſome very white crown-glaſs made in Leith; and we obtained the following meaſures:

$$m = 1{,}529 \qquad \frac{d\,m}{d\,m'} = \frac{142}{219} = 0{,}64841.$$
$$m' = 1{,}578$$

We computed ſome forms for triple object-glaſſes made of theſe glaſſes, which we ſhall ſubjoin as a ſpecimen of the variations which this change of data will occaſion.

If all the three lenſes are made iſoſceles, we have

$$a = +0{,}796 \qquad a' = -0{,}474 \qquad a'' = +0{,}502$$
$$b = -0{,}796 \qquad b' = +0{,}474 \qquad b'' = -0{,}502$$

Or

$$a = 0{,}504 \qquad a' = -0{,}475 \qquad a'' = +0{,}793$$
$$b = -0{,}504 \qquad b' = 0{,}475 \qquad b'' = -0{,}793$$

If the middle lens be iſoſceles, the two crown-glaſs lenſes may be made of the ſame form and focal diſtance, and placed the ſame way. This will give us

$$a = +0{,}705 \qquad a' = -0{,}475 \qquad a'' = +0{,}705$$
$$b = -0{,}547 \qquad b' = +0{,}475 \qquad b'' = -0{,}547$$

N. B. This conſtruction allows a much better form, if the meaſures of refraction and diſperſion are the ſame that we uſed formerly. For we ſhall have

$$a = +0{,}628 \qquad a' = -0{,}579 \qquad a'' = +0{,}628$$
$$b = -0{,}749 \qquad b' = +0{,}579 \qquad b'' = -0{,}749$$

And this is pretty near the practice of the London opticians.

We may here obſerve, upon the whole, that an amateur has little chance of ſucceeding in theſe attemps. The diverſity of glaſſes, and the uncertainty of the workman's producing the very curvatures which he intends, is ſo great, that the object-glaſs turns out different from our expectation. The artiſt who makes great numbers acquires a pretty certain gueſs at the remaining error; and having many lenſes, intended to be of one form, but unavoidably differing a little from it, he tries ſeveral of them with the other two, and finding one better than the reſt, he makes uſe of it to complete the ſet.

The great difficulty in the conſtruction is to find the exact proportion of the diſperſive powers of the crown and flint glaſs. The crown is pretty conſtant; but there is hardly two pots of flint-glaſs which have the ſame diſperſive power. Even if conſtant, it is difficult to meaſure it accurately: and an error in this greatly affects the inſtrument, becauſe the focal diſtances of the lenſes muſt be nearly as their diſperſive powers. The method of examining this circumſtance, which we found moſt accurate, was as follows:

The ſun's light, or that of a brilliant lamp, paſſed through a ſmall hole in a board, and fell on another board pierced alſo with a ſmall hole. Behind this was placed a fine priſm A (fig. 10.), which formed a ſpectrum ROV on a ſcreen pierced with a ſmall hole. Behind this was placed a priſm B of the ſubſtance under examination. The ray which was refracted by it fell on the wall at D, and the diſtance of its illumination from that point to C, on which an unrefracted ray would have fallen, was carefully meaſured. This ſhowed the refraction of that colour. Then, in order that we might be certain that we always compared the refraction of the ſame preciſe colour by the different priſms placed at B, we marked the preciſe poſition of the priſm A when the ray of a particular colour fell on the priſm B. This was done by an index AG attached to A, and turning with it, when we cauſed the different colours of the ſpectrum formed by A to fall on B. Having examined one priſm B with reſpect to all the colours in the ſpectrum formed by A, we put another B in its place. Then bringing A to all its former poſitions ſucceſſively, by means of a graduated arch HGK, we were certain that when the index was at the ſame diviſion of the arch it was the very ray which had been made to paſs through the firſt priſm B in a former experiment. We did not ſolicitouſly endeavour to find the very extreme red and violet rays; becauſe, although we did not learn the whole diſperſions of the two priſms, we learned their proportions, which is the circumſtance wanted in the conſtruction of achromatic glaſſes. It is in vain to attempt this by meaſuring the ſpectrums themſelves; for we cannot be certain of ſelecting the very ſame colours for the compariſon, becauſe they ſucceed in an inſenſible gradation.

The intelligent reader will readily obſerve, that we have hitherto proceeded on the ſuppoſition, that when, by means of contrary refractions, we have united the extreme red and violet rays, we have alſo united all the others. But this is quite gratuitous. Sir Iſaac Newton would, however, have made the ſame ſuppoſition; for he imagined that the different colours divided the ſpectrum formed by all ſubſtances in the proportions of a muſical canon. This is a miſtake. When a ſpectrum is formed by a priſm of crown-glaſs, and another of preciſely the ſame length is formed by the ſide of it by a priſm of flint-glaſs, the confine between the green and blue will be found preciſely in the middle of the firſt ſpectrum, but in the ſecond it will be conſiderably nearer to the red extremity. In ſhort, different ſubſtances do not diſperſe the colours in the ſame proportion.

The effect of this irrationality (ſo to call it) of diſperſion, will appear plainly, we hope, in the following manner: Let A (fig. 9. A) repreſent a ſpot of white ſolar light falling perpendicularly on a wall. Suppoſe a priſm of common glaſs placed behind the hole through which the light is admitted, with its refracting angle facing the left hand. It will refract the beam of light to the right, and will at the ſame time diſperſe this heterogeneous light into its component rays, carrying the extreme red ray from A to R, the extreme orange from A to O, the extreme yellow from A to Y, &c. and will form the uſual priſmatic ſpectrum ROYGBPVC. If the whole length RC be divided into 1000 parts, we ſhall have (when the whole refraction AR is ſmall) RO very nearly 125, RY=200, RG=333, RB=500, RP=667, RV=778, and RC=1000; this being the proportion obſerved in the difference of the ſines of refraction by Sir Iſaac Newton.

Perhaps a refracting medium may be found ſuch, that a priſm made of it would refract the white light from A′, in the upper line of this figure, in ſuch a manner that a ſpectrum R′O′Y′G′B′P′V′C′ ſhall be formed at the ſame diſtance from A′, and of the ſame length, but divided in a different proportion. We do not know that ſuch a medium has been found; but we know that a priſm of flint-glaſs has its refractive and diſperſive powers ſo conſtituted, that if A′H′ be taken about $\frac{1}{3}$d of AR, a ſpot of white light, formed by rays falling perpendicularly at H′, will be ſo refracted and diſperſed, that the extreme red ray will be carried from H′ to R′, and the extreme violet from H′ to C′, and the intermediate colours to intermediate points, forming a ſpectrum reſembling the other, but having the colours more conſtipated towards R′, and more dilated towards C; ſo that the ray which the common glaſs carried to the middle point B of the ſpectrum RC is now in a point B′ of the ſpectrum R′C′, conſiderably nearer to R′.

Dr Blair has found, on the other hand, that certain fluids, particularly ſuch as contain the muriatic acid, when formed into a priſm, will refract the light from H″ (in the lower line) ſo as to form a ſpectrum R″C″ equal to RC, and as far removed from A″ as RC is from A, but having the colours more dilated toward R″, and more conſtipated toward C, than is obſerved in RC; ſo that the ray which was carried by the priſm of common glaſs to the middle point B is carried to a point B″, conſiderably nearer to C″.

Let us now ſuppoſe that, inſtead of a white ſpot at A, we have a priſmatic ſpectrum AB (fig. 9. B), and that the priſm of common glaſs is applied as before, immediately behind the priſm which forms the ſpectrum AB. We know that this will be refracted ſidewiſe, and will make a ſpectrum ROYGBPC, inclined to the plane of refraction in an angle of 45°; ſo that drawing the perpendicular RC′, we have RC′=C′C.

We alſo know that the priſm of flint-glaſs would refract the ſpectrum formed by the firſt priſm on EHF, in ſuch a manner that the red ray will go to R, the violet to C, and the intermediate rays to points *o*, *y*, *g*, *b*, *p*, *v*, ſo ſituated that O′ *o* is = R O′ of the other figure; Y *y* is = R′ Y′ of that figure, G *g* = R′G′, &c. Theſe points muſt therefore lie in a curve R *o y g b p v* C, which is convex toward the axis R′C′.

In like manner we may be aſſured that Dr Blair's fluid will form a ſpectrum R *o′y′g′b′p′*, *v′* C, concave toward R′C.

Let it be obſerved by the way, that this is a very good method for diſcovering whether a medium diſperſes the light in the ſame proportion with the priſm which is employed for forming the firſt ſpectrum AB or EF. It diſperſes in the ſame or in a different proportion, according as the oblique ſpectrum is ſtraight or crooked; and the exact proportion correſponding to each colour is had by meaſuring the ordinates of the curves R *b* C or R *b′* C.

Having formed the oblique ſpectrum RBC by a priſm of common glaſs, we know that an equal priſm of the ſame glaſs, placed in a contrary poſition, will bring back all the rays from the ſpectrum RBC to the ſpectrum AB, laying each colour on its former place.

In like manner, having formed the oblique ſpectrum R *b* C by a priſm of flint-glaſs, we know that another priſm of flint-glaſs, placed in the oppoſite direction, will bring all the rays back to the ſpectrum EHF.

But having formed the oblique ſpectrum RBC by a priſm of common glaſs, if we place the flint-glaſs priſm in the contrary poſition, it will bring the colour R back to E, and the colour C to F; but it will not bring the colour B to H, but to a point *b*, ſuch that B *b* is equal to *b* H, and *b* B to *b* H. In like manner, the other colours will not be brought back to the ſtraight line EHF, but to a curve E *b* F, forming a crooked ſpectrum.

In like manner, the fluids diſcovered by Dr Blair, when employed to bring back the oblique ſpectrum RBC formed by common glaſs, will bring its extremities back to E and F, and form the crooked ſpectrum E *b′* F lying beyond EHF.

This experiment evidently gives us another method for examining the proportionality of the diſperſion of different ſubſtances.

Having, by common glaſs, brought back the oblique ſpectrum formed by common glaſs to its natural place AB, ſuppoſe the original ſpectrum at AB to contract gradually (as Newton has made it do by means of a lens), it is plain that the oblique ſpectrum will alſo contract, and ſo will the ſecond ſpectrum at AB; and it will at laſt coaleſce into a white ſpot. The effect will be equivalent to a gradual compreſſion of the whole figure, by which the parallel lines AR and BC gradually approach, and at laſt unite.

In like manner, when the oblique ſpectrum formed by flint-glaſs is brought back to EHF by a flint-glaſs priſm, and the figure compreſſed in the ſame gradual manner, all the colours will coaleſce into a white ſpot.

But when flint-glaſs is employed to bring back the oblique ſpectrum formed by common glaſs, it forms the crooked ſpectrum E *b* F. Now let the figure be compreſſed. The curve E *b* F will be doubled down on the line H *b*, and there will be formed a compound ſpectrum H *b*, quite unlike the common ſpectrum, being purple or claret coloured at H by the mixture of the extreme red and violet, and green edged with blue at *b* by the mixture of the green and blue. The fluid priſms would in like manner form a ſpectrum of the ſame kind on the other ſide of H.

This is preciſely what is obſerved in achromatic object-glaſſes made of crown-glaſs and flint: for the refraction from A to R correſponds to the refraction of the convex crown-glaſs; and the contrary refraction from R to E correſponds to the contrary refraction of the concave flint-glaſs, which ſtill leaves a part of the firſt refraction, producing a convergence to the axis of the teleſcope. It is found to give a purple or wine coloured focus, and within this a green one, and between theſe an imperfect white. Dr Blair found, that when the eye-glaſs was drawn out beyond its proper diſtance, a ſtar was ſurrounded by a green fringe, by the green end of the ſpectrum, which croſſed each other within the focus; and when the eye-glaſs was too near the object-glaſs, the ſtar had a wine coloured fringe. The green rays were ultimately moſt refracted. *N. B.* We ſhould expect the fringe to be of a blue colour rather than a green. But this is eaſily explained: The extreme violet rays are very faint, ſo as hardly to be ſenſible; therefore when a compound glaſs is made as achromatic as poſſible to our ſenſes, in all probability (nay certainly) theſe almoſt inſenſible violet rays are left out, and perhaps the extreme colours which are united are the red and the middle violet rays. This makes the green to be the mean ray, and therefore the moſt outſtanding when the diſperſions are not proportional.

Dr Blair very properly calls theſe ſpectrums, H *b* and H *b′*, *ſecondary ſpectrums*, and ſeems to think that he is the firſt who has taken notice of them. But Mr Clairault was too accurate a mathematician, and too careful an obſerver, not to be aware of a circumſtance which was of primary conſequence to the whole inquiry. He could not but obſerve that the ſucceſs reſted on this very particular, and that the proportionality of diſperſion was indiſpenſably neceſſary.

This ſubject was therefore touched on by Clairault; and *fully* diſcuſſed by Boſcovich, firſt in his Diſſertations publiſhed at Vienna in 1759; then in the *Comment. Bononienſis*; and, laſtly, in his *Opuſcula*, publiſhed in 1785. Dr Blair, in his ingenious Diſſertation on Achromatic Glaſſes, read to the Royal Society of Edinburgh in 1793, ſeems not to have known of the labours of theſe writers; ſpeaks of it as a new diſcovery; and exhibits ſome of the conſequences of this principle in a ſingular point of view, as ſomething very paradoxical and inconſiſtent with the uſually received notions on theſe ſubjects. But they are by no means ſo. We are, however, much indebted to his ingenious reſearches, and his ſucceſsful endeavours to find ſome remedy for this imperfection of achromatic glaſſes. Some of his contrivances are exceedingly ingenious; but had the Doctor conſulted theſe writers, he would have ſaved himſelf a good deal of trouble.

Boſcovich ſhows how to unite the two extremes with the moſt outſtanding colour of the ſecondary ſpectrum, by means of a third ſubſtance. When we have done this, the aberration occaſioned by the ſecondary ſpectrums muſt be prodigiouſly diminiſhed; for it is evidently equivalent to the union of the points H and *b* of our figure. Whatever cauſe produces this muſt diminiſh the curvature of the arches E *b* and *b* F: but even if theſe curvatures were not diminiſhed, their greateſt ordinates cannot exceed ¼th of H *b*; and we may ſay, without heſitation, that by uniting the mean or moſt outſtanding ray with the two extremes, the remaining diſperſion will be as much leſs than the uncorrected colour of Dollond's achromatic glaſs, as this is leſs than four times the diſperſion of a common object-glaſs. It muſt therefore be altogether inſenſible.

Boſcovich aſſerts, that it is not poſſible to unite more than two colours by the oppoſite refraction of two ſubſtances, which do not diſperſe the light in the ſame proportions. Dr Blair makes light of this aſſertion, as he finds it made in general terms in the vague and paltry extract made by Prieſtley from Boſcovich in his Eſſay on the Hiſtory of Optics; but had he read this author in his own diſſertations, he would have ſeen that he was perfectly right. Dr Blair, however, has hit on a very ingenious and effectual method of producing this union of three colours. In the ſame way as we correct the diſperſion of a concave lens of crown-glaſs, by the oppoſite diſperſion of a concave lens of flint-glaſs, we may correct the ſecondary diſperſion of an achromatic convex lens by the oppoſite ſecondary diſperſion of an achromatic concave lens. But the intelligent reader will obſerve, that this union does not contradict the aſſertion of Boſcovich, becauſe it is *neceſſarily* produced by means of three refracting ſubſtances.

The moſt eſſential ſervice which the public has received at the hands of Dr Blair is the diſcovery of fluid mediums of a proper diſperſive power. By compoſing the lenſes of ſuch ſubſtances, we are at once freed from the irregularities in the refraction and diſperſion of flint-glaſs, which the chemiſts have not been able to free it from. In whatever way this glaſs is made, it conſiſts of parts which differ both in refractive and diſperſive power; and when taken up from the pot, theſe parts mix in threads, which may be diſſeminated through the maſs in any degree of fineneſs. But they ſtill retain their properties; and when a piece of flint-glaſs has been formed into a lens, the eye, placed in its focus, ſees the whole ſurface occupied by gliſtening threads or broader veins running acroſs it. Great rewards have been offered for removing this defect, but hitherto to no purpoſe. We beg leave to propoſe the following method: Let the glaſs be reduced to powder, and then melted with a great proportion of alkaline ſalt, ſo as to make a liquor ſilicum. When precipitated from this by an acid, it muſt be in a ſtate of very uniform compoſition. If again melted into glaſs we ſhould hope that it would be free from this defect; if not, the caſe ſeems to be deſperate.

But by uſing a fluid medium, Dr Blair was freed from all this embarraſſment; and he acquired another immenſe advantage, that of adjuſting at pleaſure both the refractive and diſperſive powers of his lenſes. In ſolid lenſes, we do not know whether we have taken the curvatures ſuited to the refractions till our glaſs is finiſhed; and if we have miſtaken the proportions, all our labour is loſt. But when fluids are uſed, it is enough that we know nearly the refractions. We ſuit our focal diſtances to theſe, and then ſelect our curvatures, ſo as to remove the aberration of figure, preſerving the focal diſtances. Thus, by properly tempering the fluid mediums, we bring the lens to agree preciſely with the theory, perfectly achromatic, and the aberration of figure as much corrected as is poſſible.

Dr Blair examined the refractive and diſperſive powers of a great variety of ſubſtances, and found great varieties in their actions on the different colours. This is indeed what every well informed naturaliſt would expect. There is no doubt now among naturaliſts about the mechanical connection of the phenomena of nature; and all are agreed that the chemical actions of the particles of matter are perfectly like in kind to the action of gravitating bodies; that all theſe phenomena are the effects of forces like thoſe which we call attractions and repulſions, and which we obſerve in magnets and electrified bodies; that light is refracted by forces of the ſame kind, but differing chiefly in the ſmall extent of their ſphere of activity. One who views things in this way will expect, that as the actions of the ſame acid for the different alkalis are different in degree, and as the different acids have alſo different actions on the ſame alkali, in like manner different ſubſtances differ in their general refractive powers, and alſo in the proportion of their action on the different colours. Nothing is more unlikely therefore than the proportional diſperſion of the different colours by different ſubſtances; and it is ſurpriſing that this inquiry has been ſo long delayed. It is hoped that Dr Blair will oblige the public with an account of the experiments which he has made. This will enable others to cooperate in the improvement of achromatic glaſſes. We cannot derive much knowledge from what he has already publiſhed, becauſe it was chiefly with the intention of giving a popular, though not an accurate, view of the ſubject. The conſtructions which are there mentioned are not thoſe which he found moſt effectual, but thoſe which would be moſt eaſily underſtood, or demonſtrated by the ſlight theory which is contained in the diſſertation; beſides, the manner of expreſſing the difference of refrangibility, perhaps choſen for its paradoxical appearance, does not give us a clear notion of the characteriſtic differences of the ſubſtances examined. Thoſe rays which are ultimately moſt deflected from their direction, are ſaid to have become the moſt refrangible by the combination of different ſubſtances, although, in all the particular refractions by which this effect is produced, they are leſs refracted than the violet light. We can juſt gather this much, that common glaſs diſperſes the rays in ſuch a manner, that the ray which is in the confine of the green and blue occupies the middle of the priſmatic ſpectrum; but in glaſſes, and many other ſubſtances, which are more diſperſive, this ray is nearer to the ruddy extremity of the ſpectrum. While therefore the ſtraight line RC' (fig. 9. B) terminates the ordinates Oo', YY', Gg', &c. which repreſent the diſperſion of common glaſs, the ordinates which expreſs the diſperſions of theſe ſubſtances are terminated by a curve paſſing through R and C', but lying below the line RC'. When therefore parallel heterogeneous light is made to converge to the axis of a convex lens of common glaſs, as happens at F in fig. 5. C, the light is diſperſed, and the violet rays have a ſhorter focal diſtance. If we now apply a concave lens of greater diſperſive power, the red and violet rays are brought to one focus F'; but the green rays, not being ſo much refracted away from F, are left behind at φ, and have now a ſhorter focal diſtance. But Dr Blair afterwards found that this was not the caſe with the muriatic acid, and ſome ſolutions in it. He found that the ray which common glaſs cauſed to occupy the middle of the ſpectrum was much nearer to the blue extremity when refracted by theſe fluids. Therefore a concave lens formed of ſuch fluids which united the red and violet rays in F', refracted the green rays to f'.

Having obſerved this, it was an obvious conjecture, that a mixture of ſome of theſe fluids might produce a medium, whoſe action on the intermediate rays ſhould have the ſame proportion that is obſerved on common glaſs; or that two of them might be found which formed ſpectra ſimilarly divided, and yet differing ſufficiently in diſperſive power to enable us to deſtroy the diſperſion by contrary refractions, without deſtroying the whole refraction. Dr Blair accordingly found a mixture of ſolutions of ammoniacal and mercurial ſalts, and alſo ſome other ſubſtances, which produced diſperſions proportional to that of glaſs, with reſpect to the different colours.

And thus has the reſult of this intricate and laborious inveſtigation correſponded to his utmoſt wiſhes. He has produced achromatic teleſcopes which ſeem as perfect as the thing will admit of; for he has been able to give them ſuch apertures, that the *incorrigible* aberration ariſing from the ſpherical ſurfaces becomes a ſenſible quantity, and precludes farther amplification by the eye-glaſſes. We have examined one of his teleſcopes: The focal diſtance of the object-glaſs did not exceed 17 inches, and the aperture was fully 3½ inches. We viewed ſome ſingle and double ſtars and ſome common objects with this teleſcope; and found, that in magnifying power, brightneſs, and diſtinctneſs, it was manifeſtly ſuperior to one of Mr Dollond's of 42 inches focal length. It alſo gave us an opportunity of admiring the dexterity of the London artiſts, who could work the glaſſes with ſuch accuracy. We had moſt diſtinct viſion of a ſtar when uſing an erecting eye-piece, which made this teleſcope magnify more than a hundred times; and we found the field of viſion as uniformly diſtinct as with Dollond's 42 inch teleſcope magnifying 46 times. The intelligent reader muſt admire the nice figuring and centering of the very deep eye-glaſſes which are neceſſary for this amplification.

It is to be hoped that Dr Blair will extend his views to *glaſſes* of different compoſitions, and thus give us object-glaſſes which are ſolid; for thoſe compoſed of fluids have inconveniences which will hinder them from coming into general uſe, and will confine them to the muſeums of philoſophers. We imagine that antimonial glaſſes bid fair to anſwer this purpoſe, if they could be made free of colour, ſo as to tranſmit enough of light. We recommend this diſſertation to the careful peruſal of our readers. Thoſe who have not made themſelves much acquainted with the delicate and abſtruſe theory of aberrations, will find it exhibited in ſuch a popular form as will enable them to underſtand its general aim; and the well-informed reader will find many curious indications of inquiries and diſcoveries yet to be made.

We now proceed to conſider the eye-glaſſes or glaſſes of teleſcopes. The proper conſtruction of an eye-piece is not leſs eſſential than that of the object-glaſs. But our limits will not allow us to treat this ſubject in the ſame detail. We have already extended this article to a great length, becauſe we do not know of any performance in the Engliſh language which will enable our readers to underſtand the conſtruction of achromatic teleſcopes; an invention which has completed the diſcoveries of the illuſtrious Newton, and reflects honour on his country. Our readers will find abundant information in Dr Smith's Optics concerning the eye-glaſſes, chiefly deduced from Huyghen's fine theory of aberration (A). At the ſame time, we muſt again pay Mr Dollond

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(A) While we thus repeatedly ſpeak of the theory of ſpherical aberration as coming from Mr Huyghens, we muſt not omit

Dollond the merited compliment of ſaying, that he was the firſt who made any ſcientific application of this theory to the compound eye-piece for erecting the object. His eye-pieces of five and ſix glaſſes are very ingenious reduplications of Huyghens's eye-piece of two glaſſes, and would probably have ſuperſeded all others, had not his diſcovery of achromatic object-glaſſes cauſed opticians to conſider the chromatic diſperſion with more attention, and pointed out methods of correcting it in the eye-piece without any compound eye-glaſſes. They have found that this may be more conveniently done with four eye-glaſſes, without ſenſibly diminiſhing the advantages which Huyghens ſhowed to reſult from employing many ſmall refractions inſtead of a leſſer number of great ones. As this is a very curious ſubject, we ſhall give enough for making our readers fully acquainted with it, and content ourſelves with merely mentioning the principles of the other rules for conſtructing an eye-piece.

Such readers as are leſs familiarly acquainted with optical diſcuſſions will do well to keep in mind the following conſequences of the general focal theorem (OPTICS n° 141. Cor. 5.).

If AB (fig. 10. B) be a lens, R a radiant point or focus of incident rays, and a the focus of parallel rays coming from the oppoſite ſide; then,

1. Draw the perpendicular $a\,a'$ to the axis, meeting the incident ray in a', and a' A to the centre of the lens. The refracted ray BF is parallel to a' A: for $\mathrm{R}a' : a'\mathrm{A}$ $(= \mathrm{R}a : a\mathrm{A}) = \mathrm{RB} : \mathrm{BF}$ $(= \mathrm{RA} : \mathrm{AF})$, which is the focal theorem.

2. An oblique pencil BPb proceeding from any point P which is not in the axis, is collected to the point f, where the refracted ray BF cuts the line PA f drawn from P through the centre of the lens: for $\mathrm{P}a' : a'\mathrm{A} = \mathrm{PB} : \mathrm{B}f$, which is alſo the focal theorem.

The Galilean teleſcope is ſuſceptible of ſo little improvement, that we need not employ any time in illuſtrating its performance.

The ſimple aſtronomical teleſcope is repreſented in fig. 11. The beam of parallel rays, inclined to the axis, is made to converge to a point G, where it forms an image of the loweſt point of a very diſtant object. Theſe rays decuſſating from G fall on the eye-glaſs; the ray from the loweſt point B of the object-glaſs falls on the eye-glaſs at b; and the ray from A falls on a; and the ray from the centre O falls on o. Theſe rays are rendered parallel, or nearly ſo by refraction through the eye-glaſs, and take the direction $b\,i'$, o I, $a\,i$. If the eye be placed ſo that this pencil of parallel rays may enter it, they converge to a point of the retina, and give diſtinct viſion of the loweſt point of the object. It appears inverted, becauſe the rays by which we ſee its loweſt point come in the direction which in ſimple viſion is connected with the upper point of an object. They come from above, and therefore are thought to proceed from above. We ſee the point as if ſituated in the direction I o. In like manner the eye placed at I, ſees the upper point of the object in the direction IP, and its middle in the direction IE. The proper place for the eye is I: if brought much nearer the glaſs, or removed much farther from it, ſome, or the whole, of this extreme pencil of ray will not enter the pupil. It is therefore of importanc to determine this point. Becauſe the eye requires paralle rays for diſtinct viſion, it is plain that F muſt be the prin cipal focus of the eye-glaſs. Therefore, by the common focal theorem (OPTICS, n° 141. Cor. 5.), OF : OE = OE : OI, or OF : FE = OE : EI.

The magnifying power being meaſured by the magnitude of the viſual angle, compared with the magnitude of the viſual angle with the naked eye, we have $\frac{o\mathrm{I}p}{o\mathrm{O}p}$, or $\frac{o\mathrm{IF}}{o\mathrm{OF}}$ for the meaſure of the magnifying power. This is very nearly $= \frac{\mathrm{OE}}{\mathrm{EI}}$, or $\frac{\mathrm{OF}}{\mathrm{FI}}$.

As the line OE, joining the centres of the lenſes, and perpendicular to their ſurfaces, is called the axis of the teleſcope, ſo the ray OG is called the axis of the oblique pencil, being really the axis of the cone of light which has the object-glaſs for its baſe. This ray is through its whole courſe the axis of the oblique pencil; and when its courſe is determined, the amplification, the field of viſion, the apertures of the glaſſes, are all determined. For this purpoſe we have only to conſider the centre of the object-glaſs as a radial point, and trace the proceſs of a ray from this point through the other glaſſes: this will be the axis of ſome oblique pencil.

It is evident, therefore, that the field of viſion depends on the breadth of the eye-glaſs. Should we increaſe this, the extreme pencil will paſs through I, becauſe O and I are ſtill the conjugate foci of the eye-glaſs. On the other hand, the angle reſolved on for the extent or field of viſion gives the breadth of the eye-glaſs.

We may here obſerve, by the way, that for all optical inſtruments there muſt be two optical figures conſidered. The firſt ſhows the progreſs of a pencil of rays coming from one point of the object. The various focuſes of this pencil ſhow the places of the different images, real or virtual. Such a figure is formed by the three rays AG $a\,i'$, OG o I, BG $b\,i$.

The ſecond ſhows the progreſs of the axes of the different pencils, proceeding through the centre of the object-glaſs. The focuſes of this pencil of axes ſhow the places where an image of the object-glaſs is formed; and this pencil determines the field of viſion, the apertures of the lenſes, and the amplification or magnifying power. The three rays OG o I, OFEI, OHPI, form this figure.

See alſo fig. 17. where the progreſs of both ſets of pencils is more diverſified.

The perfection of a teleſcope is to repreſent an object in its proper ſhape, diſtinctly magnified, with a great field of viſion, and ſufficiently bright. But there are limits to all theſe qualities; and an increaſe of one of them, for the moſt part, diminiſhes the reſt. The brightneſs depends on the aperture of the object-glaſs, and will increaſe in the ſame proportion (becauſe $i\,i'$ will always be to AB in the proportion of EF to FO), till the diameter of the emergent pencil is equal to that of the pupil of the eye. Increaſing the object-glaſs any more, can ſend no more light into the eye. But we cannot make the emergent pencil nearly ſo large

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omit giving a due ſhare of the honour of it to Dr Barrow and Mr James Gregory. The firſt of theſe authors, in his Optical Lectures delivered at Cambridge, has given every propoſition which is employed by Huyghens, and has even proſecuted the matter much further. In particular, his theory of oblique ſlender pencils is of immenſe conſequence to the perfection of teleſcopes, by ſhowing the methods for making the image of an extended ſurface as flat as poſſible. Gregory, too, has given all the fundamental propoſitions in his *Optica Promota*. But Huyghens, by taking the ſubject together, and treating it in a ſyſtem, has greatly ſimplified it: and his manner of viewing the principal parts of it is incomparably more perſpicuous than the performances of Barrow and Gregory.

large as this when the teleſcope magnifies much; for the great aperture of the object-glaſs produces an indiſtinct image at GF, and its indiſtinctneſs is magnified by the eye-glaſs.

A great field of viſion is incompatible with the true ſhape of the object; for it is not ſtrictly true that all rays flowing from O are refracted to I. Thoſe rays which go to the margin of the eye-glaſs croſs the axis between E and I; and therefore they croſs it at a greater angle than if they paſſed through I. Now had they really paſſed through I, the object would have been repreſented in its due proportions. Therefore ſince the angles of the marginal parts are enlarged by the aberration of the eye-glaſs, the marginal parts themſelves will appear enlarged, or the object appear diſtorted. Thus a cheſs board viewed through a reading glaſs appears drawn out at the corners, and the ſtraight lines are all changed into curves, as is repreſented in fig. 13.

The circumſtance which moſt peremptorily limits the extent of field is the neceſſary diſtinctneſs. If the viſion be indiſtinct, it is uſeleſs, and no other quality can compenſate this defect. The diſtortion is very inconſiderable in much larger angles of viſion than we can admit, and is unworthy of the attention paid to it by optical writers. They have been induced to take notice of it, becauſe the means of correcting it in a conſiderable degree are attainable, and afford an opportunity of exhibiting their knowledge; whereas the indiſtinctneſs which accompanies a large field is a ſubject of moſt difficult diſcuſſion, and has hitherto baffled all their efforts to expreſs by any intelligible or manageable formulæ.

Quæque tractata niteſcere poſſe
Deſperat relinquit.

This ſubject muſt, however, be conſidered. The image at GF of a very remote object is not a plain ſurface perpendicular to the axis of the teleſcope, but is nearly ſpherical, having O for its centre. If a number of pencils of parallel rays croſſing each other in I fall on the eye-glaſs, they will form a picture on the oppoſite ſide, in the focus F. But this picture will by no means be flat, nor nearly ſo, but very concave towards E. Its exact form is of moſt difficult inveſtigation. The elements of it are given by Dr Barrow; and we have given the chief of them in the article Optics, when conſidering the foci of infinitely ſlender pencils of oblique rays. Therefore it is impoſſible that the picture formed by the object-glaſs can be ſeen diſtinctly in all its parts by the eye-glaſs. Even if it were flat, the points G and H (fig. 11.) are too far from the eye-glaſs when the middle F is at the proper diſtance for diſtinct viſion. When, therefore, the teleſcope is ſo adjuſted that we have diſtinct viſion of the middle of the field, in order to ſee the margin diſtinctly we muſt puſh in the eye-glaſs: and having ſo done, the middle of the field becomes indiſtinct. When the field of viſion exceeds 12 or 15 degrees, it is not poſſible by any contrivance to make it tolerably diſtinct all over; and we muſt turn the teleſcope ſucceſſively to the different parts of the field that we may ſee them agreeably.

The cauſe of this indiſtinctneſs is, as we have already ſaid, the ſhortneſs of the lateral foci of lateral and oblique pencils refracted by the eye-glaſs. We have ſhown (in Optics, nº 252) how to determine theſe in all the caſes which occur. But the determination is not complete, and relates only to thoſe rays which are in a plane paſſing through the axis of the lens. But the oblique pencil *b* G *a*, by which an eye placed at I ſees the point G of the image, is a cone of light, having a circular baſe on the eye-glaſs; of which circle *a b* is one of the diameters. There is a diameter perpendicular to this, which, in this figure is repreſented by the point *o*. Fig. 12. repreſents the baſe of the cone as ſeen by an eye placed in the axis of the teleſcope, with the object-glaſs as appearing behind it. The point *b* is formed by a ray which comes from the loweſt point B of the object-glaſs, and the point *a* is illuminated by a ray from A. The point *c* at the right hand of the circular baſe of this cone of light came from the point C on the left ſide of the object-glaſs; and the light comes to *d* from D. Now the laws of optics demonſtrate, that the rays which come through the points *c* and *d* are more convergent after refraction than the rays which come through *a* and *b*. The analogies, therefore, which aſcertain the foci of rays lying in planes paſſing thro' the axis do not determine the foci of the others. Of this we may be ſenſible by looking through a lens to a figure on which are drawn concentric circles croſſed by radii. When the teleſcope is ſo adjuſted that we ſee diſtinctly the extremity of one of the radii, we ſhall not ſee diſtinctly the circumference which croſſes the extremity with equal diſtinctneſs, and *vice verſa*. This difference, however, between the foci of the rays which come through *a* and *b*, and thoſe which come through *c* and *d*, is not conſiderable in the fields of viſion, which are otherwiſe admiſſible. But the ſame difference of foci obtains alſo with reſpect to the diſperſion of light, and is more remarkable. Both d'Alembert and Euler have attempted to introduce it into their formulæ; but they have made them uſeleſs for any practical purpoſe by their inextricable complication.

This muſt ſerve as a general indication of the difficulties which occur in the conſtruction of teleſcopes, even although the object-glaſs were perfect, forming an image without the ſmalleſt confuſion or diſtortion.

There is yet another difficulty or imperfection. The rays of the pencil *a* G *b*, when refracted through the eye-glaſs, are alſo ſeparated into their component colours. The edge of the lens muſt evidently perform the office of a priſm, and the white ray G *b* will be ſo diſperſed that if *b i'* be the path of its red ray, the violet ray, which makes another part of it, will take ſuch a courſe *b n* that the angle *i' b n* will be nearly $\frac{1}{27}$th of G' *b i'*. The ray G *a* paſſing through a part of the lens whoſe ſurfaces are leſs inclined to each other will be leſs refracted, and will be leſs diſperſed in the ſame proportion very nearly. Therefore the two violet rays will be very nearly parallel when the two red rays are rendered parallel.

Hence it muſt happen, that the object will appear bordered with coloured fringes. A black line ſeen near the margin on a white ground, will have a ruddy and orange border on the outſide and a blue border within: and this confuſion is altogether independent on the object-glaſs, and is ſo much the greater as the viſual angle *b* I E is greater.

Such are the difficulties: They would be unſurmountable were it not that ſome of them are ſo connected that, to a certain extent, the diminution of one is accompanied by a diminution of the other. Our readers will recollect, that in the article Optics we gave ſome account of what are called the *Cauſtic curves* (Optics nº 252), and ſhowed that theſe curves are the geometrical loci of the foci of infinitely ſlender pencils. Conſequently the point G is very nearly in the cauſtic formed by a beam of light conſiſting of rays parallel to I *o*, and occupying the whole ſurface of the eye-glaſs, becauſe the pencil of rays which are collected at G is very ſmall. Any thing therefore that diminiſhes the mutual inclination of the adjoining rays, puts their concourſe farther off. Now this is preciſely what we want: for the point G of the image formed by the object-glaſs is already beyond the focus of the oblique ſlender pencil of parallel rays *i a* and *i b*; and therefore, if we could make this focus go a little farther from *a* and *b*, we ſhall bring it nearer to G, and obtain more diſtinct viſion of this point of the object. Now let it be recollected, that in moderate refractions through priſms, two rays which are inclined to each other in a ſmall angle are, after refraction, inclined to each other in the ſame angle. Therefore, if we can diminiſh the aberration of the ray $a\,i$, or o I, or $b\,i'$, we diminiſh their mutual inclination; and conſequently the mutual inclination of the rays G a, G o, G b', and therefore lengthen the focus, and get more diſtinct viſion of the point G. Therefore we at once correct the diſtortion and the indiſtinctneſs: and this is the aim of Mr Huyghens's great principle of dividing the refractions. See Optics, n° 100.

The general method is as follows: Let o be the object-glaſs (fig. 14. A) and E the eye-glaſs of a teleſcope, and F their common focus, and FG the image formed by the object-glaſs. The proportion of their focal diſtances is ſuppoſed to be ſuch as gives as great a magnifying power as the perfection of the object-glaſs will admit. Let BI be the axis of the emergent pencil. It is known by the focal theorem that GE is parallel to BI; therefore BGE is the whole refraction or deflection of the ray OHB from its former direction. Let it be propoſed to diminiſh the aberrations by dividing this into two parts by means of two glaſſes D and e, ſo as to make the ultimate angle of viſion $b\,i\,e$ equal to BIE, and thus retain the ſame magnifying power and viſible field. Let it be propoſed to divide it into the parts BGC and CGE.

From G draw any line GD to the axis towards O; and draw the perpendicular DH, cutting OG in H; draw H c parallel to GC, cutting GD in g; draw $g\,f$ perpendicular to the axis, and $g\,e$ parallel to GE; draw $e\,b$ perpendicular to the axis, draw D δ parallel to GC, and $\delta\,d$ perpendicular to the axis.

Then if there be placed at D a lens whoſe focal diſtance is D d, and another at e whoſe focal diſtance is $e\,f$, the thing is done. The ray OH will be refracted into H b, and this into $b\,i$ parallel to BI.

The demonſtration of this conſtruction is ſo evident by means of the common focal theorem, that we need not repeat it, nor the reaſons for its advantages (ſee Optics 100). We have the ſame magnifying power, and the ſame field of viſion; we have leſs aberration, and therefore leſs diſtortion and indiſtinctneſs; and this is brought about by a lens HD of a ſmaller aperture and a greater focal diſtance than BE. Conſequently, if we are contented with the diſtinctneſs of the margin of the field with a ſingle eye-glaſs, we may greatly increaſe the field of viſion: for if we increaſe DH to the ſize of EB we ſhall have a greater field, and much greater diſtinctneſs in the margin; becauſe HD is of a longer focal diſtance, and will bear a greater aperture, preſerving the ſame diſtinctneſs at the edge. On this account the glaſs HD is commonly called the *Field-glaſs*.

It muſt be obſerved here, however, that although the diſtortion of the object is leſſened, there is a real diſtortion produced in the image $f\,g$. But this, when magnified by the glaſs e, is ſmaller than the diſtortion produced by the glaſs E, of greater aperture and ſhorter focus, on the undiſtorted image GF. But becauſe there is a diſtortion in the ſecond image $f\,g$, this conſtruction cannot be uſed for the teleſcopes of aſtronomical quadrants, and other graduated inſtruments; becauſe then equal diviſions of the micrometer would not correſpond to equal angles.

But the ſame conſtruction will anſwer in this caſe, by taking the point D on that ſide of F which is remote from O (fig. 14 B). This is the form now employed in the teleſcopes of all graduated inſtruments.

The exact proportion in which the diſtortion and the indiſtinctneſs at the edges of the field are diminiſhed by this conſtruction, depends on the proportion in which the angle BGE is divided by GC; and is of pretty difficult inveſtigation. But it never deviates far (never $\frac{1}{8}$th in optical inſtruments) from the proportion of the ſquares of the angles. We may, without any ſenſible error, ſuppoſe it in this proportion. This gives us a practical rule of eaſy recollection, and of moſt extenſive uſe. When we would diminiſh an aberration by dividing the whole refraction into two parts, we ſhall do it moſt effectually by making them equal. In like manner, if we divide it into three parts by means of two additional glaſſes, we muſt make each $= \frac{1}{3}$d of the whole; and ſo on for a greater number.

This uſeful problem, even when limited, as we have done, to equal refractions, is as yet indeterminate; that is, ſuſceptible of an infinity of ſolutions: for the point D, where the field glaſs is placed, was taken at pleaſure: yet there muſt be ſituations more proper than others. The aberrations which produce diſtortion, and thoſe which produce indiſtinctneſs, do not follow the ſame proportions. To correct the indiſtinctneſs, we ſhould not ſelect ſuch poſitions of the lens HD as will give a ſmall focal diſtance to $b\,e$; that is, we ſhould not remove it very far from F. Huyghens recommends the proportion of 3 to 1 for that of the focal diſtances of the lens HD and $e\,b$, and ſays that the diſtance De ſhould be $= 2\,\mathrm{F}e$. This will make $e\,i = \frac{1}{2}\,e\,\mathrm{F}$, and will divide the whole refraction into two equal parts, as any one will readily ſee by conſtructing the common optical figure. Mr Short, the celebrated improver of reflecting teleſcopes, generally employed this proportion; and we ſhall preſently ſee that it is a very good one.

It has been already obſerved that the great refractions which take place on the eye-glaſſes occaſion very conſiderable diſperſions, and diſturb the viſion by fringing every thing with colours. To remedy this, achromatic eye-glaſſes may be employed, conſtructed by the rules already delivered. This conſtruction, however, is incomparably more intricate than that of object-glaſſes: for the equations muſt involve the diſtance of the radiant point, and be more complicated: and this complication is immenſely increaſed on account of the great obliquity of the pencils.

Moſt fortunately the Huyghenian conſtruction of an eye-piece enables us to correct this diſperſion to a great degree of exactneſs. A heterogeneous ray is diſperſed at H, and the red ray belonging to it falls on the lens $b\,e$ at a greater diſtance from the centre than the violet ray coming from H. It will therefore be leſs refracted (cæteris paribus) by the lens $b\,e$; and it is poſſible that the difference may be ſuch that the red and violet rays diſperſed at H may be rendered parallel at b, or even a little divergent, ſo as to unite accurately with the red ray at the bottom of the eye. How this may be affected, by a proper ſelection of the places and figures of the lenſes, will appear by the following propoſition, which we imagine is new, and not inelegant.

Let the compound ray OP (fig. 15. A) be diſperſed by the lens PC; and let PV, PR be its violet and red rays, cutting the axis in G and g. It is required to place another lens RD in their way, ſo that the emergent rays R r, V v, ſhall be parallel.

Produce the incident ray OP to Z. The angles ZPR, ZPV, are given, (and RPV is nearly $= \frac{\mathrm{ZPR}}{27}$) and the interſections G and g with the axis. Let F be the focus of parallel red light coming through the lens RD in the oppoſite direction. Then (by the common optical theorem), the perpendicular F ρ will cut PR in ſuch a point ρ, that ρ F will be parallel to the emergent ray R r (ſee Optics, n° 252—256), and to V v. Therefore if ρ D cut PV in u, and $u\,f$ be drawn perpendicular to the axis, we ſhall have (alſo by the common theorem) the point f for the focus of violet rays, and $DF : Df = D\rho : Du = 28 : 27$ neatly, or in a given ratio.

The problem is therefore reduced to this, "To draw from a point D in the line CG a line $D\rho$, which ſhall be cut by the lines PR and PV in the given ratio.

The following conſtruction naturally offers itſelf: Make $GM : gM$ in the given ratio, and draw MK parallel to Pg. Through *any* point D of CG draw the ſtraight line PDK, cutting MK in K. Join GK, and draw $D\rho$ parallel to KG. This will ſolve the problem; and, drawing ρF perpendicular to the axis, we ſhall have F for the focus of the lens RD for parallel red rays.

The demonſtration is evident: for MK being parallel to Pg, we have $GM : gM = GK : HK, = \rho D : uD, = FD\ fD$, in the ratio required.

This problem admits of an infinity of ſolutions; becauſe the point D may be taken anywhere in the line CG. It may therefore be ſubjected to ſuch conditions as may produce other advantages.

1. It may be reſtricted by the magnifying power, or by the diviſion which we chooſe to make of the whole refraction which produces this magnifying power. Thus, if we have reſolved to diminiſh the aberrations by making the two refractions equal, we have determined the angle RrD. Therefore draw GK, making the angle MGK equal to that which the emergent pencil muſt make with the axis, in order to produce this magnifying power. Then draw MK parallel to Pg, meeting GK in K. Then draw PK, cutting the axis in D, and $D\rho$ parallel to GK, and ρF perpendicular to the axis. D is the place, and DF the focal diſtance of the eye-glaſs.

2. Particular circumſtances may cauſe us to fix on a particular place D, and we only want the focal diſtance. In this caſe the firſt conſtruction ſuffices.

3. We may have determined on a certain focal diſtance DF, and the place muſt be determined. In this caſe let

$$GF : F\rho = 1 : \text{tan. } G$$
$$F\rho : fu = 1 : m,\ m \text{ being} = \tfrac{27}{28}$$
$$fu : fg = \text{tan. } g : 1$$
then $$GF : fg = \text{tan. } g : m \text{ tan. } G$$
then $$GF - fg : GF = \text{tan. } g - m \text{ tan. } G : \text{tan. } g$$
or $$Gg + Ff : GF = \text{tan. } g - m \text{ tan. } G : \text{tan. } g;$$
and $$GF = Gg + Ff \frac{\text{tan. } g}{\text{tan. } g - m.\ \text{tan. } G},$$ and is therefore given, and the place of F is determined; and ſince FD is given by ſuppoſition, D is determined.

The application of this problem to our purpoſe is difficult, if we take it in the moſt general terms; but the nature of the thing makes ſuch limitations that it becomes very eaſy. In the caſe of the diſperſion of light, the angle GPg is ſo ſmall that MK may be drawn parallel to PG without any ſenſible error. If the ray OP were parallel to CG, then G would be the focus of the lens PC, and the point M would fall on C; becauſe the focal diſtance of red rays is to that of violet rays in the ſame proportion for every lens, and therefore $CG : Cg = DF : Df$. Now, in a teleſcope which magnifies conſiderably, the angle at the object-glaſs is very ſmall and CG hardly exceeds the focal diſtance; and CG is to Cg very nearly in the ſame proportion of 28 to 27. We may therefore draw through C (fig. 15. B) a line CK parallel to PG: then draw GK′ perpendicular to the axis of the lens, and join PK′; draw K′BE parallel to CG, cutting PK in B; draw BHI parallel to GK, cutting GK′ in H: Join HD and PK. It is evident that CG is biſected in F′, and that $K'B = 2\ F'D$: alſo $K'H : HG = K'B : BE, = CD : DG$. Therefore DH is parallel to CK′, or to PG. But becauſe $PF = F'K'$, PD is $= DB$, and $IH = HB$. Therefore $\rho D = HB$, and $FD = K'B, = 2\ F'D$; and FD is biſected in F′. Therefore $CD = \frac{CG + FD}{2}$.

That is, in order that the eye-glaſs RD may correct the diſperſion of the field-glaſs PC, *the diſtance between them muſt be equal to the half ſum of their focal diſtances* very nearly. More exactly, *the diſtance between them muſt be equal to the half ſum of the focal diſtance of the eye glaſs, and the diſtance at which the field-glaſs would form an image of the object-glaſs.* For the point G is the focus to which a ray coming from the centre of the object-glaſs is refracted by the field-glaſs.

This is a very ſimple ſolution of this important problem. Huyghens's eye-piece correſponds with it exactly. If indeed the diſperſion at P is not entirely produced by the refraction, but perhaps combined with ſome previous diſperſion, the point M (fig. 15. A) will not coincide with C, (fig. 15. B), and we ſhall have GC to GM, as the natural diſperſion at P to the diſperſion which really obtains there. This may deſtroy the equation $CD = \frac{CG + FD}{2}$.

Thus, in a manner rather unexpected, have we freed the eye-glaſſes from the greateſt part of the effect of diſperſion. We may do it entirely by puſhing the eye-glaſs a little nearer to the field-glaſs. This will render the violet rays a little divergent from the red, ſo as to produce a perfect picture at the bottom of the eye. But by doing ſo we have hurt the diſtinctneſs of the whole picture, becauſe F is not in the focus of RD. We remedy this by drawing both glaſſes out a little, and the teleſcope is made perfect.

This improvement cannot be applied to the conſtruction of quadrant teleſcopes, ſuch as fig. 14. B. Mr Ramſden has attempted it, however, in a very ingenious way, which merits a place here, and is alſo inſtructive in another way. The field-glaſs HD (fig. 14. B) is a plano-convex, with its plane ſide next the image GF. It is placed very near this image. The conſequence of this diſpoſition is, that the image GF produces a vertical image gf, which is much leſs convex towards the glaſs. He then places a lens on the point C, where the red ray would croſs the axis. The violet ray will paſs on the other ſide of it. If the focal diſtance of this glaſs be fc, the viſion will be diſtinct and free from colour. It has, however, the inconveniency of obliging the eye to be cloſe to the glaſs, which is very troubleſome.

This would be a good conſtruction for a magic-lanthorn, or for the object-glaſs of a ſolar microſcope, or indeed of any compound microſcope.

We may preſume that the reader is now pretty familiar with the different circumſtances which muſt be conſidered in the conſtruction of an eye-piece, and proceed to conſider thoſe which muſt be employed to erect the object.

This may be done by placing the lens which receives the light from the object-glaſs in ſuch a manner that a ſecond image (inverted with reſpect to the firſt) may be formed beyond it, and this may be viewed by an eye-glaſs. Such a conſtruction is repreſented in fig. 16. But, beſides many other defects, it tinges the object prodigiouſly with colour. The ray od is diſperſed at d into the red ray dr, and the violet dv, v being farther from the centre than r, the refracted ray vv' croſſes rr' both by reaſon of ſpherical aberration and its greater refrangibility. Plate DIV.

But the common day teleſcope, invented by F. Rheita, has, in this reſpect, greatly the advantage of the one now deſcribed. See Optics, nº 266. The rays of compound light are diſperſed at e and f. (Plate CCCLXIV. fig. 13.). The violet ray proceeding from f, falls without the red ray at g, but is accurately collected with it at the focus E, as we ſhall demonſtrate by and by. Since they croſs each other in E, the violet ray muſt fall within the red ray at i, and be leſs refracted than if it had fallen on the ſame point with the red ray. Had it fallen there it would have ſeparated from it; but by a proper diminution of its refraction, it is kept parallel to it, or nearly ſo. And this is one excellence of this teleſcope: when conſtructed with three eye-glaſſes perfectly equal, the colour is ſenſibly diminiſhed, and by uſing an eye-glaſs ſomewhat ſmaller, it may be removed entirely.—We ſay no more of it at preſent, becauſe we ſhall find its conſtruction included in another, which is ſtill more perfect.

It is evident at firſt ſight that this teleſcope may be improved, by ſubſtituting for the eye-glaſs $i\,k$ (fig. 13.) the Huyghenian double eye-glaſs, or field glaſs and eye-glaſs repreſented in fig. 14. A, and fig. 14. B; and that the firſt of theſe may be improved and rendered achromatic. This will require the two glaſſes $e\,f$ and $g\,h$ to be increaſed from their preſent dimenſions to the ſize of a field glaſs, ſuited to the magnifying power of the teleſcope, ſuppoſing it an aſtronomical teleſcope. Thus we ſhall have a teleſcope of four eye-glaſſes. The three firſt will be of a conſiderable focal diſtance, and two of them will have a common focus at b. But this is conſiderably different from the eye piece of four glaſſes which are now uſed, and are far better. We are indebted for them to Mr Dollond, who was a mathematician as well as an artiſt, and in the courſe of his reſearch diſcovered reſources which had not been thought of. He had not then diſcovered the achromatic object-glaſs, and was buſy in improving the eye-glaſſes by diminiſhing their ſpherical aberration. His firſt thought was to make the Huyghenian addition at both the images of the day teleſcope. This ſuggeſted to him the following eye-piece of five glaſſes.

Plate DIV.

Fig. 17. repreſents this eye-piece, but there is not room for the object-glaſs at its proper diſtance. A pencil of rays coming from the upper point of the object is made to converge (by the object-glaſs) to G, where it would form a picture of that part of the object. But it is intercepted by the lens Aa and its axis is bent towards the axis of the teleſcope in the direction $a\,b$. At the ſame time the rays which converged to G converge to g, and there is formed an inverted picture of the object at $g\,f$. The axis of the pencil is again refracted at b, croſſes the axis of the teleſcope in H, is refracted again at c, at d, and at e, and at laſt croſſes the axis in I. The rays of this pencil, diverging from g, are made leſs diverging, and proceed as if they came from g', in the line B$g\,g'$. The lens cC cauſes them to converge to g', in the line G′ C g'. The lens dD makes them converge ſtill more to G″, and there they form an erect picture G″ F″; diverging from G″, they are rendered parallel by the refraction at e.

At H the rays are nearly parallel. Had the glaſs Bb been a little farther from A, they would have been accurately ſo, and the object-glaſs, with the glaſſes A and B, would have formed an aſtronomical teleſcope with the Huyghenian eye-piece. The glaſſes C, D, and E, are intended merely for bending the rays back again till they again croſs the axis in I. The glaſs C tends chiefly to diminiſh the great angle BHb; and then the two glaſſes D and E are another Huyghenian eye-piece.

The art in this conſtruction lies in the proper adjuſtment of the glaſſes, ſo as to divide the whole bending of the pencil pretty equally among them, and to form the laſt image in the focus of the eye glaſs, and at a proper diſtance from the other glaſs. Bringing B nearer to A would bend the pencil more to the axis. Placing C farther from B would do the ſame thing; but this would be accompanied with more aberration, becauſe the rays would fall at a greater diſtance from the centres of the lenſes. The greateſt bending is made at the field-glaſs D; and we imagine that the teleſcope would be improved, and made more diſtinct at the edges of the field, by employing another glaſs of great focal diſtance between C and D.

There is an image formed at H of the object-glaſſes, and the whole light paſſes through a ſmall circle in this place. It is uſual to put a plate here pierced with a hole which has the diameter of this image. A ſecond image of the object-glaſs is formed at I, and indeed wherever the pencils croſs the axis. A lens placed at H makes no change in any of the angles, nor in the magnifying power, and affects only the place where the images are formed. And, on the other hand, a lens placed at f, or F″, where a real image is formed, makes no change in the places of the images, but affects the mutual inclination of the pencils. This affords a reſource to the artiſt, by which he may combine properties which ſeem incompatible.

The aperture of A determines the viſible field and all the other apertures.

We muſt avoid forming a real image, ſuch as $f\,g$, or F″ G″, on or very near any glaſs. For we cannot ſee this image without ſeeing along with it every particle of duſt and every ſcratch on the glaſs. We ſee them as making part of the object when the image is exactly on the glaſs, and we ſee them confuſedly, and ſo as to confuſe the object, when the image is near it. For when the image is on or very near any glaſs, the pencil of light occupies a very ſmall part of its ſurface, and a particle of duſt intercepts a great proportion of it.

It is plain that this conſtruction will not do for the teleſcope of graduated inſtruments, becauſe the micrometer cannot be applied to the ſecond image $f\,g$, on account of its being a little diſtorted, as has been obſerved of the Huyghenian eye-piece.

Alſo the interpoſition of the glaſs C makes it difficult to correct the diſperſion.

By proper reaſoning from the correction in the Huyghenian eye-piece, we are led to the beſt conſtruction of one with three glaſſes; which we ſhall now conſider, taking it in a particular form, which ſhall make the diſcuſſion eaſy, and make us fully maſters of the principles which lead to a better form. Therefore let PA (fig. 18.) be the glaſs which firſt receives the light proceeding from the image formed by the object-glaſs, and let OP be the axis of the extreme pencil. This is refracted into PR, which is again refracted into Rr by the next lens Br. Let b be the focus of parallel rays of the ſecond lens. Draw PBr. We know that $Ab : bB = PB : Br$, and that rays of one kind diverging from P will be collected at r. But if PR, PV be a red and a violet ray, the violet ray will be more refracted at V, and will croſs the red ray in ſome intermediate point g of the line Rr. If therefore the firſt image had been formed preciſely on the lens PA, we ſhould have a ſecond image at $f\,g$ free from all coloured fringes.

If the refractions at P and R are equal (as in the common day teleſcope), the diſperſion at V muſt be equal to that at P, or the angle $vVr = VPR$. But we have ultimately $RPV : RrV = BC : AB$, ($= Bb : Ab$ by the focal theorem). Therefore $gVr : grV$ (or $gr : gV$, or $Cf : fB$) $= Bb : Ab$, and $AB : Ab = Rr : Rg$.

This ſhows by the way the advantage of the common day teleſcope. In this $AB = 2Ab$, and therefore f is the place of the laſt image which is free from coloured fringes. But this image will not be ſeen free from coloured fringes through the eye-glaſs Cr, if f be its focus: For had $g\,r$, $g\,v$ been both red rays, they would have been parallel after refraction; but $g\,v$ being a violet ray, will be more refracted. It will not indeed be ſo much deflected from paralleliſm as the violet ray, which naturally accompanies the red ray to r, becauſe it falls nearer the centre. By computation its diſperſion is diminiſhed about $\frac{1}{7}$th.

In order that gv may be made parallel to gr after refraction, the refraction at r muſt be ſuch that the diſperſion correſponding to it may be of a proper magnitude. How to determine this is the queſtion. Let the diſperſion at g be to the diſperſion produced by the refraction at r (which is required for producing the intended magnifying power) as 1 to 9. Make $9 : 1 = ff' : f\,C, = f\,C : CD$, and draw the perpendicular $D\,r'$ meeting the refracted ray $r\,r'$ in r'. Then we know by the common focal theorem, that if f' be the focus of the lens $C\,r$, red rays diverging from g will be united in r'. But the violet ray $g\,v$ will be refracted into $v\,v'$ parallel to $r\,r'$. For the angle $v\,r'\,r : v\,g\,r =$ (ultimately) $f\,C : CD, = 9 : 1$. Therefore the angle $v\,r'\,r$ is equal to the diſperſion produced at r, and therefore equal to $r'\,v\,v'$; and $v\,v'$ is parallel to $r\,r'$.

But by this we have deſtroyed the diſtinct viſion of the image formed at fg, becauſe it is no longer at the focus of the eye-glaſs. But diſtinct viſion will be reſtored by puſhing the glaſſes nearer to the object-glaſs. This makes the rays of each particular pencil more divergent after refraction through A, but ſcarcely makes any change in the directions of the pencils themſelves. Thus the image comes to the focus f', and makes no ſenſible change in the diſperſions.

In the common day teleſcope, the firſt image is formed in the anterior focus of the firſt eye-glaſs, and the ſecond image is at the anterior focus of the laſt eye-glaſs. If we change this laſt for one of half the focal diſtance, and puſh in the eye-piece till the image formed by the object glaſs is half way between the firſt eye-glaſs and its focus, the laſt image will be formed at the focus of the new eye-glaſs, and the eye-piece will be achromatic. This is eaſily ſeen by making the uſual computations by the focal theorem. But the viſible field is diminiſhed, becauſe we cannot give the ſame aperture as before to the new eye-glaſs; but we can ſubſtitute for it two eye-glaſſes like the former, placed cloſe together. This will have the ſame focal diſtance with the new one, and will allow the ſame aperture that we had before.

On theſe principles may be demonſtrated the correction of colour in eye-pieces with three glaſſes of the following conſtruction.

Let the glaſſes A and B be placed ſo that the poſterior focus of the firſt nearly coincides with the anterior focus of the ſecond, or rather ſo that the anterior focus of B may be at the place where the image of the object-glaſs is formed, by which ſituation the aperture neceſſary for tranſmitting the whole light will be the ſmalleſt poſſible. Place the third C at a diſtance from the ſecond, which exceeds the ſum of their focal diſtances by a ſpace which is a third proportional to the diſtance of the firſt and ſecond, and the focal diſtance of the ſecond. The diſtance of the firſt eye-glaſs from the object-glaſs muſt be equal to the product of the focal diſtance of the firſt and ſecond divided by their ſum.

Let $O\,o$, $A\,a$, $B\,b$, $C\,c$, the focal diſtances of the glaſſes, be O, a, b, c. Then make $AB = a + b$ nearly; $BC = b + c + \frac{b^2}{b+c}$; $OA = \frac{bc}{b+c}$. The amplification or magnifying power will be $= \frac{ob}{ac}$; the equivalent eye-glaſs $= \frac{ac}{b}$; and the field of viſion $= 3438' \times \frac{\text{Aperture of A}}{\text{foc. diſt. ob. gl.}}$

Theſe eye-pieces will admit the uſe of a micrometer at the place of the firſt image, becauſe it has no diſtortion.

Mr Dollond was anxious to combine this achromatiſm of the eye-pieces with the advantages which he had found in the eye-pieces with five glaſſes. This eye-piece of three glaſſes neceſſarily has a very great refraction at the glaſs B, where the pencil which has come from the other ſide of the axis muſt be rendered again convergent, or at leaſt parallel to it. This occaſions conſiderable aberrations. This may be avoided by giving part of this refraction to a glaſs put between the firſt and ſecond, in the ſame way as he has done by the glaſs B put between A and C in his five glaſs eye-piece. But this deranges the whole proceſs. His ingenuity, however, ſurmounted this difficulty, and he made eye-pieces of four glaſſes, which ſeem as perfect as can be deſired. He has not publiſhed his ingenious inveſtigation; and we obſerve the London artiſts work very much at random, probably copying the proportions of ſome of his beſt glaſſes, without underſtanding the principle, and therefore frequently miſtaking. We ſee many eye-pieces which are far from being achromatic. We imagine therefore that it will be an acceptable thing to the artiſts to have preciſe inſtructions how to proceed, nothing of this kind having appeared in our language, and the inveſtigations of Euler, D'Alembert, and even Boſcovich, being ſo abſtruſe as to be inacceſſible to all but experienced analyſts. We hope to render it extremely ſimple.

It is evident, that if we make the rays of different colours unite on the ſurface of the laſt eye-glaſs but one, commonly called the *field-glaſs*, the thing will be done, becauſe the diſperſion from this point of union will then unite with the diſperſion produced by this glaſs alone; and this increaſed diſperſion may be corrected by the laſt eye-glaſs in the way already ſhown.

Therefore let A, B (fig. 19.) be the ſtations which we have fixed on for the firſt and ſecond eye-glaſſes, in order to give a proper portion of the whole refraction to the ſecond glaſs. Let b be the anterior focus of B. Draw $PB\,r$ through the centre of B. Make $A\,b : b\,B = AB : BK$. Draw the perpendicular $K\,r$, meeting the refracted ray in r. We know by the focal theorem, that red rays diverging from P will converge to r; but the violet ray PV, being more refracted, will croſs $R\,r$ in ſome point g. Drawing the perpendicular fg, we get f for the proper place of the field glaſs. Let the refracted ray $R\,r$, produced backwards, meet the ray OP coming from the centre of the object glaſs in O. Let the angle of diſperſion RPV be called p, and the angle of diſperſion at V, that is, $r\,V\,v$, be v, and the angle $V\,r\,R$ be r.

It is evident that $OR : OP = p : v$, becauſe the diſperſions are proportional to the ſines of the refractions, which in this caſe, are very nearly as the refractions themſelves.

Let $\frac{OP}{OR}\left(\text{or } \frac{op}{pB} \text{ or } \frac{pB}{bB}\right)$ be made $= m$. Then $v = mp$; alſo $p : r = BK : AB, = b\,B : A\,b$, and $r = p.\frac{Ab}{b\,B}$, or, making $\frac{Ab}{Bb} = n$, $r = n\,p$; therefore $v : r = m : n, = \frac{pB}{bB} : \frac{Ab}{bB}, = p\,B : A\,b$.

The angle $R\,g\,V = g\,V\,r + g\,r\,V = p.\overline{m+n}$; and $R\,g\,V : R\,r\,v = R\,r : R\,g$, or $m + n : n = R\,r : R\,g$, and $R\,g = R\,r\,\frac{n}{m+n}$. But $R\,r$ is ultimately $= BK = AB$

$b\,B$

Teleſcope. $\frac{bB}{Ab} = \frac{AB}{n}$. Therefore $Rg = \frac{AB}{n} \times \frac{n}{m+n} = \frac{AB}{m+n}$, and $Bf = \frac{AB}{m+n}$.

This value of Bf is evidently $= bB \times \frac{AB}{pB + Ab}$. Now bB being a conſtant quantity while the glaſs B is the ſame, the place of union varies with $\frac{AB}{pB+Ab}$. If we remove B a little farther from A, we increaſe AB, and pB, and Ab, each by the ſame quantity. This evidently diminiſhes Bf. On the other hand, bringing B nearer to A increaſes Bf. If we keep the diſtance between the glaſſes the ſame, but increaſe the focal diſtance bB, we augment Bf, becauſe this change augments the numerator and diminiſhes the denominator of the fraction $\frac{bB \times AB}{pB + Ab}$.

In this manner we can unite the colours at what diſtance we pleaſe, and conſequently can unite them in the place of the intended field-glaſs, from which they will diverge with an increaſed diſperſion, viz. with the diperſion competent to the refraction produced there, and the diſperſion $p \times \overline{m+n}$ conjoined.

It only remains to determine the proper focal diſtances of the field-glaſs and eye-glaſs, and the place of the eye-glaſs, ſo that this diſperſion may be finally corrected.

This is an indeterminate problem, admitting of an infinity of ſolutions. We ſhall limit it by an equal diviſion of the two remaining refractions, which are neceſſary in order to produce the intended magnifying power. This conſtruction has the advantage of diminiſhing the aberration. Thus we know the two refractions, and the diſperſion competent to each; it being nearly $\frac{1}{17}$th of the refraction. Call this q. The whole diſperſion at the field-glaſs conſiſts of q, and of the angle KgV of fig. 19. which we alſo know to be $= p \times \overline{m+n}$. Call their ſum s.

Let fig. 20. n° 1. repreſent this addition to the eye-piece. Cg is the field-glaſs coming in the place of fg of fig. 19. and Rgw is the red ray coming from the glaſs BR. Draw gs parallel to the intended emergent pencil from the eye-glaſs; that is, making the angle Csg with the axis correſpond to the intended magnifying power. Biſect this angle by the line gK. Make $sg : gq = s : q$, and draw qK, cutting Cg in t. Draw $t\delta D$, cutting gk in δ, and the axis in D. Draw δd and Dr perpendicular to the axis. Then a lens placed in D, having the focal diſtance Dd, will deſtroy the diſperſion at the lens $g\epsilon$, which refracts the ray gw into gr.

Let gv be the violet ray, making the angle $vgr = s$. It is plain, by the common optical theorem, that gr will be refracted into rr' parallel to δD. Draw gDr' meeting rr', and join vr'. By the focal theorem two red rays gr, gv, will be united in r'. But the violet ray gv will be more refracted, and will take the path vv', making the angle of diſperſion $r'vv' = q$, very nearly, becauſe the diſperſion at v does not ſenſibly differ from that at r. Now, in the ſmall angles of refraction which obtain in optical inſtruments the angles $rr'v$, rgv are very nearly as gr and rr', or as gD and Dr', or as CD and DT; which, by the focal theorem, are as Cd and dD; that is, $Dd : dc = rgv : rr'v$. But $Dd : dC = D\delta : \delta t, = sg : gq, = s : q$. But $rgv = s$; therefore $rr'v = q, = r'vv'$, and vv' is parallel to rr', and the whole diſperſion at g is corrected by the lens Dr. The focal diſtance Cc of Cg is had by drawing Cx parallel to Kg, meeting Rg in x, and drawing xc perpendicular to the axis.

It is eaſy to ſee that this (not inelegant) conſtruction is not limited to the equality of the refractions wgr, Krr'. In whatever proportion the whole refraction wgs is divided, we always can tell the proportion of the diſperſions which the two refractions occaſion at g and r, and can therefore find the values of s and q. Indeed this ſolution includes the problem in p. 365. col. 1. par. 2.; but it had not occurred to us till the preſent occaſion. Our readers will not be diſpleaſed with this variety of reſource.

The intelligent reader will ſee, that in this ſolution ſome quantities and ratios are aſſumed as equal which are not ſtrictly ſo, in the ſame manner as in all the elementary optical theorems. The paralleliſm, however, of vv' and rr' may be made accurate, by puſhing the lens Dr nearer to Cg, or retiring it from it. We may alſo, by puſhing it ſtill nearer, induce a ſmall divergency of the violet ray, ſo as to produce accurate viſion in the eye, and may thus make the viſion through a teleſcope more perfect than with the naked eye, where diſperſion is by no means avoided. It would therefore be an improvement to have the eye-glaſs in a ſliding tube for adjuſtment. Bring the teleſcope to diſtinct viſion; and if any colour be viſible about the edges of the field, ſhift the eye-glaſs till this colour is removed. The viſion may now become indiſtinct: but this is corrected by ſhifting the place of the whole eye-piece.

We have examined trigonometrically the progreſs of a red and a violet ray through many eye-pieces of Dollond's and Ramſden's beſt teleſcopes; and we have found in all of them that the colours are united on or very near the field-glaſs; ſo that we preſume that a theory ſomewhat analogous to ours has directed the ingenious inventors. We meet with many made by other artiſts, and even ſome of theirs, where a conſiderable degree of colour remains, ſometimes in the natural order and often in the contrary order. This muſt happen in the hands of mere imitators, ignorant of principle. We preſume that we have now made this principle ſufficiently plain.

Fig. 20. N° 2. repreſents the eye-piece of a very fine ſpy-glaſs by Mr Ramſden; the focal length of its object-glaſs is $8\frac{1}{2}$ inches, with $1\frac{1}{10}$th of aperture, 2° 05′ of viſible field, and 15,4 magnifying power. The diſtances and focal lengths are of their proper dimenſions, but the apertures are $\frac{1}{2}$ larger, that the progreſs of a lateral pencil might be more diſtinctly drawn. The dimenſions are as follow:

Foc. lengths $Aa=0,775$ $Bb=1,025$ $Cc=1,01$ $Dd=0,79$
Diſtances $AB=1,18$ $BC=1,83$ $CD=1,105$.

It is perfectly achromatic, and the colours are united, not preciſely, at the lens Cg, but about $\frac{1}{20}$th of an inch nearer the eye-glaſs.

It is obvious that this combination of glaſſes may be uſed as a microſcope; for if, inſtead of the image formed by the object-glaſs at FG, we ſubſtitute a ſmall object, illuminated from behind, as in compound microſcopes; and if we draw the eye-piece a very ſmall way from this object, the pencils of parallel rays emergent from the eye-glaſs D will become convergent to very diſtant points, and will there form an inverted and enlarged picture of the object, which may be viewed by a Huyghenian eye-piece; and we may thus get high magnifying powers without uſing very deep glaſſes. We tried the eye-piece of which we have given the dimenſions in this way, and found that it might be made to magnify 180 times with very great diſtinctneſs. When uſed as the magnifier of a ſolar microſcope, it infinitely ſurpaſſes every thing we have ever ſeen. The picture formed by a ſolar microſcope is generally ſo indiſtinct, that it is fit only for amuſing ladies; but with this magnifier it ſeemed perfectly ſharp. We therefore recommend this to the artiſts as a valuable article of their trade.

The only thing which remains to be conſidered in the theory of refracting teleſcopes is the forms of the different lenſes. Hitherto we have had no occaſion to conſider any thing but their focal diſtances; but their aberrations depend greatly on the adjuſtment of their forms to their ſituations. When the conjugate focuſes of a lens are determined by the ſervice which it is to perform, there is a certain form or proportion between the curvatures of their anterior and poſterior ſurfaces, which will make their aberrations the ſmalleſt poſſible.

It is evident that this proportion is to be obtained by making the fluxion of the quantity within the parentheſis in the formula of par. 2. col. 2. p. 348, equal to nothing. When this is done we obtain this formula for a, the radius of curvature for the anterior ſurface of a lens. $\frac{1}{a} = \frac{2m^2+m}{2m+4} + \frac{4m+4}{2(m+4)r}$, where m is the ratio of the ſine of incidence to the ſine of refraction, and r is the diſtance of the focus of incident rays, poſitive or negative, according as they converge or diverge, all meaſured on a ſcale of which the unit is n, = half of the radius of the equivalent iſoſceles lens.

It will be ſufficiently exact for our purpoſe to ſuppoſe $m = \frac{3}{2}$, though it is more nearly $\frac{31}{20}$. In this caſe $\frac{1}{a} = \frac{b}{7} + \frac{10}{7r}, = \frac{42r+70}{49r}$. Therefore $a = \frac{49r}{42r+70}$. And $\frac{1}{b} = \frac{1}{a} - 1, = \frac{1-a}{a}$.

As an example, let it be required to give the radii of curvature in inches for the eye-glaſs be of page 362. col. 1. par. 2. which we ſhall ſuppoſe of $1\frac{1}{2}$ inches focal diſtance, and that ec $(=r)$ is $3\frac{3}{4}$th inches.

The radius of curvature for the equivalent iſoſceles lens is 1,5, and its half is 0,75. Therefore $r = \frac{3\frac{3}{4}}{0,75}, = 5$; and our formula is $a = \frac{49 \times 5}{42 \times 5 + 70}, = \frac{245}{280}, = 0,875$; and $\frac{1}{b} = \frac{1-a}{a}, = \frac{0,125}{0,875}$, and $b = \frac{0,875}{0,125}, = 7$.

These values are parts of a ſcale, of which the unit is 0,75 inches. Therefore

a, in inches, $= 0,875 \times 0,75, = 0,65525$
b, in inches, $= 7 \times 0,75, = 5,25$.

And here we muſt obſerve that the poſterior ſurface is concave: for b is a poſitive quantity, becauſe $1 - a$ is a poſitive quantity as well as a; therefore the centre of ſphericity of both ſurfaces lies beyond the lens.

And this determination is not very different from the uſual practice, which commonly makes this lens a plane convex with its flat ſide next the eye: and there will not be much difference in the performance of theſe two lenſes; for in all caſes of maxima and minima, even a pretty conſiderable change of the beſt dimenſions does not make a ſenſible change in the reſult.

The ſame conſideration leads to a rule which is very ſimple, and ſufficiently exact for ordinary ſituations. This is to make the curvatures ſuch, that the incident and emergent pencils may be nearly equally inclined to the ſurfaces of the lens. Thus in the eye-piece with five glaſſes, A and B ſhould be moſt convex on their anterior ſides; C ſhould be moſt convex on the poſterior ſide; D ſhould be nearly iſoſceles; and E nearly plano-convex.

But this is not ſo eaſy a matter as appears at firſt ſight. The lenſes of an eye-piece have not only to bend the ſeveral pencils of light to and from the axis of the teleſcope; they have alſo to form images on the axes of theſe pencils. Theſe offices frequently require oppoſite forms, as mentioned in par. 3. col. 2. p. 360. Thus the glaſs A of fig. 20. n° 2. ſhould be moſt convex on the ſide next the object, that it may produce little diſtortion of the pencils. But it ſhould be moſt convex next the eye, that it may produce diſtinct viſion of the image FG, which is very near it. This image ſhould have its concavity turned towards A, whereas it is towards the object-glaſs. We muſt therefore endeavour to make the vertical image fg flatter, or even convex. This requires a glaſs very flat before and convex behind. For ſimilar reaſons the object-glaſs of a microſcope and the ſimple eye-glaſs of an aſtronomical teleſcope ſhould be formed the ſame way.

This is a ſubject of moſt difficult diſcuſſion, and requires a theory which few of our readers would reliſh; nor does our limits afford room for it. The artiſts are obliged to grope their way. The proper method of experiment would be, to make eye-pieces of large dimenſions, with extravagant apertures to increaſe the aberrations, and to provide for each ſtation A, B, C, and D, a number of lenſes of the ſame focal diſtance, but of different forms: and we would adviſe making the trial in the way of a ſolar microſcope, and to have two eye-pieces on trial at once. Their pictures can be formed on the ſame ſcreen, and accurately compared; whereas it is difficult to keep in remembrance the performance of one eye-piece, and compare it with another.

We have now treated the theory of refracting teleſcopes with conſiderable minuteneſs, and have perhaps exceeded the limits which ſome readers may think reaſonable. But we have long regretted that there is not any theory on this ſubject from which a curious perſon can learn the improvements which have been made ſince the time of Dr Smith, or an artiſt learn how to proceed with intelligence in his profeſſion. If we have accompliſhed either of theſe ends, we truſt that the public will receive our labours with ſatiſfaction.

We cannot add any thing to what Dr Smith has delivered on the theory of reflecting teleſcopes. There appears to be the ſame poſſibility of correcting the aberration of the great ſpeculum by the contrary aberration of a convex ſmall ſpeculum, that we have practiſed in the compound object-glaſs of an achromatic refracting teleſcope. But this cannot be, unleſs we make the radius of the convex ſpeculum exceedingly large, which deſtroys the magnifying power and the brightneſs. This therefore muſt be given up. Indeed their performance, when well executed, does already ſurpaſs all imagination. Mr Herſchel has found great advantages in what he calls the *front view*, not uſing a plane mirror to throw the pencils to one ſide. But this cannot be practiſed in any but teleſcopes ſo large, that the loſs of light, occaſioned by the interpoſition of the obſerver's head, may be diſregarded.

Nothing remains but to deſcribe the mechaniſm of ſome of the moſt convenient forms.

To deſcribe all the varieties of ſhape and accommodation which may be given to a teleſcope, would be a taſk as trifling as prolix. The artiſts of London and of Paris have racked their inventions to pleaſe every fancy, and to ſuit every purpoſe. We ſhall content ourſelves with a few general maxims, deduced from the ſcientific conſideration of a teleſcope, as an inſtrument by which the viſual angle ſubtended by a diſtinct object is greatly magnified.

The chief conſideration is to have a ſteady view of the diſtant object. This is unattainable, unleſs the axis of the inſtrument be kept conſtantly directed to the ſame point of it: for when the teleſcope is gently ſhifted from its poſition, the object *ſeems to move* in the ſame or in the oppoſite direction, according as the teleſcope inverts the object or ſhows it erect. This is owing to the magnifying power, becauſe the apparent angular motion is greater than what we naturally connect with the motion of the teleſcope.

This does not happen when we look through a tube without glaſſes.

All ſhaking of the inſtrument therefore makes the object dance before the eye; and this is diſagreeable, and hinders us from ſeeing it diſtinctly. But a tremulous motion, however ſmall, is infinitely more prejudicial to the performance of a teleſcope, by making the object quiver before us. A perſon walking in the room prevents us from ſeeing diſtinctly; nay, the very pulſation in the body of the obſerver, agitates the floor enough to produce this effect, when the teleſcope has a great magnifying power: For the viſible motion of the object is then an imperceptible tremor, like that of an harpſichord wire, which produces an effect preciſely ſimilar to optical indiſtinctneſs; and every point of the object is diffuſed over the whole ſpace of the angular tremor, and appears coexiſtent in every part of this ſpace, juſt as a harpſichord wire does while it is ſounding. The more rapid this motion is, the indiſtinctneſs is the more complete. Therefore the more firm and elaſtic and well bound together the frame-work and apertures of our teleſcope is, the more hurtful will this conſequence be. A mounting of lead, were it practicable, would be preferable to wood, iron, or braſs. This is one great cauſe of the indiſtinctneſs of the very fineſt reflecting teleſcopes of the uſual conſtructions, and can never be totally removed. In the Gregorian form it is hardly poſſible to damp the elaſtic tremor of the ſmall ſpeculum, carried by an arm ſupported at one end only, even though the tube were motionleſs. We were witneſſes of a great improvement made on a four-feet reflecting teleſcope, by ſupporting the ſmall ſpeculum by a ſtrong plate of lead placed acroſs the tube, and led by an adjuſting ſcrew at each end. But even the great mirror may vibrate enough to produce indiſtinctneſs. Refracting teleſcopes are free from this inconveniency, becauſe a ſmall angular motion of the object-glaſs round one of its own diameters has no ſenſible effect on the image in its focus. They are affected only by an angular motion of the axis of the teleſcope or of the eye-glaſſes.

This ſingle conſideration gives us great help towards judging of the merits of any particular apparatus. We ſhould ſtudy it in this particular, and ſee whether its form makes the tube readily ſuſceptible of ſuch tremulous motions. If it does, the firmer it is and the more elaſtic it is, the worſe. All forms therefore where the tube is ſupported only near the middle, or where the whole immediately or remotely depend on one narrow joint, are defective.

Reaſoning in this way, we ſay with confidence, that of all the forms of a teleſcope apparatus, the old faſhioned ſimple ſtand repreſented in fig. 21. is by far the beſt, and that others are ſuperior according as the diſpoſition of the points of ſupport of the tube approaches to this. Let the pivots A, B, be fixed in the lintel and ſole of a window. Let the four braces terminate very near to theſe pivots. Let the teleſcope lie on the pin F *f*, reſting on the ſhoulder round the eye-piece, while the far end of it reſts on one of the pins 1, 2, 3, &c.; and let the diſtance of theſe pins from F very little exceed the length of the teleſcope. The trembling of the axis, even when conſiderable, cannot affect the poſition of the tube, becauſe the braces terminate almoſt at the pivots. The tremor of the brace CD does as little harm, becauſe it is nearly perpendicular to the tube. And if the object-glaſs were cloſe at the upper ſupporting pin, and the focus at the lower pin F, even the bending and trembling of the tube will have no effect on its optical axis. The inſtrument is only ſubject to horizontal tremors. Theſe may be almoſt annihilated by having a ſlender rod coming from a hook's joint in the ſide of the window, and paſſing through ſuch another joint cloſe by the pin F. We have ſeen an inſtrument of this form, having AB parallel to the earth's axis. The whole apparatus did not coſt 50 ſhillings, and we find it not in the leaſt ſenſible manner affected by a ſtorm of wind. It was by obſervations with this inſtrument that the tables of the motions of the Georgium Sidus, publiſhed in the Edinburgh Tranſactions, were conſtructed, and they are as accurate as any that have yet appeared. This is an excellent equatorial.

But this apparatus is not portable, and it is ſadly deficient in elegance. The following is the beſt method we have ſeen of combining theſe circumſtances with the indiſpenſable requiſites of a good teleſcope.

The pillar VX (fig. 22.) riſes from a firm ſtand, and has a horizontal motion round a cone which completely fills it. This motion is regulated by a rack-work in the box at V. The ſcrew of this rack-work is turned by means of the handle P, of a convenient length, and the ſcrew may be diſengaged by the click or detent V, when we would turn the inſtrument a great way at once. The teleſcope has a vertical motion round the joint Q placed near the middle of the tube. The lower end of the tube is ſupported by the ſtay OT. This conſiſts of a tube RT, faſtened to the pillar by a joint T, which allows the ſtay to move in a vertical plane. Within this tube ſlides another, with a ſtiff motion. This tube is connected with the teleſcope by another joint O, alſo admitting motion in a vertical plane. The ſide M of this inner tube is formed into a rack, in which works a pinion fixed to the top of the tube RT, and turned by the flat finger-piece R. The reader will readily ſee the advantages and the remaining defects of this apparatus. It is very portable, becauſe the teleſcope is eaſily diſengaged from it, and the legs and ſtay fold up. If the joint Q were immediately under A, it would be much freer from all tremor in the vertical plane. But nothing can hinder other tremors ariſing from the long pillar and the three ſpringy legs. Theſe communicate all external agitations with great vigour. The inſtrument ſhould be ſet on a ſtone pedeſtal, or, what is better, a caſk filled with wet ſand. This pedeſtal, which neceſſity perhaps ſuggeſted to our ſcientific navigators, is the beſt that can be imagined.

Fig. 23. is the ſtand uſually given to reflecting teleſcopes. The vertical tube FBG is faſtened to the tube by finger ſcrews, which paſs through the ſlits at F and G. This arch turns round a joint in the head of the divided pillar, and has its edge cut into an oblique rack, which is acted on by the horizontal ſcrew, furniſhed with the finger-piece A. This ſcrew turns in a horizontal ſquare frame. This frame turns round a horizontal joint in the off-ſide, which cannot be ſeen in this view. In the ſide of this frame next the eye there is a finger-ſcrew *a*, which paſſes through the frame, and preſſes on the round horizontal plate D. By ſcrewing down this finger-ſcrew, the frame is brought up, and preſſes the horizontal ſcrew to the rack. Thus the elevation of the teleſcope is fixed, and may be nicely changed by the finger applied to A and turning this ſcrew. The horizontal round plate D moves ſtiffly round on another plate of nearly equal diameter. This under plate has a deep conical hollow ſocket, which is nicely fitted by grinding to a ſolid cone formed on the top of the great upright pillar, and they may be firmly fixed in any poſition by the finger-ſcrew E. To the under plate is faſtened a box *c*, containing a horizontal ſcrew C, which always works in a rack cut in the edge of the upper plate, and cannot be diſengaged from it. When a great vertical or horizontal motion is wanted, the ſcrews *a* and E are ſlacked, and by tightening them the teleſcope may be fixed

TELEGRAPH.

Plate DII.

Fig. 1.

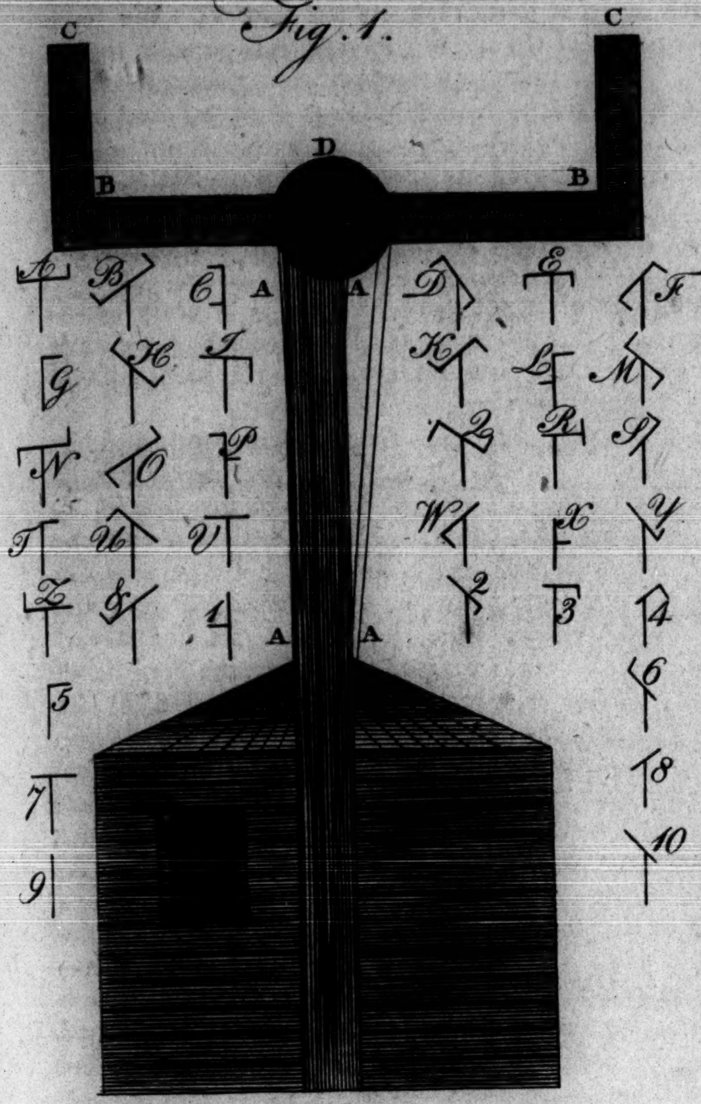

C
C
D
B
B
A
A
A
A
A B C D E F
G H I K L M
N O P Q R S
T U V W X Y
Z & 1 2 3 4
5 6
7 8
9 10

Fig. 2.

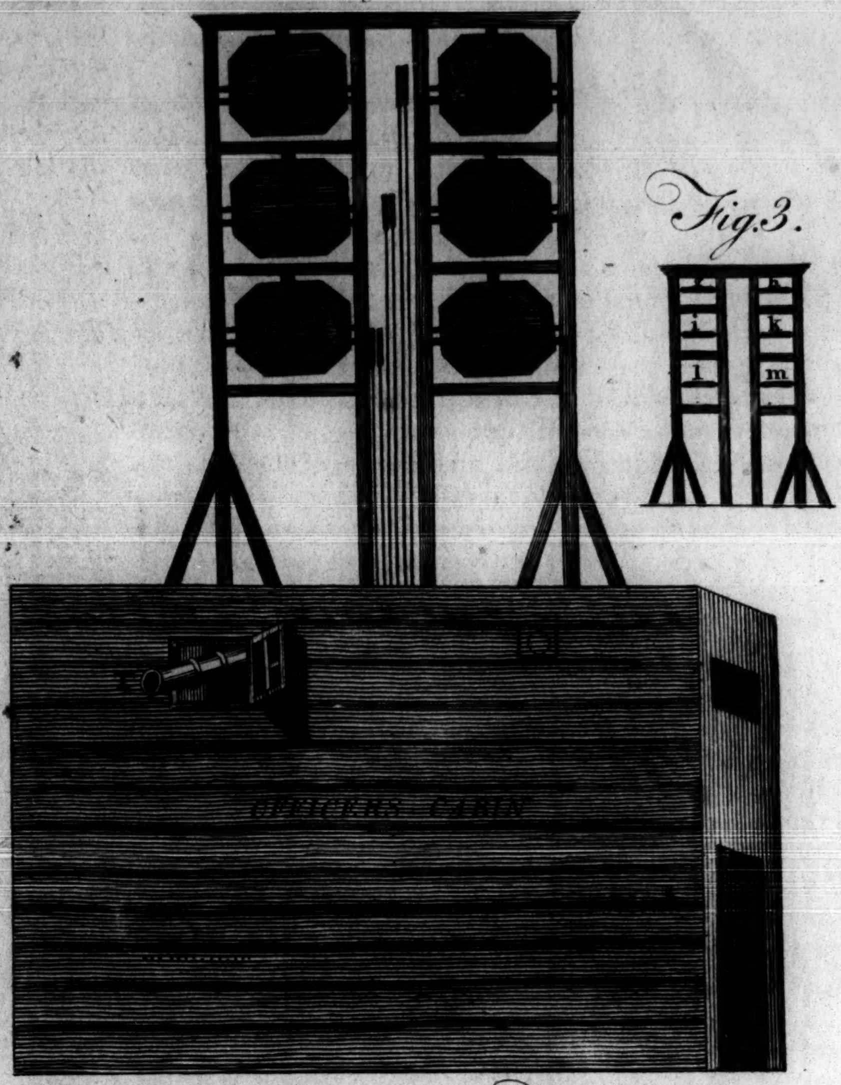

OFFICERS CABIN

Fig. 3.

h
i
k
l
m

TELESCOPE

Fig. 1.

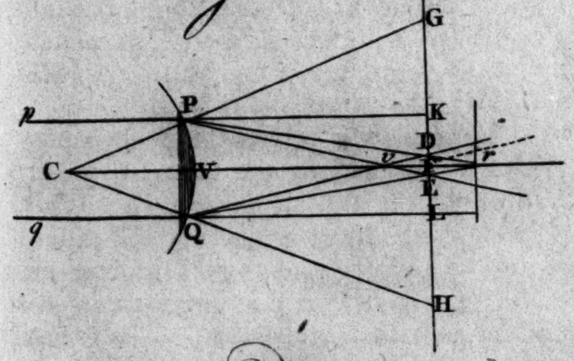

G
P
K
p
D
C
V
E
L
q
Q
H
v
r

Fig. 3.

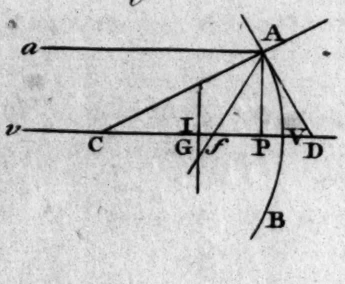
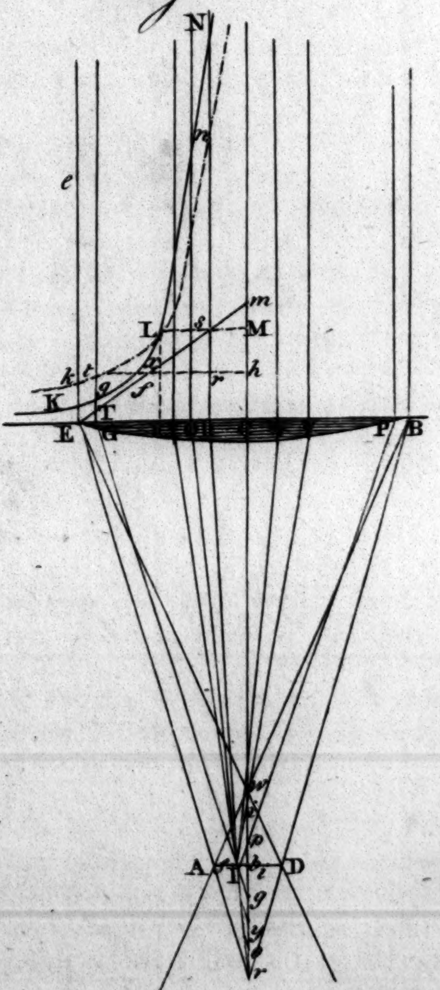

a
A
v
C
I
G
f
P
V
D
B

Fig. 2.


N
n
e
m
L
s
M
k
t
h
K
r
E
G
T
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I
D
r

Fig. 4. A

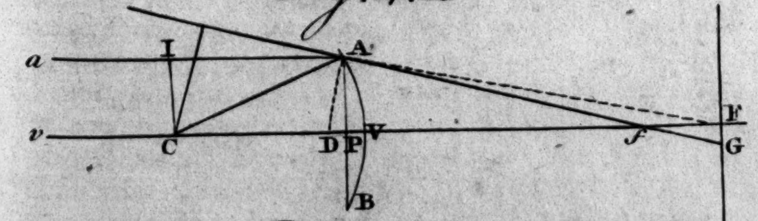
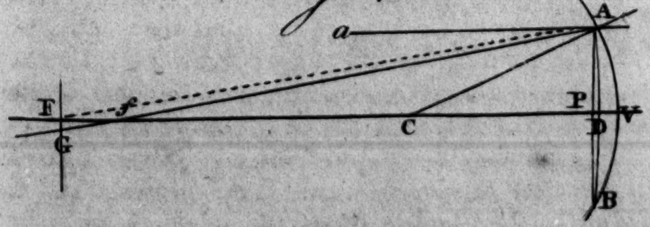

a
I
A
F
v
C
D
P
V
f
G
B

Fig. 4. B


A
a
F
f
G
C
P
D
V
B

Vallance Sc

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Fig. 5.B.

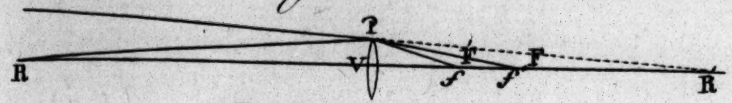


Fig. 5.C.

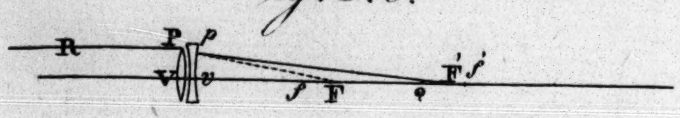

R
P
p
V
v
f
F
φ
F'
f'

Fig. 7.

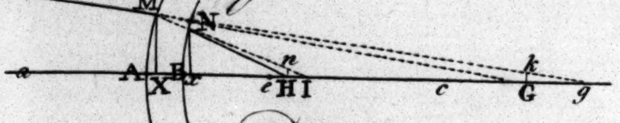

m
M
N
a
A
X
B
n
i
H
I
c
k
G
g

Fig. 8.

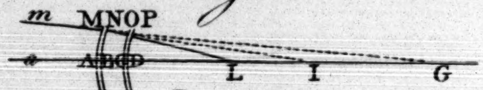

m
MNOP
a
ABCD
L
I
G

Fig. 10.B.

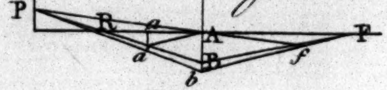


Fig. 10.

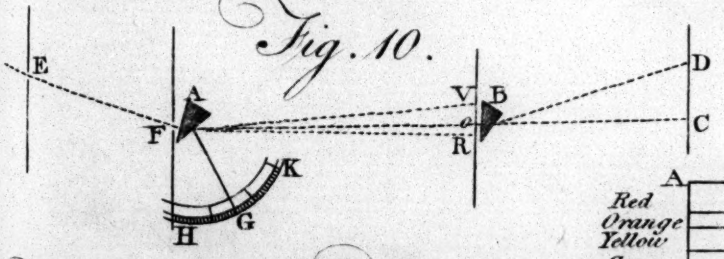

E
A
F
H
G
K
V
B
φ
R
D
C

Fig. 13.

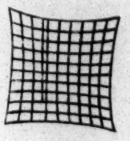


Fig. 12.

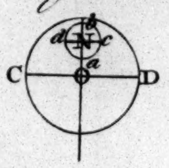


Fig. 15.A.

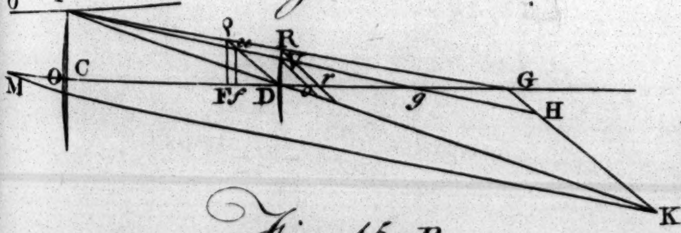
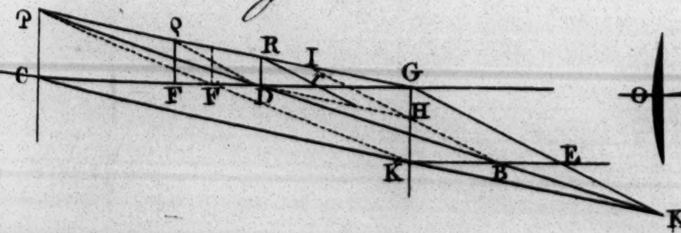

O
P
z
Q
R
C
M
F
f
D
e
r
g
G
H
K

Fig. 15.B.


P
Q
R
L
C
F
F
D
l
G
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K
B
E
K

Fig. 5.

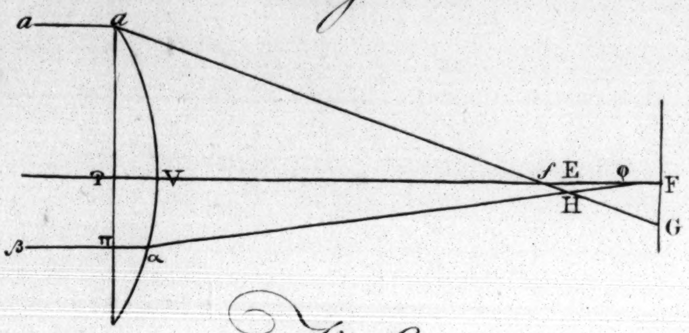
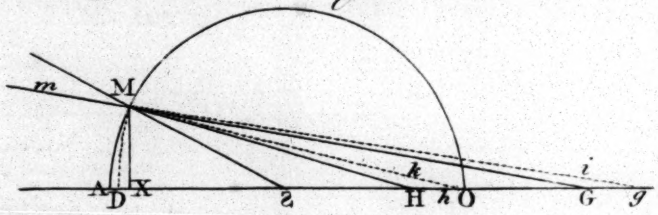

a
a
P
V
f
E
φ
F
H
G
β
π
α

Fig. 6.


m
M
A
D
X
S
k
H
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O
i
G
g

Fig. 9.A.

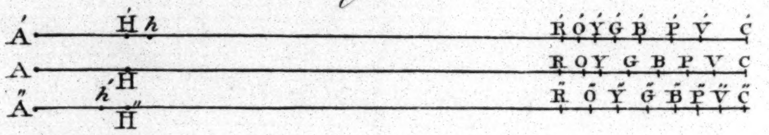
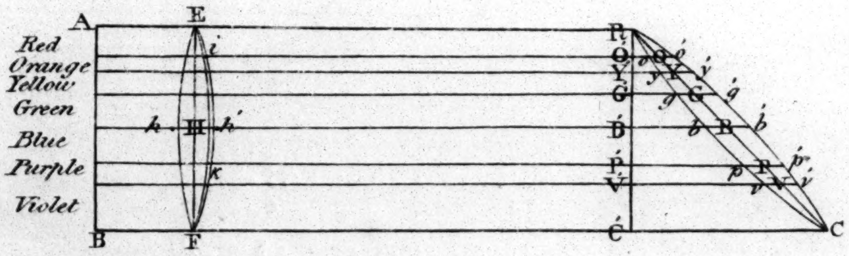

A'
H'
h
A
H
A''
h''
H''
R O Y G B P V C

Fig. 9.B.


A
E
Red
Orange
Yellow
Green
Blue
Purple
Violet
h
H
h'
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k
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F
R
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Y
G
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P
V
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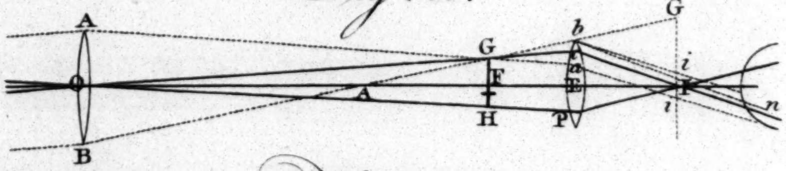
C

Fig. 11.


A
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B
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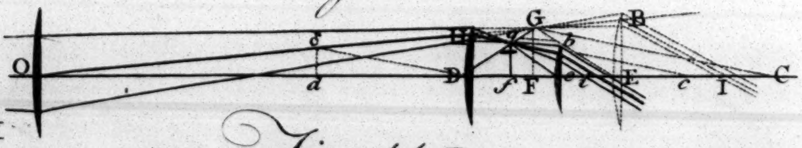
n

Fig. 14.A.


O
δ
d
H
D
G
f
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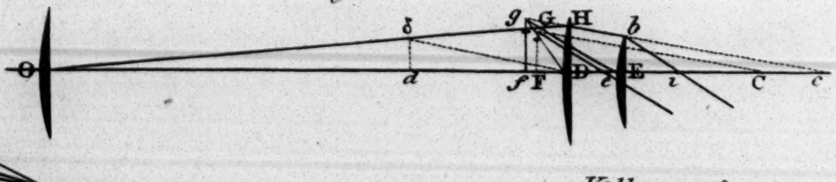
b
e
E
B
c
I
C

Fig. 14.B.


O
δ
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i
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c

Vallance Sc

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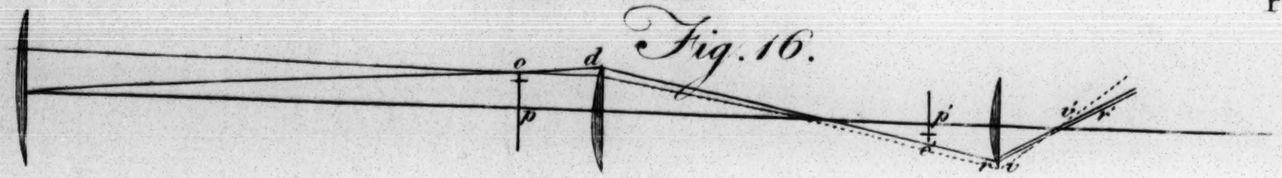
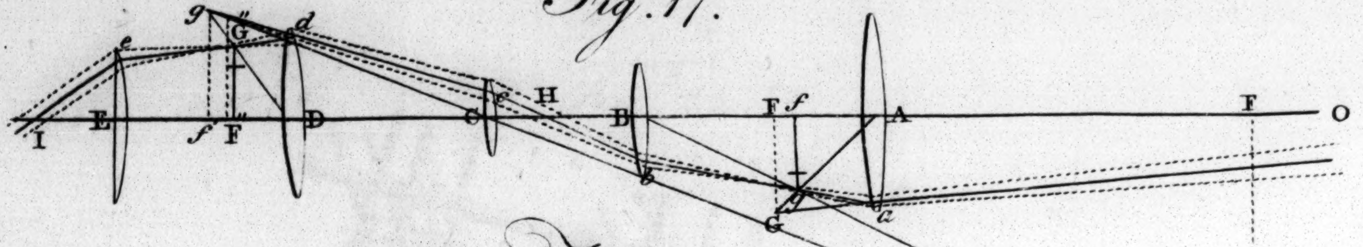


Fig. 16.

Fig. 17.



g
G''
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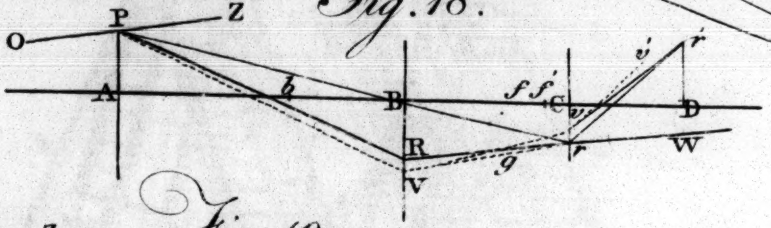
G
a

Fig. 18.



O
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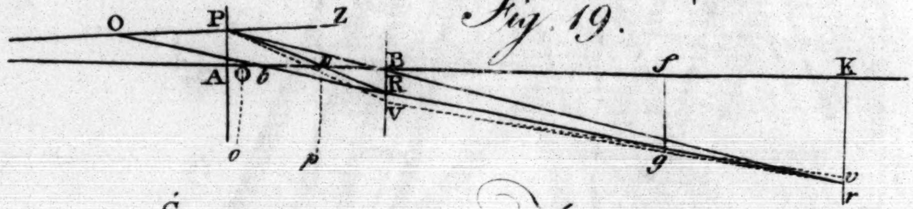
f f'
C
v
v'
r'
D
R
V
g
r
W

Fig. 19.



O
P
Z
A
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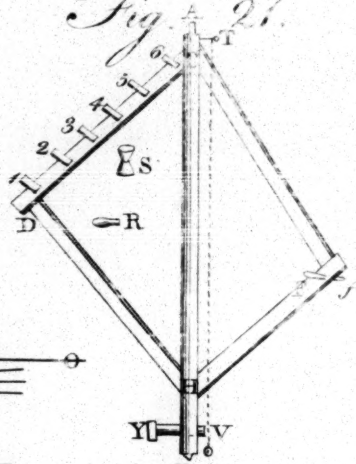
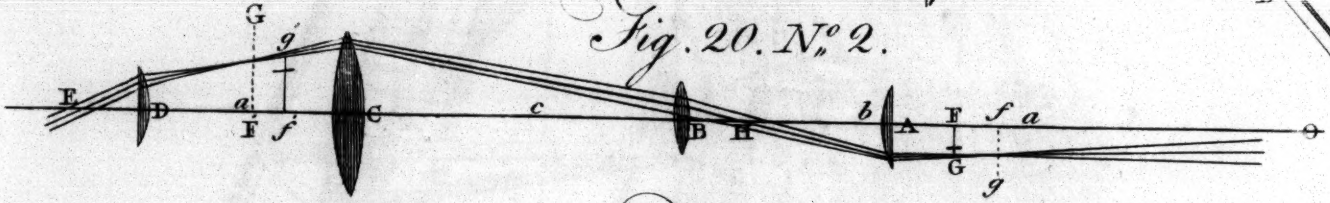
B
R
V
f
K
o
p
g
v
r

Fig. 21.



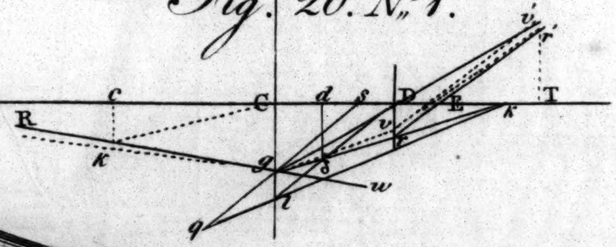
A
T
6
5
4
3
2
1
S
D
R
f
H
Y
V
B
X

Fig. 20. No. 2.



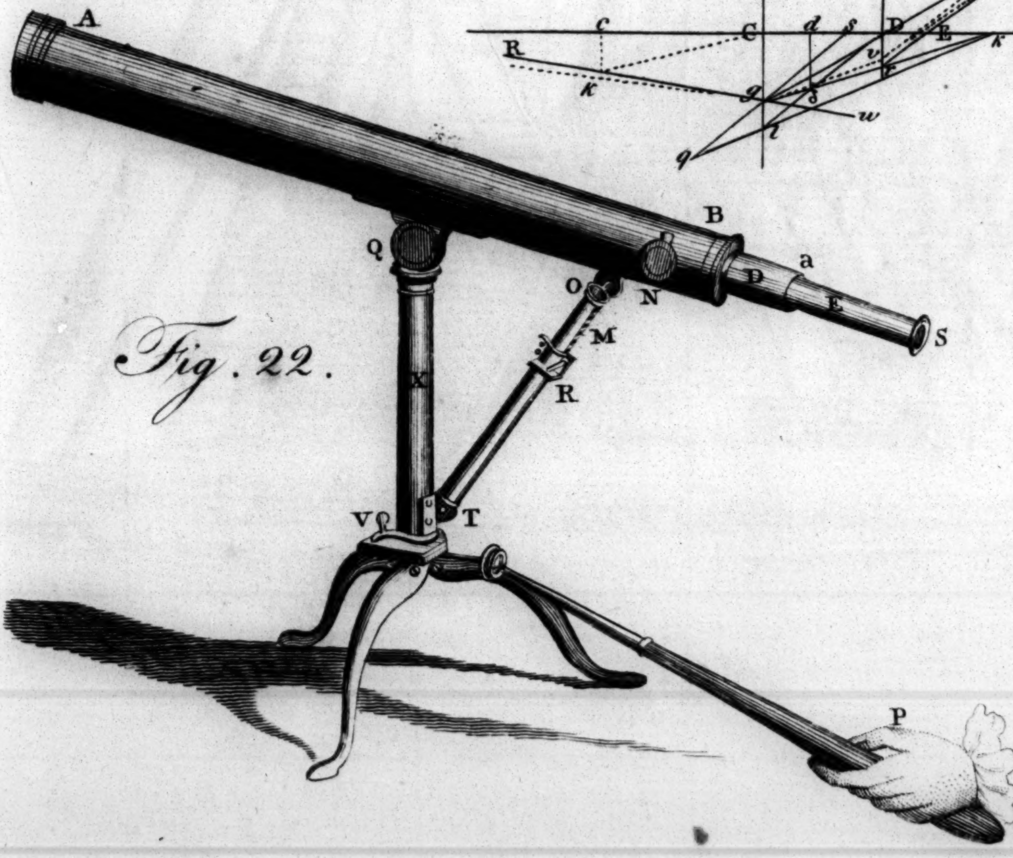
G
g
E
D
a
F
f
C
c
B
H
b
A
F
G
f
a
g
O

Fig. 20. No. 1.



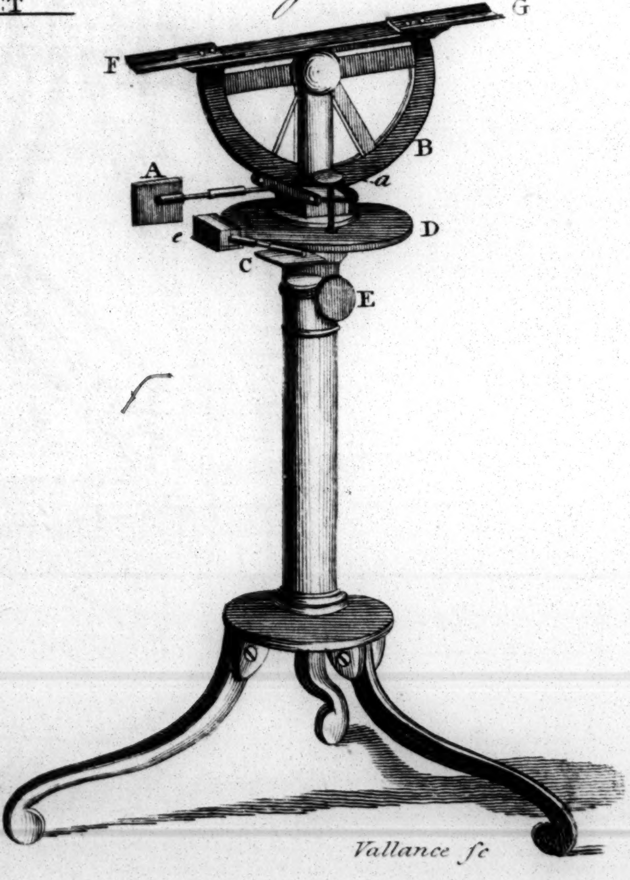
v
r
R
c
C
d
s
D
E
T
k
v
r
g
s
k
l
w
q

Fig. 23.



A
B
a
Q
D
E
S
O
N
M
X
R
V
T
P

Fig. 22.

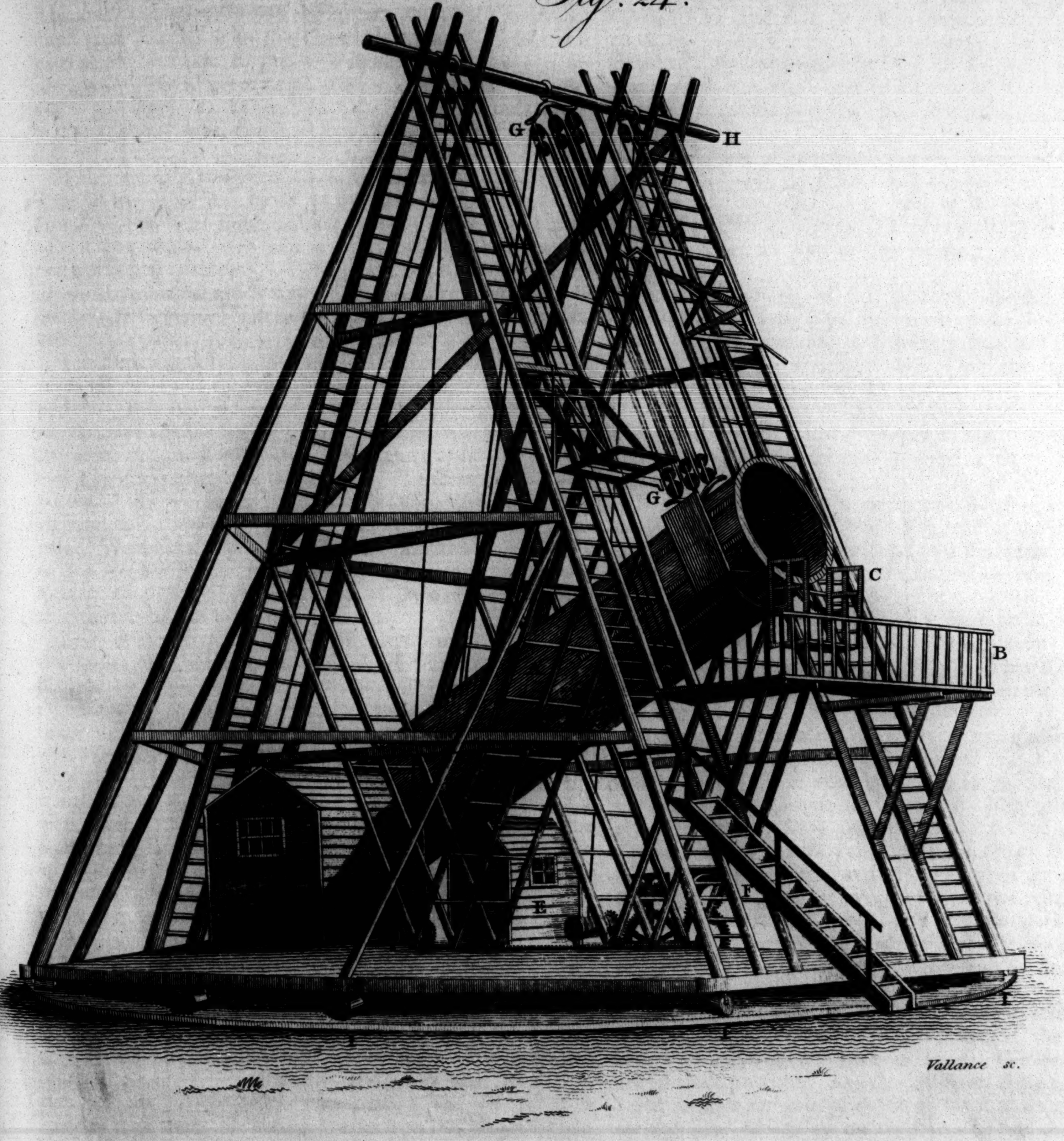


Vallance sc

BRITISH MUSEUM

HERSCHEL'S GRAND TELESCOPE. Plate IV

Fig. 24.



Vallance sc.

BRITISH MUSEUM

fixed in any poſition, and then any ſmall movements may be given it by the finger plates A and C.

This ſtand is very ſubject to briſk tremor, either from external agitation of the pedeſtal, or from the immediate action of the wind; and we have ſeldom ſeen diſtinctly through teleſcopes mounted in this manner, till one end of the tube was preſſed againſt ſomething that was very ſteady and unelaſtic. It is quite aſtoniſhing what a change this produces. We took a very fine teleſcope made by James Short, and laid the tube on a great lump of ſoft clay, preſſing it firmly down into it. Several perſons, ignorant of our purpoſe, looked through it, and read a table of logarithms at the diſtance of 310 yards. We then put the teleſcope on its ſtand, and pointed it to the ſame object; none of the company could read at a greater diſtance than 235 yards, although they could perceive no tremor. They thought the viſion as ſharp as before; but the incontrovertible proof of the contrary was, that they could not read at ſuch a diſtance.

If the round plates were of much greater dimenſions; and if the lower one, inſtead of being fixed to the pillar, were ſupported on four ſtout pillars ſtanding on another plate; and if the vertical arch had a horizontal axis turning on two upright frames firmly fixed to the upper plate—the inſtrument would be much freer from tremor. Such ſtands were made formerly; but being much more bulky and inconvenient for package, they have gone into diſuſe.

The high magnifying powers of Dr Herſchel's teleſcopes made all the uſual apparatus for their ſupport extremely imperfect. But his judgment, and his ingenuity and fertility in reſource, are as eminent as his philoſophical ardour. He has contrived for his reflecting teleſcopes ſtands which have every property that can be deſired. The tubes are all ſupported at the two ends. The motions, both vertical and horizontal, are contrived with the utmoſt ſimplicity and firmneſs. We cannot more properly conclude this article than with a deſcription of his 40 feet teleſcope, the nobleſt monument of philoſophical zeal and of princely munificence that the world can boaſt of.

Plate DV. repreſents a view of this inſtrument in a meridional ſituation, as it appears when ſeen from a convenient diſtance by a perſon placed to the ſouth-weſt of it. The foundation in the ground conſiſts of two concentric circular brick walls, the outermoſt of which is 42 feet in diameter, and the inſide one 21 feet. They are two feet ſix inches deep under ground; two feet three inches broad at the bottom, and one foot two inches at the top; and are capped with paving ſtones about three inches thick, and twelve and three quarters broad. The bottom frame of the whole apparatus reſts upon theſe two walls by twenty concentric rollers III, and is moveable upon a pivot, which gives a horizontal motion to the whole apparatus, as well as to the teleſcope.

The tube of the teleſcope A, though very ſimple in its form, which is cylindrical, was attended with great difficulties in the conſtruction. This is not to be wondered at, when its ſize, and the materials of which it is made, are conſidered. Its length is 39 feet four inches; it meaſures four feet ten inches in diameter; and every part of it is of iron. Upon a moderate computation, the weight of a wooden tube muſt have exceeded an iron one at leaſt 3000 pounds; and its durability would have been far inferior to that of iron. It is made of rolled or ſheet iron, which has been joined together without rivets, by a kind of ſeaming well known to thoſe who make iron-funnels for ſtoves.

Very great mechanical ſkill is uſed in the contrivance of the apparatus by which the teleſcope is ſupported and directed. In order to command every altitude, the point of ſupport is moveable; and its motion is effected by mechaniſm, ſo that the teleſcope may be moved from its moſt backward point of ſupport to the moſt forward, and, by means of the pulleys GG ſuſpended from the great beam H, be ſet to any altitude, up to the very zenith. The tube is alſo made to reſt with the point of ſupport in a pivot, which permits it to be turned ſidewiſe.

The concave face of the great mirror is 48 inches of poliſhed ſurface in diameter. The thickneſs, which is equal in every part of it, remains now about three inches and a half; and its weight, when it came from the caſt was 2118 pounds, of which it muſt have loſt a ſmall quantity in poliſhing. To put this ſpeculum into the tube, it is ſuſpended vertically by a crane in the laboratory, and placed on a ſmall narrow carriage, which is drawn out, rolling upon planks, till it comes near the back of the tube; here it is again ſuſpended and placed in the tube by a peculiar apparatus.

The method of obſerving by this teleſcope is by what Dr Herſchel calls the *front view*; the obſerver being placed in a ſeat C, ſuſpended at the end of it, with his back towards the object he views. There is no ſmall ſpeculum, but the magnifiers are applied immediately to the firſt focal image.

From the opening of the teleſcope, near the place of the eye-glaſs, a ſpeaking pipe runs down to the bottom of the tube, where it goes into a turning joint; and after ſeveral other inflections, it at length divides into two branches, one going into the obſervatory D, and the other into the workroom E. By means of the ſpeaking-pipe the communications of the obſerver are conveyed to the aſſiſtant in the obſervatory, and the workman is directed to perform the required motions.

In the obſervatory is placed a valuable ſideral time-piece, made by Mr Shelton. Cloſe to it, and of the ſame height, is a polar diſtance-piece, which has a dial-plate of the ſame dimenſions with the time-piece: this piece may be made to ſhow polar diſtance, zenith diſtance, declination or altitude, by ſetting it differently. The time and polar diſtance pieces are placed ſo that the aſſiſtant ſits before them at a table, with the ſpeaking-pipe riſing between them; and in this manner obſervations may be written down very conveniently.

This noble inſtrument, with proper eye-glaſſes, magnifies above 6000 times, and is the largeſt that has ever been made. Such of our readers as wiſh for a fuller account of the machinery attached to it, viz. the ſtairs, ladders, and platform B, may have recourſe to the ſecond part of the Tranſactions of the Royal Society for 1795: in which, by means of 18 plates and 63 pages of letter preſs, an ample detail is given of every circumſtance relating to joiner's work, carpenter's work, and ſmith's work, which attended the formation and erection of this teleſcope. It was completed on Auguſt the 28th 1789, and on the ſame day was the ſixth ſatellite of Saturn diſcovered.

TELL (William), an illuſtrous Swiſs patriot, chief inſtrument of the revolution which delivered the Swiſs cantons from the German yoke in 1307. Griſler, the governor of theſe provinces for the emperor Albert, having ordered him, under pain of death, to ſhoot at an apple placed on the head of one of his children; he had the dexterity, though the diſtance was very conſiderable, to ſtrike it off without hitting the child. The tyrant, perceiving he had another arrow concealed under his cloak, aſked him for what purpoſe? To which he boldly replied, "To have ſhot you through the heart, if I had had the misfortune to kill my ſon." The enraged governor now ordered him to be hanged; but his fellow-citizens, animated by his fortitude and pa-

patriotiſm, flew to arms; attacked and vanquiſhed Griſler, who was ſhot to death by Tell; and the aſſociation for the independency took place that inſtant.

Tell-Tale, a name ſometimes given to the *Perpetual-Log*. See that article.

"TELLER, an officer of the exchequer, in ancient records called *tallier*. There are four of theſe officers, whoſe duty is to receive all ſums due to the king, and to give the clerk of the pells a bill to charge him therewith. They likewiſe pay all money due from the king, by warrant from the auditor of the receipt; and make weekly and yearly books both of their receipts and payments, which they deliver to the lord treaſurer."

TELLINA, in natural hiſtory, a genus of animals belonging to the claſs of *vermes*, and order of *teſtaceæ*. The animal is a tethys; the ſhell is bivalve, generally ſloping to one ſide, with three teeth at the hinge. Gmelin reckons about 90 ſpecies.

The tellinæ bury themſelves in the mud or ſand at the bottom of the ſea, keeping a communication with the water above by means of ſhort tubes or pipes.

TEMISSA, a large town in Africa, about 120 miles north-eaſt of Mourzouk, the capital of Fezzan. Here the caravan of pilgrims from Bornou and Nigritia, which takes, its departure from Mourzouk, and travels by the way of Cairo to Mecca, uſually provides the ſtores of corn and dates, and dried meat, that are requiſite for its dreary paſſage.

TEMPE (anc. geog.), a moſt pleaſant place or valley of Theſſaly. That it was there, appears from the epithets *Theſſalica* (Livy), *Theſſala* (Ovid); but in what particular diſtrict is the queſtion. From the Phthiotica of Catullus, it ſhould ſeem to be of Phthiotis: but the Peneus, which ran through Tempe, was at too great a diſtance, being ſeparated from it by Mount Othrys and others. Firſt, however, we ſhall define Tempe, previous to the determining the particular diſtrict in which it lay. The Peneus, according to Pliny, running down between Oſſa to the ſouth and Olympus to the north for 500 ſtadia, is for half that ſpace navigable: in the direction of this courſe lies what is called *Tempe*, extending in length for five miles, in breadth for almoſt an acre and an half, with gentle convexities riſing on the right and left beyond ken of human ſight. Within glides the Peneus in its verdant light, green in its pebbles, charming in the graſs on its banks, harmoniouſly vocal with the muſic of birds. In this deſcription Strabo and Ælian agree; the laſt adding, that it has an agreeable variety of places of retreat; and that it is not the work of man's hand, but the ſpontaneous production of nature; and Strabo ſays, that formerly the Peneus formed a lake in this ſpot, being checked in its courſe by the higher grounds about the ſea; but that an opening being made by an earthquake, and Mount Oſſa torn from Olympus, the Peneus gained a free courſe between them. But Livy, who calls Tempe a grove, remarks a degree of horror rather than amenity, with which the Roman army was ſtruck on marching over the narrow paſs; for, beſides the defile, difficult to go over, which runs on for five miles, there are ſteep rocks on each hand, down which the proſpect is apt to cauſe a dizzineſs, heightened by the noiſe and depth of the interfluent Peneus. Hence it appears that Tempe was in the Pelaſgiotis, whoſe extremity was formerly the Peneus, but afterwards, as is probable, allotted to Magneſia; and thus Pliny places the mouth of the Peneus not in Theſſaly itſelf, but in the Magneſia of Theſſaly.

TEMPER, in a mechanical ſenſe. See Tempering.

Temper, in a moral ſenſe, the diſpoſition of mind whether natural or acquired. The word is ſeldom uſed by good writers without an epithet, as a *good* or *bad* temper; though one of the moſt beautiful poems in our language is entitled *The Triumphs of Temper*.

It is well obſerved by an elegant eſſayiſt, that more conſtant uneaſineſs ariſes from ill temper than from ill fortune; as a bad temper embitters every ſweet, and converts a paradiſe into a place of torment. For ſubduing the heart to ſoftneſs, and preſerving a due balance of the paſſions, a proper culture of the underſtanding and of the taſte is the beſt method. He who employs his time in the ſtudies of elegant literature, or the fine arts, has almoſt always a good temper; whilſt the man who is abſorbed in the purſuits of profound ſcience is apt to acquire a ſeverity of diſpoſition, little leſs diſagreeable, though generally much leſs pernicious, than the capriciouſneſs of the idler. Muſic, painting, and poetry, teach the mind to ſelect the agreeable parts of thoſe objects which ſurround us, and by habituating it to a pure and permanent delight, gradually ſuperinduce an habitual good humour. It is of infinite importance to happineſs to accuſtom the mind, from infancy, to turn from deformed and painful ſcenes, and to contemplate whatever can be found of moral and natural beauty.

So much of the happineſs of private life depends on the government of the temper, that the temper ought to be a principal object of regard in a well-conducted education. The ſuffering of children to tyrannize without control over ſervants and inferiors, is the ruin of many an amiable diſpoſition. The virtues of humanity, benevolence, humility, cannot be too early enforced; at the ſame time, care ſhould be taken that an infant of two or three years old ſhould never be beaten or ſpoken to harſhly for any offence which it can poſſibly commit.

TEMPERAMENT, among phyſicians, the ſame with conſtitution, or a certain diſpoſition of the ſolids and fluids of the human body, by which it may be properly denominated ſtrong, weak, lax, &c.

In every perſon there are appearances of a temperament peculiar to himſelf, though the ancients only took notice of four, and ſome have imagined theſe were deduced from the theories of the four humours or four cardinal qualities; but it is more probable that they were firſt founded on obſervation, and afterwards adapted to thoſe theories, ſince we find that they have a real exiſtence, and are capable of receiving an explanation. The two that are moſt diſtinctly marked are the ſanguineous and melancholic, viz. the temperaments of youth and age.

1. *Sanguineous*. Here there is laxity of ſolids, diſcoverable by the ſoftneſs of hair and ſucculency; large ſyſtem of arteries, redundancy of fluids, florid complexion; ſenſibility of the nervous power, eſpecially to pleaſing objects; irritability from the plethora; mobility and levity from lax ſolids. Theſe characters are diſtinctly marked, and are proved by the diſeaſes incident to this age, as hæmorrhagies, fevers, &c. but theſe, as they proceed from a lax ſyſtem, are more eaſily cured.

2. *Melancholic Habit*. Here greater rigidity of ſolids occurs, diſcoverable by the hardneſs and criſpature of the hair; ſmall proportion of the fluids, hence dryneſs and leanneſs; ſmall arteries, hence pale colour; venous plethora, hence turgeſcency of theſe, and lividity; ſenſibility, frequently exquiſite; moderate irritability, with remarkable tenacity of impreſſions; ſteadineſs in action and ſlowneſs of motion, with great ſtrength; for exceſs of this conſtitution in maniacs gives the moſt extraordinary inſtance of human ſtrength we know. This temperament is moſt diſtinctly marked in old age, and in males. The ſanguineous temperament

ment of youth makes us not diſtinguiſh the melancholic till the decline of life, when it is very evident, from diſeaſes of the veins, hemorrhoids, apoplexy, cachexy, obſtructions of the viſcera, particularly of the liver, dropſies, affections of the alimentary canal, chiefly from weaker influence of the nervous power. So much for the ſanguineous and melancholic temperaments; the other two are not ſo eaſily explained. The choleric temperament takes place between youth and manhood. In the

3. *Choleric*, the diſtribution of the fluids is more exactly balanced; there is leſs ſenſibility, and leſs obeſity, with more irritability, proceeding from greater tenſion, leſs mobility and levity, and more ſteadineſs in the ſtrength of the nervous power. As to the

4. *Phlegmatic.* This temperament cannot be diſtinguiſhed by any characters of age or ſex. It agrees with the ſanguineous in laxity and ſucculency. It differs from that temperament, and the melancholic, by the more exact diſtribution of the fluids. Again, it differs from the ſanguineous, by having leſs ſenſibility, irritability, mobility, and perhaps ſtrength, though ſometimes indeed this laſt in found to be great.

Theſe are the ancient temperaments. The temperaments, indeed, are much more various; and very far from being eaſily marked and reduced to their genera and ſpecies, from the great variety which is obſervable in the conſtitutions of different men.

Temperament, in muſic, is defined by Rouſſeau to be an operation which, by means of a ſlight alteration in the intervals, cauſes the difference between two contiguous ſounds to diſappear, makes each of theſe ſounds ſeem identical with the other, which, without offending the ear, may ſtill preſerve their reſpective intervals or diſtances one from the other. By this operation the ſcale is rendered more ſimple, and the number of ſounds which would otherwiſe be neceſſary retrenched. Had not the ſcale been thus modified, inſtead of twelve ſounds alone, which are contained in the octave, more than ſixty would be indiſpenſably required to form what we properly call *modulation* in every tone.

It is proved by computation, that upon the organ, the harpſichord and every other inſtrument with keys, there is not, and there ſcarcely can be, any chords properly in tune, ſave the octave alone. The cauſe is this, that though three thirds major, or four thirds minor, ought to form a juſt octave, thoſe are found to ſurpaſs, and theſe not to reach it.

TEMPERANCE, that virtue which a man is ſaid to poſſeſs who moderates and reſtrains his ſenſual appetites. It is often, however, uſed in a much more general ſenſe, as ſynonymous with moderation, and is then applied indiſcriminately to all the paſſions.

Temperance (ſays Mr Nelſon) is the virtue that bridles our irregular deſires; it is nearly allied to prudence, and has a cloſe connection with juſtice; it calms revenge, and quenches the fire of unjuſt reſentment; it checks the Epicure, and ſtops the riotous hand of the Bacchanalian; it extinguiſhes or abates the flames of luſt, and baniſhes every lawleſs action; it ſilences the flippant detracting tongue, and gives in its ſtead a pleaſing moderation of ſpeech; it ſhuts the door againſt avarice, and proves experimentally, that happineſs does not conſiſt in the eager purſuit or acquiſition of riches, but in a contented mind; it curbs the ſtrongeſt of all other paſſions, gaming, and diſtinguiſhes juſtly the abſurdity and folly of making that a dangerous trade, which was only deſigned as a relaxation and an amuſement: temperance, in a word, is the parent of many virtues; the parent of peace, proſperity, health, and joy.

Nothing can be more ſtrange to all obſervation than the practice of forſaking temperance; ſince every day's experience proves to us, that intemperance produces the oppoſite to what we ſeek. Suppoſe, when a child is born, we aſk the parents what it is they wiſh in that child; they will anſwer, life. But as life alone, that is, mere exiſtence, may, by infirmity or other accidents, be very wretched, they will naturally wiſh for health and happineſs. Well then, life, health, and happineſs, are the general wiſhes of parents for their children. Now let us ſee how their wiſhes are likely to ſucceed. Their firſt ſtep is uſually a ſhameful neglect of the food of nature, the breaſt; the next, a blind gratification of their will; the third, an almoſt total neglect of their manners; and a fourth, the cheriſhing them in every irregular affection. Where then is the wonder that parents are diſappointed? Life and health depend on proper food and other judicious management on one part; and if ſick, an obedience to remedies on the other part; and happineſs eſſentially depends in the firſt place on health; in the next, on the due government of our ſenſes, affections, and paſſions. See here how much mankind deviate from themſelves; how far they depart from their own principles. But what is the remedy? Nothing more obvious. Let parents exerciſe their reaſon in all the ſteps they take for their children's welfare; let them examine right and wrong; let them not only avoid paſſion, but labour to correct their own errors of judgment, that they may be the better enabled to prevent them in their children; but, particularly, let them fix in them the knowledge, love, and habit, of temperance.

TEMPERING, in the mechanic arts, the preparing of ſteel and iron, ſo as to render them more compact, hard, and firm; or even more ſoft and pliant, according to their reſpective occaſions. See IRON and STEEL.

TEMPESTA. See MOLYN.

TEMPLARS, TEMPLERS, or *Knights of the Temple*, a religious order inſtituted at Jeruſalem in the beginning of the 12th century, for the defence of the holy ſepulchre and the protection of Chriſtian pilgrims. They were firſt called *The poor of the Holy City*, and afterwards aſſumed the appellation of *Templers*, becauſe their houſe was near the temple. The order was founded by Baldwin II. then king of Jeruſalem, with the concurrence of the pope; and the principal articles of their rule were: That they ſhould hear the holy office throughout every day; or that, when their military duties ſhould prevent this, they ſhould ſupply it by a certain number of pater noſters: that they ſhould abſtain from fleſh four days in the week, and on Fridays from eggs and milk-meats: that each knight might have three horſes, and one eſquire: and that they ſhould neither hunt nor fowl. After the ruin of the kingdom of Jeruſalem about 1186, they ſpread themſelves through Germany and other countries of Europe, to which they were invited by the liberality of the Chriſtians. In the year 1228, this order acquired ſtability, by being confirmed in the council of Troyes, and ſubjected to a rule of dicipline drawn up by St Bernard. In every nation they had a particular governor, called *maſter of the Temple*, or of the *militia of the Temple*. The grand-maſter had his reſidence at Paris.

The order of Templars flouriſhed for ſome time, and acquired, by the valour of its knights, immenſe riches and an eminent degree of military renown: but as their proſperity increaſed, their vices were multiplied, and their arrogance, luxury, and cruelty roſe at laſt to ſuch a monſtrous height, that their privileges were revoked, and their order ſuppreſſed with the moſt terrible circumſtances of infamy and ſeverity. Their accuſers were two of their own body, and their chief proſecutor Philip the Fair of France, who addreſſed his complaints to Clement V. The pope, though at firſt unwilling to proceed againſt them, was under a neceſſity of complying with the king's deſire; ſo that, in the year 1307, upon an appointed day, and for ſome time afterwards, all the knights, who were diſperſed throughout Europe, were ſeized and impriſoned, and many of them, after trials for capital crimes, were convicted and put to death. In 1312 the whole order was ſuppreſſed by the council of Vienne. A part of the rich revenues they poſſeſſed was beſtowed upon other orders, eſpecially on the knights of St John, now of Malta, and the reſt confiſcated to the reſpective treaſuries of the ſovereign princes in whoſe dominions their poſſeſſions lay.—The knights Templars, in order to juſtify the ſeverity with which they were treated, were charged with apoſtaſy to the Saracens, and holding correſpondence with them, with inſulting the majeſty of God, turning into deriſion the Goſpel of Chriſt, and trampling upon the obligation of all laws human and divine. Candidates, it is ſaid upon admiſſion to this order, were commanded to ſpit, in token of contempt, upon an image of Chriſt, and after admiſſion to worſhip either a cat or a wooden head crowned with gold. It is farther affirmed, that, among them, the odious and unnatural act of ſodomy was a matter of obligation; and they are charged with other crimes too horrible to be mentioned, or even imagined. However, though there be reaſon to believe, that in this order, as well as others of the ſame period, there were ſhocking examples of impiety and profligacy; yet that the whole order was thus enormouſly corrupt, there is no reaſon to believe. The pope indeed, though he acted with ſeverity, acted with juſtice. He ſent two cardinals to Paris, who, publiſhing his bull againſt the order, condemned thoſe Templars who had made the voluntary confeſſion to be burnt by a ſlow fire. The criminals recanted their former confeſſions, but acknowleged themſelves worthy of death, becauſe they had unjuſtly accuſed the order of crimes of which they were innocent. Several authors of thoſe times wrote in defence of the order; and Boccace alleges, that its extirpation was owing to the avarice of the king of France, who coveted the rich poſſeſſions the Templars then enjoyed in France.

The king of Arragon was much preſſed to treat the Templars in his kingdom as they had been treated in France; but his conſtant anſwer was, "We muſt be firſt convinced of their guilt, and it will be then time enough to talk of their puniſhment." The people, however, were in general ſo provoked againſt them, that they were compelled to ſhut themſelves up in the fortreſſes belonging to their order, to prevent their being torn in pieces; which precaution was repreſented to the king of Arragon as an act of rebellion. He marched, therefore, with a corps of troops againſt one of theſe fortreſſes. The knight who commanded ſurrendered immediately, and told the king the truth, aſſuring him that they deſired nothing but a fair trial; with which declaration the king was extremely moved, took the whole order into his protection, and forbade any to abuſe or inſult them under the heavieſt penalties. At the ſame time he declared, he was ready to receive any informations againſt them that were ſupported by proofs; but if the informers failed therein, he would puniſh them as they deſerved.

Theſe facts plead ſtrongly for the innocence of the Templars, or at leaſt they prove that their guilt muſt have been exaggerated; and if we add, that many of the accuſations advanced againſt them flatly contradict each other, and that many members of this unfortunate order ſolemnly avowed their innocence while languiſhing under the ſevereſt tortures, and even with their dying breath—it would ſeem probable, that king Philip ſet on foot this bloody tragedy, with a view to gratify his avarice, and glut his reſentment againſt the Templars and eſpecially againſt their grand-maſter, who had highly offended him. The principal cauſe of his invincible hatred againſt them was, that in his quarrel with Boniface VIII. the knights eſpouſed the cauſe of the pope, and furniſhed him with money to carry on the war. They originally wore a white habit, with red croſſes ſewed upon their cloaks as a mark of diſtinction.

TEMPLE (Sir William), was born in London in the year 1628. The family from which he ſprung was ancient, and is ſaid to have aſſumed the ſurname of Temple from the manor of Temple, in the hundred of Sparken-Hall, in Leiceſterſhire. He was firſt ſent to ſchool at Penſehurſt, in Kent, under the care of his uncle, the celebrated Dr Hammond, then miniſter of that pariſh; but at the age of ten he was removed thence to a ſchool at Biſhop-Stortford, in Hertfordſhire. When he had acquired a ſufficient knowledge of the Greek and Latin, he returned home at the age of fifteen; and, two years after, he went to Cambridge, where he was placed under the tuition of the learned Dr Cudworth, then fellow of Emanuel College. His father, Sir John Temple, being a ſtateſmen, ſeems to have deſigned him for the ſame way of life; and on this account, after reſiding at Cambridge two years, which were principally ſpent in acquiring a competency of French and Spaniſh, both languages exceedingly uſeful for his intended purſuits, he was ſent abroad to finiſh his education.

Mr Temple began his travels by viſiting France in 1648. As he choſe to paſs through the Iſle of Wight, where his majeſty was detained a priſoner, he there accidentally met with the ſecond daughter of Sir Peter Oſborn of Chickſand, in Bedfordſhire, then governor of Guernſey for the king; and this lady being on a journey with her brother to St Maloes, where their father then was, our young traveller joined their party. This gave riſe to an honourable amour, which, at the end of ſeven years, concluded in a happy marriage. Having reſided two years in France, and learned the French language perfectly, Mr Temple made a tour through Holland, Flanders, and Germany, during which he became completely maſter of the Spaniſh. In 1654 he returned from the continent, and, marrying Miſs Oſborn, paſſed his time in retirement with his father, his two brothers, and a ſiſter, then in Ireland, happy in that perfect harmony which has been ſo often remarked in their family.

As he rejected all offers made him of employment under Cromwell, the five years which he lived in Ireland were ſpent chiefly in improving himſelf in hiſtory and philoſophy; but at the Reſtoration, in 1660, being choſen a member of the convention there, while others were trying to make their court to the king, Mr Temple oppoſed the poll-bill with ſo much ſpirit, that his conduct ſoon attracted the attention of the public, and brought him into notice. In the ſucceeding parliament, in 1661, he was elected with his father for the country of Carlow; and, in the year following, he was choſen one of the commiſſioners to be ſent from that parliament to the king, which gave him an opportunity of waiting on the duke of Ormond, the new lord-lieutenant, then at London. Soon after he went back to Ireland, but with a reſolution of quitting that kingdom, and of removing with his family to England.

On his return he met with a very favourable reception from the duke of Ormond; and ſoon accquired ſuch a conſiderable ſhare in his eſteem, that the duke complained of him as the only man in Ireland that had never aſked any thing from him. When he mentioned his deſign of carrying his family to England, his grace ſaid, that he hoped he would at leaſt give him leave to write in his favour to the two great miniſters, Clarendon then lord chancellor, and the earl of Arlington, who was ſecretary of ſtate. This the duke did in ſuch ſtrong terms, as procured him the friendſhip of theſe two noblemen, as well as the good opinion of the king. Mr Temple, however, made no other uſe of this advantage than to tell lord Arlington, that if his majeſty had any employment abroad, which he was fit for, he ſhould be happy to undertake it; but, at the ſame time, he requeſted that he might not be ſent into any of the northern climates, to which he had a very great averſion. Lord Arlington replied, he was very ſorry he had made ſuch an objection, as there was no other employment then undiſpoſed of except that of going envoy to Sweden. However, in 1665, about the beginning of the firſt Dutch war, lord Arlington ſent a meſſenger to acquaint him that he muſt immediately come to his houſe; which he did, and found that his lordſhip's buſineſs was to tell him, that the king had occaſion to ſend ſome perſon abroad upon an affair of the utmoſt importance, and that he had reſolved to make him the firſt offer; but that he muſt know, without delay, and without telling him what it was, whether he would accept of it, and that he muſt be ready to ſet out in two or three days, without mentioning it to any of his friends. After a little conſideration, Mr Temple told his lordſhip, that, as he took him to be his friend, and as he had adviſed him not to refuſe, as it would be an entrance into his majeſty's ſervice, he ſhould conſult no farther. This buſineſs was to carry a ſecret commiſſion to the biſhop of Munſter; which he ſet out with on the ſecond of Auguſt, and executed ſo much to the ſatisfaction of Charles II. that, on his return to Bruſſels, his majeſty appointed him reſident there, and created him a baronet. As Bruſſels was a place which he had long wiſhed to reſide at, in April 1666 he ſent for his family; but, before their arrival, he had been again obliged to depart upon buſineſs to the prelate's court: for the biſhop having liſtened to terms of accommodation with France, Sir William wrote two letters to diſſuade him from that alliance; and theſe not having the deſired effect, he went in diſguiſe to Munſter, where, though he arrived too late to ſecure the prince in his firſt engagement, yet he prevailed on him to permit five or ſix thouſand of his beſt troops to enter into the Spaniſh ſervice. In this journey he paſſed for a Spaniſh envoy, having twenty Spaniſh guards to attend him. In this manner he firſt went to Duſſeldorp, where the duke of Newburgh, though in the French intereſt, gave him a guard to Dortmund; but when he reached that place, finding the gates ſhut, he was forced to proceed to a village, at the diſtance of a league, which, being full of Brandenburg troops, he was under the neceſſity of lodging in a barn, upon a ſtraw bed, with his page for a pillow. Next day he was entertained at a caſtle belonging to the biſhop of Munſter, by one Gorges a Scotch lieutenant-general in that prelate's ſervice, with what he calls a very epiſcopal way of drinking. The general coming to the large hall, in which ſtood a great many flaggons ready charged, he called for wine to drink the king's health. A ſilver bell, that might hold about two quarts, was upon this brought him; and, as ſoon as he received it, he pulled out the clapper, and giving it to Sir William, to whom he intended to drink, ordered the bell to be filled. When this was done, he drank off the contents to his majeſty's health; and aſking Sir William for the clapper, put it on, and turning down the bell, rang it, to ſhew that he had drank fair, and left nothing in it. He then took out the clapper, deſired Sir William to give it to whomſoever he pleaſed; and, ordering the bell to be filled again, preſented it to Sir William: but as the latter ſeldom uſed to drink, he had generally ſome gentleman with him to ſupply his place in this reſpect whenever it might be neceſſary. Having finiſhed his buſineſs at Munſter, he returned to Bruſſels, where he paſſed a year with great pleaſure and ſatisfaction.

Two months after the concluſion of the peace with the Dutch at Breda, Sir William's ſiſter, who reſided with him at Bruſſels, being very deſirous of ſeeing Holland, he went thither incognito to gratify her deſire: but while he was at the Hague, he paid a private viſit to Mr De Witt, in which he laid the foundation of that cloſe intimacy which afterwards ſubſiſted between them.

In the ſpring of 1667, a new war breaking out between France and Spain, which expoſed Bruſſels to the danger of falling into the hands of the former, Sir William ſent his lady and family to England; but he himſelf remained there with his ſiſter till the Chriſtmas following, when he was ordered by the king to come over privately to London. Taking the Hague in his way, he paid another viſit to De Witt, and, purſuant to his inſtructions, propoſed thoſe overtures to him which produced the triple alliance. Soon after his arrival at the Britiſh court, he returned, on the 16th of January 1668, with the character of envoy extraordinary and plenipotentiary to Holland; where a conference being opened, he brought that treaty to a perfect concluſion in the ſhort ſpace of five days. The ratifications of this alliance being exchanged on the 15th of February, he repaired to Bruſſels; and a treaty being ſet on foot between France and Spain at Aix la-Chapelle, he ſet out for that place on the 24th of April in quality of his majeſty's ambaſſador extraordinary and mediator. Here he arrived on the 27th: and it was chiefly owing to his aſſiſtance that the Spaniards were brought to ſign the articles of that peace on the ſecond of May. This ſervice being completed, he returned to Bruſſels, with a view of remaining there in his former ſtation of reſident; but he received letters from the earl of Arlington, with the king's order to continue as ambaſſador, and to ſerve his country in that quality in Holland, as, on account of the late alliances, his majeſty was reſolved to renew a character which the crown of England had diſcontinued there ſince the time of king James. Sir William being now left at liberty to return to England, embraced the opportunity; and upon his arrival at London, he was received with every poſſible demonſtration of favour both by the king and the court.

Setting out again for Holland, with his new character of the king's ambaſſador, he arrived at the Hague in the end of Auguſt 1668. Here he enjoyed the confidence of that great miniſter De Witt, and lived in great intimacy with the prince of Orange, who was then only eighteen years of age; but, in September 1669, he was hurried back to England by lord Arlington, who ordered him to put his foot in the ſtirrup as ſoon as he ſhould receive his letter. When Sir William waited on the earl, he found that he had not one word to ſay to him; for, after making him attend a long time, he only aſked him a few indifferent queſtions reſpecting his journey. Next day he was received as coolly by the king; but the ſecret ſoon came out, and he was preſſed to return to the Hague, and pave the way for a war with Holland. This, however, he excuſed himſelf from having any hand in; which ſo much provoked the lord treaſurer Clifford, that he refuſed to pay him an arrear of two thouſand pounds due from his embaſſy. Diſguſted with Arlington's behaviour, which was ſo unlike the friendſhip he had formerly profeſſed, Sir William now retired to his houſe at Sheen near Richmond, in Surry; and in this retreat, when free from the hurry of buſineſs, he wrote his Obſervations on the United Provinces, and one part of his Miſcellanies, in the time of the ſecond Dutch war. About the end of ſummer, however, 1673, the king wiſhing to put an end to the war, ſent for Sir William, and deſired him to go to Holland to negotiate a peace; but powers having been ſent from thence at this time to the Marquis de Freſno, the Spaniſh ambaſſador at London, Sir William was ordered to confer with him; and a treaty was accordingly concluded in three days, and the point carried reſpecting the ſuperiority of the Britiſh flag, which had been ſo long conteſted. In June 1674 he was again ſent ambaſſador to Holland to offer the king's mediation between France and the conſederates, then at war, which was accepted not long after; Lord Berkeley, Sir William Temple, and Sir Leoline Jenkins, being declared ambaſſadors and mediators; and Nimeguen, which Sir William had propoſed, was at length agreed upon by all parties to be the place of treaty. During his ſtay at the Hague, the prince of Orange, who was fond of the Engliſh language, and of the plain Engliſh way of eating, conſtantly dined and ſupped once or twice a week at his houſe; and by this familiarity he ſo much gained the prince's confidence and eſteem, that he had a conſiderable hand in his marriage with the Princeſs Mary, daughter of James II.

In July 1676 he removed his family to Nimeguen, where he ſpent the remainder of that year without making any progreſs in the treaty; and the year following his ſon was ſent over with letters from the lord treaſurer, ordering him to return, and ſucceed Mr Coventry as ſecretary of ſtate. In conſequence of this order, Sir William went over to England in the ſpring of 1677; and though the affair of the ſecretary's place was dropped at his deſire, he did not return to Nimeguen that year. About this time, the prince having the king's leave to come over, he ſoon after married the Princeſs Mary; and this gave occaſion for a new coolneſs between lord Arlington and Sir William, as he and the lord treaſurer Oſborn, who was related to Sir William's lady, were only privy to that affair. After the prince and princeſs were gone to Holland, as the court always ſeemed inclined to favour France, the king wiſhed to engage Sir William in ſome negotiations with that crown: but he was ſo ill ſatisfied with this propoſal, that he offered to give up all pretenſions to the office of ſecretary; and deſiring the lord treaſurer to acquaint his majeſty with his intentions, retired to Sheen, in hopes of being taken at his word. Upon a diſcovery, however, of the French deſigns not to evacuate the Spaniſh towns agreed by the treaty to be delivered up, the king commanded him to go upon a third embaſſy to the ſtates; with whom he concluded a treaty: by which England engaged, in caſe France refuſed to evacuate the towns in forty days, to declare war immediately againſt that nation: but before half that time was elapſed, one Du Croſs was ſent from the Engliſh court to Holland upon a buſineſs which damped all the good humour excited by the treaty there, and which produced ſuch ſudden and aſtoniſhing changes in this country, as gave Sir William a diſtaſte for all public employments.

In 1679 he went back to Nimeguen, where the French delayed to ſign the treaty till the laſt hour; but having concluded it, he returned to the Hague, whence he was ſoon after ſent for to enter upon the ſecretary's office, which Mr Coventry at length reſolved to reſign. He accordingly went over, and went to court, as all his friends hoped, with a full intention of aſſuming his office; but he ſtarted ſome difficulty, becauſe he had not a ſeat in the houſe of commons, thinking that, by his not being a member, the public buſineſs would ſuffer at ſuch a critical time, when the conteſts between the two parties ran ſo high that the king thought fit to ſend the duke of York into Flanders, and the parliament to put the lord treaſurer Danby into the Tower. After this his majeſty ſtill preſſed Sir William to be ſecretary of ſtate; uſing as an argument for his compliance, that he had nobody to conſult with at a time when he had the greateſt need of the beſt advice. Notwithſtanding all this, Sir William declined the king's offer, adviſing him to chooſe a council in whom he could confide, and upon whoſe abilities he could depend. This advice the king followed; and the choice of the perſons being concerted between his majeſty and Sir William, the old council was diſſolved four days after, and the new one eſtabliſhed, of which the latter was a member.

In 1680 the councils began again to be changed, on the king's illneſs, at the end of ſummer, and the duke of York's return privately to court. In this juncture Sir William, endeavouring to bring to the king's favour and buſineſs ſome perſons to whom his majeſty had taken a diſlike, if not an averſion, he met with ſuch treatment from them as gave him a freſh diſtaſte to the court, at which he ſeldom made his appearance; ſo that he reſided principally at Sheen. Soon after this the king ſent for him again; and having propoſed that he ſhould go as ambaſſador into Spain, Sir William conſented: but when his equipage was almoſt ready, and part of the money paid down for it, the king changed his mind, and told him that he would have him defer his journey till the end of the ſeſſion of parliament, in which he was choſen a member for the univerſity of Cambridge. In this ſeſſion the ſpirit of party ran ſo high that it was impoſſible to bring the houſe to any kind of temper. The duke was ſent into Scotland; but this would not ſatisfy them, nor any thing but a bill of excluſion; which Sir William ſtrenuouſly oppoſed, ſaying, that "His endeavour ever would be to unite the royal family, and that he ſhould never enter into any councils to divide them." Not long after this period, the parliament being diſſolved by his majeſty, without the advice of his privy council, and contrary to what he had promiſed, Sir William made a bold ſpeech againſt it; for which he was very ill uſed by ſome of thoſe friends who had been moſt earneſt in promoting the laſt change in the miniſtry. Upon this he grew quite tired of public buſineſs, declined the offer he had of again ſerving for the univerſity in the next parliament, that was ſoon after called, and met at Oxford; and ſeeing his majeſty reſolved to govern without his parliament, and to ſupply his treaſury through another channel, he retired to Sheen a few days after, whence he ſent word by his ſon, that "he would paſs the reſt of his days like a good ſubject, but would never more meddle with public affairs." From that time Sir William lived at this place till the end of that reign and for ſome time in the next; when having purchaſed a ſmall ſeat, called *Moor Park*, near Farnham in Surry, which he conceived a great fondneſs for on account of its ſolitude and retirement, and its healthy and pleaſant ſituation, and being much afflicted with the gout, and broken with age and infirmities—he reſolved to ſpend the remainder of his life in this agreeable retreat. In his way thither, therefore, he waited on king James, who was then at Windſor, and begged his favour and protection to one "that would always live as a good ſubject, but, whatever might happen, never again enter upon any public employment;" deſiring his majeſty to give no credit to any thing he might hear to the contrary. The king, who uſed to ſay that Sir William Temple's character was always to be believed, promiſed him whatever he deſired, gently reproached him for not entering into his ſervice, which, he ſaid, was his own fault; and kept his word as faithfully to Sir William as Sir William did to his majeſty, during the ſurpriſing turn of affairs that ſoon after followed by the arrival of the prince of Orange. At the time of this happy revolution, in 1688, Moor-Park becoming unſafe,

ſafe, as it lay in the way of both armies, he went back to the houſe at Sheen, which he had given up to his ſon; to whom he refuſed leave, though importunately begged, to go and meet the prince of Orange at his landing: but after king James's abdication, when the Prince reached Windſor, he went thither to wait upon his highneſs, and carried his ſon along with him. The prince preſſed him to enter into his ſervice, and to be ſecretary of ſtate; but his age and infirmities confirming him in the reſolution he had made not to meddle any more with public affairs, he was ſatisfied that his ſon alone ſhould enjoy his majeſty's favour. Mr John Temple was upon this appointed ſecretary at war; but he had hardly been a week in that office, when he reſolved to put an end to his own exiſtence; which he did on the 14th of April 1689, by throwing himſelf out of a boat, hired for that purpoſe, in ſhooting London-bridge; having firſt put ſtones into his pocket to make him ſink ſpeedily.

In 1694 Sir William had the misfortune to loſe his lady, who was a very extraordinary woman, as well as an affectionate wife. He was then conſiderably turned of ſixty; at which age he practiſed what he had ſo often declared to be his opinion, that "an old man ought then to conſider himſelf of no farther uſe in the world except to himſelf and his friends." After this he lived four years, very much afflicted with the gout; and his ſtrength and ſpirits being worn out by the infirmities of age, he expired in the month of January 1698. He died at Moor-Park, where his heart was buried in a ſilver box under the ſun dial in his garden, oppoſite to a window from which he uſed to contemplate and admire the works of nature, with his ſiſter the ingenious lady Gifford. This was according to his will; in purſuance of which his body was privately interred in Weſtminſter Abbey, and a marble monument erected in 1722, after the death of lady Gifford, who reſembled him in genious as well as in perſon, and left behind her the character of one of the beſt and moſt conſtant friends in the world.

Sir William Temple's principal works are, 1. Memoirs from 1672 to 1692: They are very uſeful for thoſe who wiſh to be acquainted with the affairs of that period. 2. Remarks upon the State of the United Provinces. 3. An Introduction to the Hiſtory of England: This is a Sketch of a General Hiſtory. 4. Letters written during his laſt embaſſies. And, 5. Miſcellanies, which contain a great many curious pieces that diſplay conſiderable depth of thought. He was an accompliſhed gentleman, a ſound politician, a patriot, and a great ſcholar. And if this great idea ſhould perchance be ſhaded by ſome touches of *vanity* and *ſpleen*, the reader will be ſo candid as to conſider, that the greateſt, wiſeſt, and the beſt of men, have ſtill ſome failings and imperfections which are inſeparable from human nature.

Temple, *templum*, a public building, erected in honour of ſome deity, either true or falſe; and wherein the people meet to pay religious worſhip to the ſame. The word is formed from the Latin *templum*, which ſome derive from the Greek τεμενος, ſignifying the ſame thing; and others from τεμνω, *abſcindo*, "I cut off, I ſeparate," in regard a temple is a place ſeparated from common uſes; others with more probability derive it from the old Latin word *templare*, "to contemplate." It is certain the ancient augurs gave the name *templa* to thoſe parts of the heavens which were marked out for the obſervation of the flight of birds. Their formula was this: *Templa teſqua ſunto.* Temples were originally all open, and hence received their name. See Phil. Tranſ. n° 471. ſect. 5. where we have an account of an ancient temple in Ireland of the ſame ſort as the famous Stonehenge. The word *templum*, in its primary ſenſe among the old Romans, ſignified nothing more than a place ſet apart and conſecrated by the augurs, whether incloſed or open, in the city or in the fields.

Clemens Alexandrinus and Euſebius refer the origin of temples to the ſepulchres built for the dead. This notion has been lately illuſtrated and confirmed by a variety of teſtimonies by Mr Farmer in his Treatiſe on the Worſhip of Human Spirits, p. 373, &c. Herodotus and Strabo will have the Egyptians to have been the firſt who built temples to the gods. The firſt erected in Greece is aſcribed to Deucalion, by Apollonius, Argonaut. lib. iii. In antiquity we meet with many people who would not build any temples to their gods for fear of confining them to too narrow bounds. They performed their ſacrifices in all places indifferently, from a perſuaſion that the whole world is the temple of God, and that he required no other. This was the doctrine of the magi, followed by the Perſians, the Scythians, the Numidians, and many other nations mentioned by Herodotus, lib. i. Strabo, lib. xv. and Cicero in his ſecond oration againſt Verres.

The Perſians, who worſhipped the ſun, believed it would wrong his power to incloſe him in the walls of a temple, who had the whole world for his habitation; and hence, when Xerxes ravaged Greece, the magi exhorted him to deſtroy all the temples he met with.

The Sicyonians would build no temple to their goddeſs Coronis; nor the Athenians, for the like reaſon, erect any ſtatue to Clemency, who, they ſaid, was to live in the hearts of men, not within ſtone walls.

The Bithynians had no temples but the mountains to worſhip on; nor had the ancient Germans any other but the woods.

Even ſome philoſophers have blamed the uſe and building of temples, particularly Diogenes, Zeno, and his followers the Stoics. But it may be ſaid, that if God hath no need of temples, men have need of places to meet in for the public offices of religion: accordingly temples may be traced back even into the remoteſt antiquity. See *Hoſpinian de Origine Templorum*.

The Romans had ſeveral kinds of temples; whereof thoſe built by the kings, &c. conſecrated by the augurs, and wherein the exerciſe of religion was regularly performed, were called, by way of eminence, *templa*, "temples." Thoſe that were not conſecrated, were called *ædes*. The little temples, that were covered or roofed, they called *ædiculæ*. Thoſe open, *ſacella*. Some other edifices, conſecrated to particular myſteries of religion, they called *fana* and *delubra*.

All theſe kinds of temples, Vitruvius tells us, had other particular denominations, according to the form and manner of their conſtruction, as will be hereafter ſpecified.

Indeed the Romans outdid all nations with regard to temples: they not only built temples to their gods, to their virtues, to their diſeaſes, &c. but alſo to their emperors, and that in their life time: inſtances whereof we meet with in medals, inſcriptions, and other monuments. Horace compliments Auguſtus hereupon, and ſets him above Hercules and all the heroes of fable; becauſe thoſe were admitted into temples only after their death, whereas Auguſtus had his temples and altars while living.

> *Præſenti tibi maturos largimur honores;*
> *Jurandaſque tuum per nomen ponimus aras.*
>
> Epiſt. ad Aug.

Suetonius, on this occaſion, gives an inſtance of the modeſty of that emperor, who would allow of no *temples* being erected to him in the city; and even in the provinces, where he knew it was uſual to raiſe temples to the very proconſuls, refuſed any but thoſe erected in the name of Rome as well as his own.

The moſt celebrated temples among the Romans were the Capitol and Pantheon. They had alſo the temple of Saturn, which ſerved for the public treaſury; and the temple of Janus.

The temple at Jeruſalem was ſimilar in its plan to the Tabernacle. The firſt temple was begun by Solomon about the year of the world 2992, and before Chriſt 1012 according to ſome chronologers, and finiſhed in eight years. Great miſtakes have been committed reſpecting the dimenſions of this temple, by confounding the emblematical deſcription of Ezekiel with the plain account of it in the books of Kings and Chronicles. It conſiſted of the holy of holies, the ſanctuary, and a portico. The holy of holies was a ſquare room of 20 cubits; the ſanctuary, or holy place, was 40 cubits long and 20 broad, conſequently the length of both theſe together was 60 cubits. The portico, which ſtood before the ſanctuary, was 20 cubits long and 10 cubits broad. Whether the portico was ſeparated by a wall from the reſt of the temple or not, is not mentioned in Scripture. If it was, the whole length of the temple, computing the cubit at 22 inches, did not exceed 110 feet in length and 36 feet 8 inches in breadth. In the portico ſtood the two brazen pillars called *Jachin* and *Boaz*, which, upon comparing and reconciling the ſeemingly different account in different places, appear to have been 40 cubits high and about 4 cubits diameter. The court probably at firſt extended all round the temple. Now we are told, that the court about the tabernacle was 100 cubits long and 50 broad; and as Solomon made every part of the temple about twice as large as the correſponding part in the tabernacle, we have reaſon to conclude, that the court around the temple was 200 cubits long and 100 broad. According to this deſcription, which is taken from the Scripture hiſtory, the temple of Solomon was by no means ſo large as it is commonly repreſented. Still, however, it was very magnificent in ſize and ſplendid in ornament. It was plundered of its treaſures in the reign of Rehoboam, and repaired by Joaſh; it was again ſpoiled in the time of Ahaz and of Hezekiah; and after being reſtored by Joſiah, was demoliſhed by Nebuchadnezzar in the year of the world 3416, after it had ſtood 476 years according to Joſephus, and according to Uſher 428 years.

The ſecond temple was built by the Jews, after their return from the Babyloniſh captivity, under the direction and influence of Zerubbabel their governor, and of Joſhua the high-prieſt, with the leave and encouragement of Cyrus the Perſian emperor, to whom Judea was now become a tributary kingdom. According to the Jews, this temple was deſtitute of five remarkable appendages, which were the chief glory of the firſt temple; viz. the ark and mercy-ſeat, the Shechinah, the holy fire on the altar, which had been firſt kindled from heaven, the urim and thummim, and the ſpirit of prophecy. This temple was plundered and profaned by Antiochus Epiphanes, who alſo cauſed the public worſhip in it to ceaſe; and afterwards purified by Judas Maccabæus, who reſtored the divine worſhip; and after having ſtood five hundred years, rebuilt by Herod, with a magnificence approaching to that of Solomon's. Tacitus calls it *immenſæ opulentiæ templum*; and Joſephus ſays, it was the moſt aſtoniſhing ſtructure he had ever ſeen, as well on account of its architecture as its magnitude, and likewiſe the richneſs and magnificence of its various parts and the reputation of its ſacred appurtenances. This temple, which Herod began to build about ſixteen year before the birth of Chriſt, and ſo far completed in nine years and a half as to be fit for divine ſervice, was at length deſtroyed by the Romans on the ſame month and day of the month on which Solomon's temple was deſtroyed by the Babylonians.

Maurice's Indian Antiquities, vol. iii. p. 352.

The Indian temples, or pagodas, are ſometimes of a prodigious ſize. They are commonly erected near the banks of the Ganges, Kiſtna, or other ſacred rivers, for the benefit of ablution in the purifying ſtream. Where no river flows near the foot of the pagoda, there is invariably in the front of it a large tank or reſervoir of water. Theſe are, for the moſt part, of a quadrangular form, are lined with free-ſtone or marble, have ſteps regularly deſcending from the margin to the bottom, and Mr Crauford obſerved many between three and four hundred feet in breadth. At the extrance of all the more conſiderable pagodas there is a portico, ſupported by rows of lofty columns, and aſcended by a handſome flight of ſtone ſteps; ſometimes, as in the inſtance of Tripetti*, to the number of more than a hundred. Under this portico, and in the courts that generally incloſe the whole building, an innumerable multitude aſſemble at the riſing of the ſun; and, having bathed in the ſtream below, and, in conformity to an immemorial cuſtom over all the Eaſt, having left their ſandals on the border of the tank, impatiently await the unfolding of the gates by the miniſtring brahmin. The gate of the pagoda univerſally fronts the eaſt, to admit the ray of the ſolar orb; and, opening, preſents to the view an edifice partitioned out, acccording to M. Thevenot in his account of Chitanagar, in the manner of the ancient cave-temples of Elora, having a central nave or body; a gallery ranging on each ſide; and, at the farther end, a ſanctuary, or chapel of the deity adored, ſurrounded by a ſtone balluſtrade to keep off the populace. Thoſe who wiſh to peruſe a more particular account of the Indian temples may conſult Maurice's Indian Antiquities. See alſo Pagoda and Seringham.

Crauford's Sketches, vol. i. p. 160.

* Voyage des Indes. tom. iii.

Temple, in architecture. The ancient temples were diſtinguiſhed, with regard to their conſtruction, into various kinds; as, *Temple in antæ, Ædes in antis*. Theſe, according to Vitruvius, were the moſt ſimple of all temples, having only angular pilaſters, called *antæ* or *paraſtatæ*, at the corners, and two Tuſcan columns on each ſide of the doors. *Temple, tetraſtyle*, or ſimple *tetraſtyle*, was a temple that had four columns in front and as many behind. Such was the temple of Fortuna Virilis at Rome. *Temple, proſtyle*, that which had only columns in its front or fore ſide; as that of Ceres at Eleuſis in Greece. *Temple, amphiproſtyle*, or *double proſtyle*, that which had columns both before and behind, and which was alſo tetraſtyle. *Temple, periptere*, that which had four rows of inſulated columns around, and was hexaſtyle, *i. e.* had ſix columns in front; as the temple of Honour at Rome. *Temple, diptere*, that which had two wings and two rows of columns around, and was alſo octoſtyle, or had eight columns in front; as that of Diana at Epheſus.

Temples, among us denote two inns of court in London, thus called, becauſe anciently the dwelling-houſe of the knights-templars. At the ſuppreſſion of that order, they were purchaſed by the profeſſors of the common law, and converted into *hoſpitia* or inns. They are called the *inner* and *middle temple*, in relation to Eſſex-houſe; which was alſo a part of the houſe of the templars, and called the *outer temple*, becauſe ſituated without Temple-Bar. In the middle temple, during the time of the templars, the king's treaſure was kept; as was alſo that of the kings of France in the houſe templars at Paris. The chief officer was the maſter of the temple, who was ſummoned to parliament in 47. Hen. III. and from him the chief miniſter of the temple church is ſtill called *maſter of the temple*.

Temples, in anatomy, a double part of the head, reaching from the forehead and eyes to the two ears. The temples are chiefly formed of two bones called *oſſa temporis*.

Theſe parts, according to phyſicians, were called *tempora*, from their ſhowing the age or time of a man by the colour of the hair, which turns white in this part before any other; which Homer ſeems to have been aware of, by his calling men *poliocrotaphi*, *q. d.* "grey-templed."

TEMPORAL, a term generally uſed for ſecular, as a diſtinction from eccleſiaſtical. Thus we ſay temporal lords, and ſpiritual or eccleſiaſtical lords.

TEMPORALTIES *of* BISHOPS, are the revenues, lands, tenements, and lay-fees, belonging to biſhops, as they are barons and lords of parliament.

The cuſtody of the temporalties of biſhops forms a branch of the king's ordinary revenues (ſee REVENUE.).—Theſe, upon the vacancy of the biſhopric, are immediately the right of the king, as a conſequence of his prerogative in church matters; whereby he is conſidered as the founder of all archbiſhoprics and biſhoprics, to whom, during the vacancy, they revert. And for the ſame reaſon, before the diſſolution of abbeys, the kings had the cuſtody of the temporalties of all ſuch abbeys and priories as were of royal foundation (but not of thoſe founded by ſubjects), on the death of the abbot or prior. Another reaſon may alſo be given why the policy of the law hath veſted this cuſtody in the king; becauſe, as the ſucceſſor is not known, the lands and poſſeſſions of the ſee would be liable to ſpoil and devaſtation if no one had a property therein. Therefore the law has given the king, not the temporalties themſelves, but the cuſtody of the temporalties, till ſuch time as a ſucceſſor is appointed; with power of taking to himſelf all the intermediate profits, without giving any account to the ſucceſſor; and with the right of preſenting (which the crown very frequently exerciſes) to ſuch benefices and other preferments as fall within the time of vacation. This revenue is of ſo high a nature, that it could not be granted out to a ſubject, before or even after it accrued: but now, by the ſtatute 15 Edw. III. ſt. 4. c. 4 & 5. the king may, after the vacancy, leaſe the temporalties to the dean and chapter; ſaving to himſelf all advowſons, eſcheats, and the like. Our ancient kings, and particularly William Rufus, were not only remarkable for keeping the biſhoprics a long time vacant, for the ſake of enjoying the temporalties, but alſo committed horrible waſtes on the woods and other parts of the eſtate; and to crown all, would never, when the ſee was filled up, reſtore to the biſhop his temporalties again, unleſs he purchaſed them at an exorbitant price. To remedy which, king Hen. I. granted a charter at the beginning of his reign, promiſing neither to ſell, nor let to farm, or take any thing from, the domains of the church, till the ſucceſſor was inſtalled. And it was made one of the articles of the great charter, that no waſte ſhould be committed in the temporalties of biſhoprics, neither ſhould the cuſtody of them be ſold. The ſame is ordained by the ſtatute of Weſtminſter the firſt; and the ſtatute 14 Edw. III. ſtat. 4. c. 4. (which permits a leaſe to the dean and chapter) is ſtill more explicit in prohibiting the other exactions. It was alſo a frequent abuſe, that the king would, for trifling or no cauſes, ſeize the temporalties of biſhops, even during their lives, into his own hands: but this is guarded againſt by ſtatute 1 Edw. III. ſt. 2. c. 2.

Blackſt. Comment. vol. i.

This revenue of the king, which was formerly very conſiderable, is now by a cuſtomary indulgence almoſt reduced to nothing: for, at preſent, as ſoon as the new biſhop is conſecrated and confirmed, he uſually receives the reſtitution of his temporalties quite entire and untouched from the king; and then, and not ſooner, he has a fee-ſimple in his biſhopric, and may maintain an action for the profits.

TENACITY, in natural philoſophy, that quality of bodies by which they ſuſtain a conſiderable preſſure or force of any kind without breaking. It is the quality oppoſite to fragility or brittleneſs. See *STRENGTH of Materials*.

TENACULUM, in ſurgery, an inſtrument uſed in amputation, for pulling out bleeding veſſels that are to be tied by ligatures. See SURGERY.

TENAILLES and TENAILLIONS. } See FORTIFICATION, Sect. I. § 3. and 5.

TENANT, one that holds lands or tenements of ſome lord or landlord, by rent, fealty, &c. See TENURE.

TENAWWIT. See LOXIA, ſpecies 13.

TENCH, in ichthyology. See CYPRINUS, ſpecies 3.

TENDER, a ſmall ſhip in the ſervice of men of war, for carrying men, proviſions, or any thing elſe that is neceſſary.

TENDONS, in anatomy, are white, firm, and tenacious parts, contiguous to the muſcles, and uſually forming their extremities. See ANATOMY, n° 85.

TENEBRIO, in natural hiſtory, a genus of inſects belonging to the order of *Coleoptera*. The antennæ are moniliform, the laſt joint being roundiſh; the thorax is plano-convex and marginated; the head projecting, and the elytra are ſomewhat ſtiff. Gmelin enumerates about 63 ſpecies. The larvæ of ſome live in damp places under ground among rubbiſh; of others in flour and different kinds of food, where they undergo their metamorphoſis. The perfect inſects are very troubleſome in houſes; eating bread, meat, &c. They precipitately avoid the light; reſorting in troops to dark damp cellars, where putrefaction allures and nouriſhes them. They are all of a very dark gloomy appearance, from which circumſtance they take their name.

TENEDOS (anc. geog.), an iſland on the coaſt of Troas, at the diſtance of 40 ſtadia from the continent, and 80 in compaſs; with a cognominal Æolian town, and a temple of Apollo Smintheus. Its origin is derived from Tennes or Tenes, who being expoſed in a coffer or bog by his father Cygnus the Thracian, at the inſtigation of the mother-in-law, was by fate carried to this iſland, made king of it, and at length worſhipped as a god on account of his virtues. The iſland was famous for its earthen ware, for which purpoſe it had an excellent red clay; and hence Bochart would derive the appellation from *tinedom*, a "red clay." *Tenedia ſecuris*, is a proverbial ſaying to denote ſeverity; from a law there paſſed, that perſons found in the act of adultery ſhould be put to death; a ſeverity executed on the king's ſon; and therefore, in the coins of Tenedos, on one are two heads in memorial of the king and his ſon, and on the reverſe an axe, (Ariſtotle). This iſland ſtill retains its ancient name; and is one of the ſmalleſt iſlands of the Archipelago, ſituated near the coaſt of Leſſer Aſia, weſt of the ruins of Troy. It is chiefly rocky, but fertile, being remarkable for producing the beſt Muſcadine wine in the Levant; and its poſition, thus near the mouth of the Helleſpont, has given it importance in all ages; veſſels bound towards Conſtantinople finding ſhelter in its port, or ſafe anchorage in the road, during the Eteſian or contrary winds, and in foul weather. The emperor Juſtinian erected a magazine to receive the cargoes of the corn-ſhips from Alexandria, when detained there. This was a lofty building, two hundred and eighty feet long and ninety broad. The voyage from Egypt was rendered leſs precarious, and the grain preſerved until it could be tranſported to the capital. Afterwards, during the troubles of the Greek empire, Tenedos experienced a variety of fortune. The pirates, who infeſted theſe ſeas, made it for many years their place of rendezvous; and Othman ſeized it in 1302, procured veſſels, and thence ſubdued the other iſlands of the Archipelago. It has continued in the poſſeſſion of the Turks ever ſince:

and on the eaſtern ſide is a pretty large town, ſeated at the foot of a mountain, with a fine harbour commanded by a caſtle. E. Long. 27. 0. N Lat. 29. 30.

TENERIFF, an iſland of Africa, and one of the Canaries, being the moſt conſiderable for riches, trade, and extent. It lies to the ſouth of the iſland of Salvages, to the weſt of the Grand Canary, to the north of the iſland of Gomera, and to the eaſt of that of Palma. It is of a triangular form, being about 45 miles in length and 20 in breadth; and in the centre is the famous *peak*, called by the natives *El Pico de Teyde*, which in clear weather may be ſeen at the diſtance of 120 miles, like a thin blue vapour very little darker than the ſky.

The moſt frequented harbour is called *Santa Cruz*, which is on the ſouth ſide of the iſland, and where ſhips with good anchors and cables may be ſafe in all weathers. At this port is the principal commercial town in the iſland, called alſo *Santa Cruz*, in the middle of which is a mole, built at a vaſt expence for the convenience of landing; between the mole and the town is a fort called *St Philips*, and near it is a ſteep rocky den or valley, beginning at the ſea ſhore, and running far inland, which would render the attack of an enemy very difficult; there are alſo other forts for its defence, all joined together by a thick ſtone wall, and mounted with cannon.

Glas's Hiſtorical Account of the Canary Iſlands.

Santa Cruz is a large town, containing ſeveral churches and convents, an hoſpital, and the beſt conſtructed private buildings of any in the Canary iſlands. It contains about 7000 inhabitants; it is not fortified on the land ſide, and all the country near it is dry, ſtony, and barren.

About four leagues to the ſouth of Santo Cruz, cloſe to the ſea, there is a cave, with a chapel called the *chapel of our Lady of Candelarie*, in which is an image of the Virgin Mary, that is held in as much reverence here as that of Diana was at Epheſus. This chapel is endowed with ſo many ornaments that it is the richeſt place in all the ſeven iſlands. At a certain ſeaſon of the year almoſt all the inhabitants go thither on pilgrimage, and innumerable and incredible ſtories are related and univerſally believed concerning this image.

About four miles inland from Santa Cruz ſtands the city of St Chryſtobal de la Laguna, which is the metropolis of the iſland, and contains two pariſh churches and five convents, but has no trade, being inhabited principally by the gentry of the iſland; the inhabitants are numerous, yet nobody is ſeen in the ſtreets, which are ſolitary and deſolate, ſo that graſs grows in thoſe that are moſt frequented. There are many other towns in the iſland which contain a great number of people, but none are more than three leagues from the ſea.

All the fertile ground within a league of the ſea is covered with vines; that of the next league is ſown with corn, the third is adorned with woods, and above the woods are the clouds, for the iſland gradually aſcends from the ſea, riſing on all ſides till it terminates in the peak, which is the centre.

On the ſouth-eaſt of the iſland inland from *Candelaria* is a town called *Guimar*, where there are ſome families which know themſelves to be the genuine unmixed offſpring of the original natives; but they know nothing of the manners of their anceſtors, nor have they preſerved any remains of their language. They are fairer than the Spaniards of Andaluſia.

Teneriff contains about 96,000 perſons, ſuppoſed to be equal to the number of inhabitants of all the reſt of the ſeven iſlands put together. The peaſants in general are wretchedly clothed; when they do appear better, they are habited in the Spaniſh faſhion. The men, in a genteeler line, dreſs very gayly, and are ſeldom ſeen without long ſwords. It is remarked, that few of them walk with dignity and eaſe; which may be attributed to the long cloaks they uſually wear. The women wear veils: thoſe worn by the lower ranks are of black ſtuff, thoſe of the higher of black ſilk; and ſuch among the latter as have any claim to beauty are far from being over careful in concealing their faces by them. The young ladies wear their fine long black hair plaited, and faſtened with a comb or a riband on the top of the head.

White's Voyage to New South Wales, p. 18.

The common people, and in this they reſemble the inhabitants of moſt of the iſlands in the Pacific Ocean lately diſcovered, have in them a ſtrong tendency to thieving; they are beſides lazy, and the moſt importunate beggars in the world. "I obſerved likewiſe (ſays Mr White) that the itch was ſo common among them, and had attained ſuch a degree of virulence, that one would almoſt be led to believe it was epidemic there. Some of the women are ſo abandoned and ſhameleſs, that it would be doing an injuſtice to the proſtitutes met with in the ſtreets of London to ſay they are like them. The females of every degree are ſaid to be of an amorous conſtitution, and addicted to intrigue; for which no houſes could be better adapted than thoſe in Teneriff.

"The manufactures carried on here are very few, and the product of them little more than ſufficient for their own conſumption. They conſiſt of taffeties, gauze, coarſe linens, blankets, a little ſilk, and curious garters. The principal dependence of the inhabitants is on their wine (their ſtaple commodity), oil, corn, and every kind of ſtock for ſhipping. With theſe the iſland abounds: and, in their ſeaſon, produces not only the tropical fruits, but the vegetable productions of the European gardens, in the greateſt plenty. Teneriff enjoys an agreeable and healthful mediocrity of climate. Indeed none ſeems better adapted for the reſtoration of a valetudinarian; as, by going into the mountains, he may graduate the air, and chooſe that ſtate of it which beſt ſuits his complaint. But although the inhabitants are thus healthy, and have ſo little occaſion for medical aid, they loudly complain of the want of knowledge in the profeſſional gentlemen of the iſland."

Rye's Excurſion to the Peak of Teneriff.

The height of the peak of Teneriff has been ſo variouſly eſtimated and calculated by different travellers and geographers, that we can only take the mean between the two extremes of their deciſions. Dr Halley allows but two miles and a quarter from the level of the ſea to the ſummit of the ſugar-loaf, whilſt the Spaniſh account of the Canary iſlands, tranſlated by Mr Glas in 1763, makes it no leſs than five miles; and others have aſſigned a height different from both theſe. That it is an extinguiſhed volcano is univerſally known; and we are perſuaded that the following account of the crater, and of ſome experiments made on its brink by M. Mongez on the 24th of Auguſt 1785, will prove not unacceptable to our chemical readers.

Journal de Phyſique.

"The crater of the peak of Teneriff (ſays he) is a true ſulphur-pit, ſimilar to thoſe of Italy. It is about 50 fathoms long and 40 broad, riſing abruptly from eaſt to weſt. At the edges of the crater, particularly on the under ſide, are many ſpiracles, or natural chimneys, from which there exhale aqueous vapours and ſulphureous acids, which are ſo hot as to make the thermometer riſe from 9° to 34° of Reaumur. The inſide of the crater is covered with yellow, red, or white, argillaceous earth, and blocks of lava partly decompoſed. Under theſe blocks are found ſuperb cryſtals of ſulphur; theſe are eight ſided rhomboidal cryſtals, ſometimes an inch in length, and, I ſuppoſe, they are the fineſt cryſtals of volcanic ſulphur that have ever been found. The water that exhales from the ſpiracles is perfectly pure, and not in the leaſt acid, as I was convinced by ſeveral experiments.

“ The elevation of the peak above the level of the ſea is near 1900 toiſes; which induced me to make ſeveral chemical experiments in order to compare the phenomena with thoſe that occur in our laboratories. I ſhall here confine myſelf merely to the reſults.

“ The volatilization and cooling of liquors were here very conſiderable. Half a minute was ſufficient for the diſſipation of a pretty ſtrong doſe of æther. The action of acids on metals, earths, and alkalis, was ſlow; and the bubbles which eſcaped during the efferveſcence were much larger than ordinary. The production of vitriols was attended with very ſingular phenomena. That of iron aſſumed all at once a very beautiful violet colour, and that of copper was ſuddenly precipitated of a very bright blue colour. I examined the moiſture of the air by means of the hygrometer, of pure alkali, and of vitriolic acid; and I thence concluded, as well as from the direction of the aqueous vapours, that the air was very dry; for at the end of three hours the vitriolic acid had ſuffered hardly any change either in colour or weight; the fixed alkali remained dry, except near the edges of the veſſel that contained it, where it was a little moiſt; and Sauſſure's hygrometer pointed to 64°, as nearly as the impetuous wind which then blew would permit us to judge.

“ Liquors appeared to us to have loſt nothing of their ſmell or ſtrength at this height; a circumſtance which contradicts all the tales that have hitherto been related on this head: volatile alkali, ether, ſpirit of wine, retained all their ſtrength; the ſmoking ſpirit of Boyle was the only one that ſeemed to have loſt any ſenſible portion of its energy. Its evaporation, however, was not the leſs quick; in 30 ſeconds, a quantity which I had poured into a cup was entirely volatilized; and nothing remained but the ſulphur which tinged the rims and the bottom. When I poured the vitriolic acid on this liquor, there happened a violent detonation, and the vapours that aroſe had a very ſenſible degree of heat. I tried to form volatile alkali by decompoſing ſal ammoniac with the fixed alkali; but the production was ſlow and hardly ſenſible, while at the level of the ſea this proceſs, made with the ſame ſubſtances, in the ſame proportions, ſucceeded very readily and in abundance.

“ As I was curious to inveſtigate the nature of the vapours that exhale from the crater, and to know whether they contained inflammable air, fixed air, and marine acid, I made the following experiments: I expoſed on the edge of one of the ſpiracles a nitrous ſolution of ſilver in a cup; it remained more than an hour in the midſt of the vapours which were continually exhaling, but without any ſenſible alteration; which ſufficiently ſhews that no vapours of marine acid exhale from the crater. I then poured into it ſome drops of marine acid, when a precipitation of luna cornea immediately enſued: but inſtead of being white, as that precipitate generally is, it was of a fine dark violet colour, which quickly became grey, and it aſſumed the form of ſmall ſcaly cryſtals. Theſe were very diſtinct when looked at with a glaſs, and they were even viſible to the naked eye. I think myſelf juſtifiable in attributing this alteration of colour to the vapours of inflammable air, according to ſome experiments that I have made on the precipitation of luna cornea in ſuch air. Lime-water, expoſed for three hours on the margin of the crater, and in the neighbourhood of a ſpiracle, was not covered with any calcareous pellicle, nor even hardly with any filmy appearance; which proves, in my opinion, not only that no vapours of fixed air exhale from the crater, but that the atmoſpheric air, which reſts upon it, contains very little of that air, and that the inflammable vapours and ſulphureous acids alone are ſenſible and conſiderable. The electricity of the atmoſphere was pretty conſiderable, for Sauſſure's electrometer, when held in the hand at the height of about five feet, indicated three degrees, while on the ground it pointed only to one and a half. The electricity was poſitive.” W. Long. 16. 18. N. Lat. 28. 29.

TENESMUS, in medicine, a name given by medical writers to a complaint which is a continual deſire of going to ſtool, but without any ſtool being ready to be voided. This is properly no primary diſeaſe, but merely a ſymptomatic one, and differs in degree according to the diſeaſe on which it is an attendant. See MEDICINE, n° 111.

TENIERS (David), the Elder, a Flemiſh painter, born at Antwerp in 1582. He received the firſt rudiments of his art from the famous Rubens, who highly eſteemed him for his promiſing genius, and with great ſatisfaction examined and commended his deſigns. From the ſchool of that celebrated painter Teniers went to finiſh his ſtudies at Rome. He attached himſelf to Adam Elſheimer for ſix years; and from the inſtructions of two ſuch incomparable maſters, he formed to himſelf a peculiar ſtyle, which his ſon cultivated ſo happily afterward as to bring it to the utmoſt perfection. His pictures were ſmall; and his ſubjects uſually ſhops, elaboratories, humorous converſations, and rural feſtivities. The demand for his pieces was univerſal; and even his maſter Rubens thought them an ornament to his cabinet. He died at Antwerp in 1649.

TENIERS (David) the Younger, alſo an admirable painter, was the ſon of the former, and was born at Antwerp in 1610. He obtained the name of *Ape of Painting*, from his imitating the manner of different painters with ſuch exactneſs as to deceive even the niceſt judges. He improved greatly under his father, and obtained ſuch reputation as introduced him to the favour of the great. The archduke Leopold William made him gentleman of his bed-chamber; and all the pictures of his gallery were copied by Teniers, and engraved by his direction. The king of Spain and Don Juan of Aſturia ſet ſo high a value on his pictures, that they built a gallery on purpoſe for them. William prince of Orange honoured him with his friendſhip; and Rubens not only eſteemed his works, but aſſiſted him with his advice. His principal talent lay in landſcapes adorned with ſmall figures. He alſo painted men drinking and ſmoking, chemiſts elaboratories, country fairs, and the like. His ſmall figures are ſuperior to his large ones. He died in 1694.

The works of the father and ſon are thus diſtinguiſhed: The latter diſcover a finer touch and freſher pencil, greater variety of attitudes, and a better diſpoſition of the figures. The father retained ſomething of the tone of Italy in his colouring, which was ſtronger than the ſon's; beſides, the ſon uſed to put at the bottom of his pictures, David Teniers, junior.

Abraham, another ſon of David the Elder, was equal, if not ſuperior, to his father and brother in the expreſſion of his characters, and his underſtanding the *claro obſcuro*; though he was inferior in the ſprightlineſs of his touch, and the lightneſs of his pencil.

TENISON (Dr Thomas), archbiſhop of Canterbury, was born at Cottenham in Cambridgeſhire in 1636: and ſtudied at Corpus Chriſti college in Cambridge. In his youth, while the fanatical government laſted, he applied himſelf to phyſic; but afterward went into orders, and was ſome time miniſter of St Andrew's church, Cambridge; where he attended the ſick during the plague in 1665, which his pariſhioners acknowledged by the preſent of a piece of plate. He ſhowed himſelf very active againſt the growth of Popery by his writings both in king Charles and king James's reigns: in 1680 he was preſented to the vicarage of St Martin's in the Fields, London, to which pariſh he made ſeveral donations; and among others, endowed a free ſchool, and built a handſome library, which he furniſhed with uſeful books. King William and queen Mary, in 1689, preſented him to the archdeaconry of London; in 1691, he was nominated to the ſee of Lincoln, and in 1694 he ſucceeded Dr Tillotſon as archbiſhop of Canterbury. He performed all the duties of a good primate for 20 years, and died in 1715.

TENNIS, a play at which a ball is driven by a racket.

Hoyle's Games improved by Beaufort.

As many perſons would become players at tennis, provided they could eaſily underſtand the rudiments of the game, ſo as to form ſome judgment of the players, or at leaſt to know who wins and who loſes, we have here attempted to give ſo plain a deſcription of it, that no one can be at a loſs, if ever he ſhould bett or play. As to the executive part, it requires great practice to make a good player, ſo that nothing can be done without it; all we preſume to do is to give an inſight into the game, whereby a perſon may not ſeem a total ſtranger to it when he happens to be in a tennis court.

The game of tennis is played in moſt capital cities in Europe, particularly in France, from whence we may venture to derive its origin. It is eſteemed with many to be one of the moſt ancient games in Chriſtendom, and long before king Charles I.'s time it was played in England.

This game is as intricate as any game whatever; a perſon who is totally ignorant of it may look on for a month together, without being able to make out how the game is decided. Therefore we ſhall begin by deſcribing the court in which it is played.

The ſize of a tennis court is generally about 96 or 97 feet by 33 or 34, there being no exact dimenſions aſcribed to its proportion, a foot more or leſs in length or width being of no conſequence. A line or net hangs exactly acroſs the middle, over which the ball muſt be ſtruck, either with a racket or board to make the ſtroke good. Upon the entrance of a tennis-court, there is a long gallery which goes to the dedans, that is, a kind of front gallery, where ſpectators uſually ſtand, into which, whenever a ball is ſtruck, it tells for a certain ſtroke. This long gallery is divided into different compartments or galleries, each of which has its particular name, as follows; from the line towards the dedans are the *firſt gallery*, *door*, *ſecond gallery*, and the *laſt gallery*, which is called the *ſervice ſide*. From the dedans to the laſt gallery are the figures 1, 2, 3, 4, 5, 6, at a yard diſtance each, by which the chaces are marked, and is one of the moſt eſſential parts of the game, as will appear in the following deſcription.

On the other ſide of the line are alſo the *firſt gallery*, *door*, *ſecond gallery*, and *laſt gallery*; which is called the *hazard-ſide*. Every ball ſtruck into the laſt gallery on this ſide reckons for a certain ſtroke the ſame as the dedans. Between the ſecond and this laſt gallery are the figures 1, 2, to mark the chaces on the hazard-ſide. Over this long gallery, or theſe compartments, is a covering, called the pent-houſe, on which they play the ball from the ſervice-ſide, in order to begin a ſet of tennis, from which it is called a *ſervice*. When they miſs putting the ball (ſo as to rebound from the pent-houſe) over a certain line on the ſervice-ſide, it is deemed a fault, two of which are reckoned for a ſtroke. If the ball rolls round the pent-houſe, on the oppoſite ſide of the court, ſo as to fall beyond a certain line deſcribed for that purpoſe, it is called *paſſe*, reckons for nothing on either ſide, and the player muſt ſerve again.

On the right-hand ſide of the court from the dedans is what they call the *tambour*, a part of the wall which projects, and is ſo contrived in order to make a variety in the ſtroke, and render it more difficult to be returned by the adverſary; for when a ball ſtrikes the *tambour*, it varies its direction, and requires ſome extraordinary judgment to return it over the line. The laſt thing on the right hand ſide is called the *grill*, wherein if the ball is ſtruck, it is alſo 15, or a certain ſtroke.

The game of tennis is played by what they call *ſets*; a ſet of tennis conſiſts of ſix games: but if they play what is called an advantage-ſet, two above five games muſt be won on one ſide or the other ſucceſſively, in order to decide; or, if it comes to ſix games all, two games muſt ſtill be won on one ſide to conclude the ſet; ſo that an advantage-ſet may laſt a conſiderable time: for which kind of ſets the court is paid more than for any other.

We muſt now deſcribe the uſe of the chaces, and by what means theſe chaces decide or interfere ſo much in the game. When the player gives his ſervice at the beginning of a ſet, his adverſary is ſuppoſed to return the ball; and wherever it falls after the firſt rebound untouched, the chace is called accordingly; for example, if the ball falls at the figure 1, the chace is called at a yard, that is to ſay, at a yard from the dedans: this chace remains till a ſecond ſervice is given; and if the player on the ſervice ſide lets the ball go after his adverſary returns it, and if the ball falls on or between any of theſe figures or chaces, they muſt change ſides, there being two chaces; and he who then will be on the hazard ſide, muſt play to win the firſt chace; which if he wins by ſtriking the ball ſo as to fall, after its firſt rebound, nearer to the dedans than the figure 1, without his adverſary's being able to return it from its firſt hop, he wins a ſtroke, and then proceeds in like manner to win the ſecond chace, wherever it ſhould happen to be. If a ball falls on the line with the firſt gallery door, ſecond gallery, or laſt gallery, the chace is likewiſe called at ſuch or ſuch a place, naming the gallery, door, &c. When it is juſt put over the line, it is called a chace at the line. If the player on the ſervice-ſide returns a ball with ſuch force as to ſtrike the wall on the hazard-ſide ſo as to rebound, after the firſt hop over the line, it is alſo called a chace at the line.

The chaces on the hazard-ſide proceed from the ball being returned either too hard or not quite hard enough; ſo that the ball after its firſt rebound falls on this ſide of the blue line, or line which deſcribes the hazard-ſide chaces; in which caſe it is a chace at 1, 2, &c. provided there is no chace depending. When they change ſides, the player, in order to win this chace, muſt put the ball over the line anywhere, ſo that his adverſary does not return it. When there is no chace on the hazard-ſide, all balls put over the line from the ſervice ſide, without being returned, reckon for a ſtroke.

As the game depends chiefly upon the marking, it will be neceſſary to explain it, and to recommend thoſe who play at tennis to have a good and unbiaſſed marker, for on him the whole ſet may depend: he can mark in favour of the one and againſt the other in ſuch a manner, as will render it two to one at ſtarting, though even players. Inſtead of which the marker ſhould be very attentive to the chaces, and not be anyway partial to either of the players.

This game is marked in a very ſingular manner, which makes it at firſt ſomewhat difficult to underſtand. The firſt ſtroke is called 15, the ſecond 30, the third 40, and the fourth game, unleſs the players get four ſtrokes each; in that caſe, inſtead of calling it 40 all, it is called *deuce*; after which, as ſoon as any ſtroke is got, it is called *advantage*; and in caſe the ſtrokes become equal again, *deuce* again, till one or the other gets two ſtrokes following, which win the game; and as the games are won, ſo they are marked and called; as one game love, two games to one, &c. towards the ſet, of which ſo many of theſe games it conſiſts.

Although but one ball at a time is played with, a number of balls are made uſe of at this game to avoid trouble, and are handed to the players in baſkets for that purpoſe: by which means they can play as long as they pleaſe, without ever having occaſion to ſtoop for a ball.

As to the odds at tennis, they are by no means fixed, but are generally laid as follows :

Upon the firſt ſtroke being won between even players, that is, fifteen love, the odds are of the ſingle game	7	to	4
Thirty love	4		1
Forty love	8		1
Thirty fifteen	2		1
Forty fifteen	5		1
Forty thirty	3		1
The odds of a four game ſet when the firſt game is won, are	7		4
When two games love	4		1
Three games love	8	to	1
When two games to one	2		1
Three games to one	5		1
The odds of a ſix game ſet when the firſt game is won, are	3		2
When two games love	2		1
Three games love	4		1
Four games love	10		1
Five games love	21		1
When two games to one	8		5
Three games to one	5		2
Four games to one	5		1
Five games to one	15		1
When three games to two	7		4
Four games to two	4		1
Five games to two	10		1
When four games to three	2		1
Five games to three	5		1
The odds of an advantage ſet when the firſt game is won, are	5		4
When two games love	7		4
Three games love	3		1
Four games love	5		1
Five games love	15		1
When two games to one	4		3
Three games to one	2		1
Four games to one	7		2
Five games to one	10		1
When three games to two	3		2
Four games to two	3		1
Five games to two	8		1
When four games to three	8		5
Five games to three	3		1
When five games to four	2		1
When ſix games to five	5		2

The foregoing odds, as beforeſaid, are generally laid, but the chaces interfering makes the odds very precarious ; for example, when there is a chace at half a yard, and a ſet is five games all, and in every other reſpect equal, the odds are a good five to four ; and if it were ſix games to five, and forty thirty with the ſame chace, the odds then would be a guinea to a ſhilling ; ſo that it is plain that the odds at this game differ from thoſe of any other : for one ſtroke will reduce a ſet, ſuppoſing the players to be five games all, from an even wager to three to two, and ſo on in proportion to the ſtage of the ſet.

There are various methods of giving odds at tennis, in order to make a match equal ; and that they may be underſtood, we ſhall give the following liſt of them, with their meanings, ſo that any perſon may form a judgment of the advantage received or given.

The loweſt odds that can be given, excepting the choice of the ſides, is what they call a *biſque*, that is, a ſtroke to be taken or ſcored whenever the player, who receives the advantage, thinks proper : for inſtance, ſuppoſe a critical game of the ſet to be forty thirty, by taking the *biſque*, he who is forty becomes game, and ſo in reſpect of two *biſques*, &c.

The next greater odds are *fifteen*, that is, a certain ſtroke given at the beginning of each game.

After theſe, *half thirty*, that is, fifteen one game, and thirty the next. Then follow the whole *thirty*, *forty*, &c.

There are alſo the following kind of odds which are given, viz.

Round ſervices ; thoſe are ſervices given round the penthouſe, ſo as to render it eaſy for the *ſtriker out* (the player who is on the hazard ſide) to return the ball.

Half court, that is, being obliged or confined to play into the adverſary's half-court ; ſometimes it is played ſtraightwiſe, and at other times acroſs ; both which are great advantages given by him ſo confined, but the ſtrait half-court is the greateſt.

Touch-no-wall, that is, being obliged to play within the compaſs of the walls, or ſides of the court. This is a conſiderable advantage to him who receives it ; as all the balls muſt be played gently, and conſequently they are much eaſier to take than thoſe which are played hard, or according to the uſual method of play.

Barring the hazards, that is, barring the dedans, tambour, grill, or the laſt gallery on the hazard-ſide, or any particular one or more of them.

Theſe are the common kind of odds or advantages given ; but there are many others, which are according to what is agreed by the players : ſuch as playing with *board* againſt *racket*, *cricket-bat* againſt *racket*, &c.

The game of tennis is alſo played by four perſons, two partners on each ſide. In this caſe, they are generally confined to their particular quarters, and one of each ſide appointed to ſerve and ſtrike out ; in every other reſpect, the game is played in the ſame manner as when two only play.

Any thing more to be ſaid upon this ſubject would be needleſs, as nothing can be recommended, after reading this ſhort account of tennis, but practice and attention, without which no one can become a proficient at the game.

TENOR, or Tenour, the purport or content of a writing or inſtrument in law, &c.

Tenor, in muſic, the firſt mean, or middle part, or that which is the ordinary pitch of the voice, when neither raiſed to a treble nor lowered to a baſs.

TENSE, in grammar, an inflection of verbs, whereby they are made to ſignify or diſtinguiſh the circumſtance of time in what they affirm. See Grammar.

TENT, in war, a pavilion or portable houſe. Tents are made of canvas, for officers and ſoldiers to lie under when in the field. The ſize of the officers tents is not fixed ; ſome regiments have them of one ſize and ſome of another : a captain's tent and marquee is generally 10½ feet broad, 14 deep, and 8 high : the ſubalterns are a foot leſs ; the major's and lieutenant-colonel's a foot larger ; and the colonel's two feet larger. The ſubalterns of foot lie two in a tent, and thoſe of horſe but one. The tents of private men are 6½ feet ſquare, and 5 feet high, and hold five ſoldiers each. The tents for horſe are 7 feet broad and 9 feet deep : they hold likewiſe five men and their horſe accoutrements.—The word is formed from the Latin *tentorium*, of *tendo* "I ſtretch," becauſe tents are uſually made of canvas ſtretched out, and ſuſtained by poles, with cords and pegs.

Tent, in ſurgery, a roll of lint made into the ſhape of a nail with a broad flat head, chiefly uſed in deep wounds and ulcers. They are of ſervice, not only in conveying medicines to the moſt intimate receſſes and ſinuſes of the wound, but to prevent the lips of the wound from uniting before it is healed from the bottom; and by their aſſiſtance grumous blood, ſordes, &c. are readily evacuated.

TENTER, Trier, or *Prover*, a machine uſed in the cloth manufactory, to ſtretch out the pieces of cloth, ſtuff, &c. or only to make them even and ſet them ſquare.

It is uſually about 4½ feet high, and for length exceeds that of the longeſt piece of cloth. It conſiſts of ſeveral long ſquare pieces of wood, placed like thoſe which form the barriers of a manege; ſo, however, as that the lower croſs pieces of wood may be raiſed or lowered as is found requiſite, to be fixed at any height by means of pins. Along the croſs pieces, both the upper and under one, are hooked nails, called *tenter-hooks*, driven in from ſpace to ſpace.

To put a piece of Cloth on the Tenter. While the piece is yet quite wet, one end is faſtened to one of the ends of the tenter; then it is pulled by force of arms towards the other end, to bring it to the length required: that other end being faſtened, the upper liſt is hooked on to the upper croſs piece, and the loweſt liſt to the loweſt croſs-piece, which is afterwards lowered by force, till the piece have its deſired breadth. Being thus well ſtretched, both as to length and breadth, they bruſh it with a ſtiff hair bruſh, and thus let it dry. Then they take it off; and, till they wet it again, it will retain the length and breadth the tenter gave it.

TENTHREDO, the saw-fly; a genus of inſects belonging to the order of *hymenoptera*. The mouth is furniſhed with jaws, which are horny, arched, dentated within; the right jaw being obtuſe at the apex: the lip cylindrical, trifid: there are four feelers, unequal and filiform: the wings are plain and turned: the ſting conſiſts of two ſerrated laminæ, and the ſcutellum of two grains placed at a diſtance. Gmelin mentions 143 ſpecies. Theſe inſects are not very ſhy. Some, by means of their ſaw, depoſit in the buds of flowers, others on the twigs of trees or ſhrubs, eggs from which are produced caterpillars. The implement with which they are armed is nowiſe formidable; as it appears only deſtined to the purpoſe of depoſiting their eggs.

TENTHS, and *first fruits of Spiritual Preferments*, in England, a branch of the king's revenue. See Revenue.

Blackſt. Comment. vol. i.

"Theſe were originally a part of the Papal uſurpations over the clergy of this kingdom; firſt introduced by Pandulph the pope's legate, during the reigns of king John and Henry III. in the ſee of Norwich; and afterwards attempted to be made univerſal by the popes Clement V. and John XXII. about the beginning of the 14th century. The firſt fruits, *primitiæ* or *annates*, were the firſt year's whole profits of the ſpiritual preferment, according to a rate or *valor* made under the direction of pope Innocent IV. by Walter biſhop of Norwich in 38 Hen. III. and afterwards advanced in value by commiſſion from pope Nicholas III. A. D. 1292, 20 Edw. I.; which valuation of pope Nicholas is ſtill preſerved in the exchequer. The tenths, or *decimæ*, were the tenth part of the annual profit of each living by the ſame valuation; which was alſo claimed by the holy ſee, under no better pretence than a ſtrange miſapplication of that precept of the Levitical law, which directs, that the Levites "ſhould offer the tenth part of their tithes as a heave-offering to the Lord, and give it to Aaron the high-prieſt." But this claim of the pope met with vigorous reſiſtance from the Engliſh parliament; and a variety of acts were paſſed to prevent and reſtrain it, particularly the ſtatute 6 Hen. IV. c. 1. which calls it a *horrible miſchief and damnable cuſtom*. But the Popiſh clergy, blindly devoted to the will of a foreign maſter, ſtill kept it on foot; ſometimes more ſecretly, ſometimes more openly and avowedly: ſo that in the reign of Henry VIII. it was computed, that in the compaſs of 50 years 800,000 ducats had been ſent to Rome for firſt fruits only. And as the clergy expreſſed this willingneſs to contribute ſo much of their income to the head of the church, it was thought proper (when in the ſame reign the papal power was aboliſhed, and the king was declared the head of the church of England) to annex this revenue to the crown; which was done by ſtatute 26 Hen. VIII. c. 3. (confirmed by ſtatute 1 Eliz. c. 4); and a new *valor beneficiorum* was then made, by which the clergy are at preſent rated.

"By theſe laſt mentioned ſtatutes all vicarages under ten pounds a year, and all rectories under ten marks, are diſcharged from the payment of firſt fruits: and if, in ſuch livings as continue chargeable with this payment, the incumbent lives but half a year, he ſhall pay only one quarter of his firſt fruits; if but one whole year, then half of them; if a year and a half, three quarters; and if two years, then the whole, and not otherwiſe. Likewiſe by the ſtatute 27 Hen. VIII. c. 8. no tenths are to be paid for the firſt year, for then the firſt fruits are due: and by other ſtatutes of queen Anne, in the fifth and ſixth years of her reign, if a benefice be under L. 50 *per annum* clear yearly value, it ſhall be diſcharged of the payment of firſt fruits and tenths.

"Thus the richer clergy being, by the criminal bigotry of their Popiſh predeceſſors, ſubjected at firſt to a foreign exaction, were afterwards, when that yoke was ſhaken off, liable to a like miſapplication of their revenues through the rapacious diſpoſition of the then reigning monarch; till at length the piety of queen Anne reſtored to the church what had been thus indirectly taken from it. This ſhe did, not by remitting the tenths and firſt fruits entirely; but, in a ſpirit of the trueſt equity, by applying theſe ſuperfluities of the larger benefices to make up the deficiencies of the ſmaller. And to this end ſhe granted her royal charter, which was confirmed by the ſtatute 2 Ann. c. 11. whereby all the revenue of firſt fruits and tenths is veſted in truſtees for ever, to form a perpetual fund for the augmentation of poor livings. This is uſually called *Queen Anne's bounty*; which has been ſtill farther regulated by ſubſequent ſtatutes."

TENURE, in law, ſignifies the manner whereby lands or tenements are held, or the ſervice that the tenant owes to his lord.

Blackſt. Comment. vol. ii.

Of Britain almoſt all the real property is by the policy of the laws ſuppoſed to be granted by, dependent upon, and holden of, ſome ſuperior lord, by and in conſideration of certain ſervices to be rendered to the lord by the tenant or poſſeſſor of this property. The thing holden is therefore ſtyled a *tenement*, the poſſeſſors thereof *tenants*, and the manner of their poſſeſſion a *tenure*. Thus all the lands in the kingdom is ſuppoſed to be holden, mediately or immediately, of the king; who is ſtyled the *lord paramount*, or above all. Such tenants as held under the king immediately, when they granted out portions of the lands to inferior perſons, became alſo lords with reſpect to thoſe inferior perſons, as they were ſtill tenants with reſpect to the king; and, thus partaking of a middle nature, were called *meſne* or *middle lords*. So that if the king granted a manor to A, and he granted a portion of the land to B, now B was ſaid to hold of A, and A of the king; or, in other words, B held his lands immediately of A, but mediately of the king. The king therefore was ſtyled *lord paramount*: A was both tenant and lord, or was a meſne lord; and B was called *tenant paravail*, or the *loweſt tenant*, being he who was ſuppoſed to make avail, or profit of the land. In this manner are all the lands of the kingdom holden which are in the hands of ſubjects: for, according to Sir Edward Coke, in the law of England we have not properly *allodium*, which is the name by which the feudiſts abroad diſtinguiſh ſuch eſtates of the ſubject as are not holden of any ſuperior. So that at the firſt glance we may obſerve, that the lands are either plainly feuds, or partake very ſtrongly of the feodal nature.

All tenures being thus derived, or ſuppoſed to be derived, from the king, thoſe that held immediately under him, in right of his crown and dignity, were called his *tenants in capite*, or *in chief*; which was the moſt honourable ſpecies of tenure, but at the ſame time ſubjected the tenants to greater and more burdenſome ſervices than inferior tenures did. And this diſtinction ran through all the different ſorts of tenure.

There ſeem to have ſubſiſted among our anceſtors four principal ſpecies of lay-tenures, to which all other may be reduced: the grand criteria of which were the natures of the ſeveral ſervices or renders that were due to the lords from their tenants. The ſervices, in reſpect of their quality were either *free* or *baſe* ſervices: in reſpect of their quantity and the time of exacting them were either *certain* or *uncertain*. Free ſervices were ſuch as were not unbecoming the character of a ſoldier or a freeman to perform; as to ſerve under his lord in the wars, to pay a ſum of money, and the like. Baſe ſervices were ſuch as were fit only for peaſants or perſons of a ſervile rank; as to plough the lord's land, to make his hedges, to carry out his dung, or other mean employments. The certain ſervices, whether free or baſe, were ſuch as were ſtinted in quantity, and could not be exceeded on any pretence; as, to pay a ſtated annual-rent, or to plough ſuch a field for three days. The uncertain depended upon unknown contingencies; as, to do military ſervice in perſon, or pay an aſſeſſment in lieu of it when called upon; or to wind a horn upon the appearance of invaders; which are free ſervices; or to do whatever the lord ſhould command; which is a baſe or villein ſervice.

From the various combinations of theſe ſervices have ariſen the four kinds of lay-tenure which ſubſiſted in England till the middle of the laſt century; and three of which ſubſiſt to this day. Of theſe Bracton (who wrote under Henry the Third) ſeems to give the cleareſt and moſt compendious account of any author ancient or modern; of which the following is the outline or abſtract: "Tenements are of two kinds, *frank-tenement*, and *villenage*. And of frank-tenements, ſome are held freely in conſideration of homage and knight-ſervice; others in free-ſocage, with the ſervice of fealty only. And again, of villenages, ſome are *pure*, and others *privileged*. He that holds in pure villenage ſhall do whatſoever is commanded him, and always be bound to an uncertain ſervice. The other kind of villenage is called *villein-ſocage*; and theſe villein-ſocmen do villein-ſervices, but ſuch as are certain and determined." Of which the ſenſe ſeems to be as follows; firſt, where the ſervice was free, but uncertain, as military ſervice with homage, that tenure was called the *tenure in chivalry*, *per ſervitium militare*, or by knight-ſervice. Secondly, where the ſervice was not only free, but alſo certain, as by fealty only, by rent and fealty, &c. that tenure was called *liberum ſocagium*, or *free ſocage*. Theſe were the only free holdings or tenements; the others were villenous or ſervile: as, thirdly, where the ſervice was baſe in its nature, and uncertain as to time and quantity, the tenure was *purum villenagium*, abſolute or pure villenage. Laſtly, where the ſervice was baſe in its nature, but reduced to a certainty, this was ſtill villenage, but diſtinguiſhed from the other by the name of *privileged villenage*, *villenagium privilegiatum*; or it might be ſtill called *ſocage* (from the certainty of its ſervices), but degraded by their baſeneſs into the inferior title of *villanum ſocagium*, villein-ſocage.

1. The military tenure, or that by knight-ſervice, was done away by ſtat. 12 Car. II. For an account of this ſpecies of tenure ſee *Feodal Syſtem*, and *Knight-Service*; and for its incidents, ſee Relief, Primer-seisin, Wardship, Marriage, Fines, and Escheat.

2. The ſecond ſpecies of tenure or free-ſocage, not only ſubſiſts to this day, but has in a manner abſorbed and ſwallowed up (ſince the ſtatute of Charles the Second) almoſt every other ſpecies of tenure. See Socage.

The other grand diviſion of tenure, mentioned by Bracton, is that of villenage, as contradiſtinguiſhed from *liberum tenementum*, or frank-tenure. And this (we may remember) he ſubdivides into two claſſes, pure and privileged villenage: from whence have ariſen two other ſpecies of the modern tenures.

3. From the tenure of pure villenage have ſprung the preſent copyhold tenures, or tenure by copy of court-roll at the will of the lord; in order to obtain a clear idea of which, it will be previouſly neceſſary to conſult the articles Manor and Villenage.

As a farther conſequence of what has been there explained, we may collect theſe two main principles, which are held to be the ſupporters of a copyhold-tenure, and without which it cannot exiſt; 1. That the lands be parcel of and ſituate within that manor under which it is held. 2. That they have been demiſed, or demiſable, by copy of court-roll immemorially. For immemorial cuſtom is the life of all tenures by copy; ſo that no new copyhold can, ſtrictly ſpeaking, be granted at this day.

In ſome manors, where the cuſtom hath been to permit the heir to ſucceed the anceſtor in his tenure, the eſtates are ſtyled *copyholds of inheritance*; in others, where the lords have been more vigilant to maintain their rights, they remain copyholds for life only; for the cuſtom of the manor has in both caſes ſo far ſuperſeded the will of the lord, that, provided the ſervices be performed or ſtipulated for by fealty, he cannot in the firſt inſtance refuſe to admit the heir of his tenant upon his death; nor, in the ſecond, can he remove his preſent tenant ſo long as he lives, though he holds nominally by the precarious tenure of his lord's will.

The fruits and appendages of a copyhold-tenure, that it hath in common with free tenures, are fealty, ſervices (as well in rents as otherwiſe), reliefs, and eſcheats. The two latter belong only to copyholds of inheritance; the former to thoſe for life alſo. But, beſides theſe, copyholds have alſo heriots, wardſhip, and fines. Heriots, which are agreed to be a Daniſh cuſtom, are a render of the beſt beaſt or other good (as the cuſtom may be) to the lord on the death of the tenant. This is plainly a relic of villein tenure; there being originally leſs hardſhip in it, when all the goods and chattels belonged to the lord, and he might have ſeized them even in the villein's lifetime. Theſe are incident to both ſpecies of copyhold; but wardſhip and fines to thoſe of inheritance only. Wardſhip, in copyhold-eſtates, partakes both of that in chivalry and that in ſocage. Like that in chivalry, the lord is the legal guardian, who uſually aſſigns ſome relation of the infant tenant to act in his ſtead: and he, like guardian in ſocage, is accountable to his ward for the profits. Of fines, ſome are in the nature of primer-ſeiſins, due on the death of each tenant, others are mere fines for alienations of the lands; in ſome manors, only one of thoſe ſorts can be demanded, in ſome both, and in others neither. They are ſometimes arbitrary and at the will of the lord, ſometimes fixed by cuſtom; but, even when arbitrary, the courts of law, in favour of the liberty of copyholders, have tied them down to be reaſonable in their extent; otherwiſe they might amount to diſheriſon of the eſtate. No fine therefore is allowed to be taken upon deſcents and alienations (unleſs in particular circumſtances) of more than two years improved value of the eſtate. From this inſtance we may judge of the favourable diſpoſition that the law of England (which is a law of liberty) hath always ſhown to this ſpecies of tenants, by removing, as far as poſſible, every real badge of ſlavery from them, however ſome nominal ones may continue. It ſuffered cuſtom very early to get the better of the expreſs terms upon which they held their lands; by declaring, that the will of the lord was to be interpreted by the cuſtom of the manor; and, where no cuſtom has been ſuffered to grow up to the prejudice of the lord, as in this caſe of arbitrary fines, the law itſelf interpoſes in an equitable method, and will not ſuffer the lord to extend his power ſo far as to diſinherit the tenant.

4. There is yet a fourth ſpecies of tenure, deſcribed by Bracton, under the name ſometimes of *privileged villenage*, and ſometimes of *villein-ſocage*. See *Privileged* VILLENAGE.

Having in the preſent article and thoſe referred to, taken a compendious view of the principal and fundamental points of the doctrine of tenures, both ancient and modern, we cannot but remark the mutual connection and dependence that all of them have upon each other. And upon the whole it appears, that, whatever changes and alterations theſe tenures have in proceſs of time undergone, from the Saxon era to the 12 Car. II. all lay-tenures are now in effect reduced to two ſpecies; free tenure in common ſocage, and baſe tenure by copy of court-roll. But there is ſtill behind one other ſpecies of tenure, reſerved by the ſtatute of Charles II. which is of a ſpiritual nature, and called the tenure in *Frank-Almoign*; ſee that article.

A particular account of the ancient tenures would to many perſons be highly amuſing. We can only ſelect a few of the moſt ſingular, referring the curious reader for more information to Anderſon's Origin of Commerce, Henry's Hiſtory of Britain, and Blount's *Fragmenta Antiquitates*.

In the 19th of Henry III. Walter Gately held the manor of Weſtcourt, in Bedington in Surry, yielding yearly to the king one croſs-bow, *baliſtam*, value twelve pence.

Anno tertio Edw. I. Oſbert de Lonchamp, knight, held his lands of Ovenhelle in Kent, for perſonally guarding the king forty days into Wales at his own expence, with one horſe of five ſhillings value, one ſack worth ſix-pence, and one broch for that ſack. *N. B.* All perſonal ſervices, or attendances on Engliſh kings in thoſe times, were limited to forty days, at their own expence.

The like the ſame year of Laurence de Broke, who for his hamlet of Renham in Middleſex, found the king one ſoldier, a horſe worth five ſhillings, a ſack worth fivepence, and a broch worth twopence (this broch was a kind of cup, jug, pot, or baſon), for forty days, at his own expence, wherever his army ſhall be within the four ſeas. This was ſettled (ſays Mr Blount) at the Stone Croſs, which ſtood near the May-pole in the Strand, London, where the judges-itinerant uſed in old times to ſit.

Robert Maunſel's tenure of lands in Peverel paid the ſame ſervice, and the horſe, ſack, and broch, of the ſame prices.

13*mo* Edw. I. Henry de Averning's tenure of the manor of Morton in Eſſex, was to find a man, a horſe worth ten ſhillings, four horſe-ſhoes, a leather ſack, and an iron broch.

The year following, three perſons held thirty acres of land in Carleton in Norfolk, by the ſervice of bringing the king, whenever he ſhall be in England, twenty-four paſties of freſh herrings, at their firſt coming in.

Another held his manor in Norfolk of that king, by annually ſupplying him at his exchequer with two veſſels, called *mues*, of wine made of pearmains. "Here (ſays our author) it is worth obſerving, that in King Edward the Firſt's time pearmain cyder was called *wine*." This therefore ſeems to account for the mention of vineyards in old times in Kent, Suſſex, and other parts of England, which has ſo often puzzled many people to elucidate.

Another perſon, in the 21ſt of the ſaid king, held thirty acres of land, valued at ten ſhillings yearly in the exchequer, or fourpence *per* acre, in Cambridgeſhire, for furniſhing a truſs of hay for the king's neceſſary-houſe or privy, whenever he ſhall come into that county.

Another, in the 34th of that king, held a manor in Kent, for providing a man to lead three greyhounds when the king ſhall go into Gaſcony, ſo long as a pair of ſhoes of fourpence ſhould laſt.

And that we may not again recur to theſe old tenures, we ſhall further add, from the ſame author, that in the firſt year of king Edward II. Peter Spileman made fine to the king for his lands by ſerjeanty, to find one to ſerve as a ſoldier for forty days in England, with a coat of mail; alſo to find ſtraw for the king's bed, and hay for his horſe.

This article of ſtraw for the king's bed we did not ſo much wonder at, when we found it in an article in William the Conqueror's time; but it is ſomewhat more remarkable ſo late as the days of king Edward the Second.

Several others, we find, held their lands of the crown in thoſe times by very different tenures. One, by paying two white capons annually; another, by carrying the king's ſtandard whenever he happens to be in the county of Suſſex; another, by carrying a rod or batoon before the king on certain occaſions; another, by ſerving the office of chamberlain of the exchequer, a very good place at preſent; another, by building and upholding a bridge; another, by being marechal (*meretricum*), *i. e.* as Mr Blount tranſlates it, of the laundreſſes in the king's army; another, by acting as a ſerjeant at arms for the king's army whilſt in England; one ſupplies a ſervant for the king's larder; another, for his wardrobe; others, to find ſervants for this or that foreſt; another, a hawk; one preſents the king a pair of ſcarlet hoſe annually; others are bound to ſupply ſoldiers with armour for certain days, for the keeping this or that caſtle; one, viz. for the manor of Elſton in Nottinghamſhire, pays yearly rent of one pound weight of cummin ſeed, two pair of gloves, and a ſteel needle; another, is to repair the ironwork of the king's ploughs; Ela Counteſs of Warwick, in the 13th year of king Edward I. held the manor of Hokenorton in Oxfordſhire, in the barony of D'Oyly, by the ſerjeanty of carving at the king's table on his birth-day, and ſhe to have the knife the king then uſes at table.

TEOS, one of the twelve Ionian cities, was ſituated on the ſouth ſide of the Ionian peninſula, and diſtinguiſhed by being the place where the poet Anacreon and the hiſtorian Hecatæus were born.

TERAPHIM, or THERAPHIM, a word in the Hebrew language, which has exerciſed much the ingenuity of the critics. It occurs 13 or 14 times in the Old Teſtament, and is commonly interpreted *idols*. We will not trouble our readers with the numerous conjectures which have been formed reſpecting the meaning of this word. The only way to determine it, if it be at all poſſible, would be to examine and compare all the paſſages in which it occurs, and to conſult the ancient tranſlations. Conjectures are uſeleſs; every man may make a new one, which will have juſt as good a title to belief as thoſe which have been already propoſed.

TERCERY, one of the largeſt iſlands of the Azores, or Weſtern Iſlands, lying in the Atlantic Ocean. It is about 40 miles in circumference; and ſurrounded with craggy rocks, which render it almoſt inacceſſible. The ſoil is fertile, abounding in corn, wine, and fruits; and they have ſuch plenty of cattle, that they ſupply the ſhips therewith that call there. However, their principal trade is wood. The inhabitants are lively and well made; and they pretend to a great deal of religion and gallantry at the ſame time. They pique themſelves upon points of honour, and are extremely revengeful. It is their cuſtom to rove about in the night-time in queſt of intrigues, and ſeldom fail in finding women for their purpoſe. It is ſubject to Portugal; and Angra is the capital town. W. Long. 27. 1. N. Lat. 28. 45.

TEREBELLA, the Piercer, in natural hiſtory, a genus of inſects belonging to the claſs of *vermes*, and order of *molluſca*. The body is filiform, the mouth placed before; the preputium puts forth a pedunculated tubulous gland. There are ſeveral capillary tentacula about the mouth. There are ten ſpecies.

Terebinthine Electuary. See Pharmacy, n° 599.

TEREBINTHUS, in botany. See Pistacia.

TEREDO, in natural hiſtory, a genus of *vermes* belonging to the order of *teſtacea*. The animal is a terebella; there are two valves, calcareous, hemiſpherical, and cut off before, and two lanceolated. The ſhell is tapering, bending, and capable of penetrating wood. There are only three ſpecies; the *navalis*, *utriculus*, and *clava*.

The *navalis*, or ſhip-worm, which has a very ſlender ſmooth cylindrical ſhell, inhabits the Indian ſeas, whence it was imported into Europe. It penetrates eaſily into the ſtouteſt oak-planks, and produces dreadful deſtruction to the ſhips by the holes it makes in their ſides and it is to avoid the effects of this inſect that veſſels require ſheathing.

The head of this creature is well prepared by nature for the hard offices which it has to undergo, being coated with a ſtrong armour, and furniſhed with a mouth like that of the leech; by which it pierces wood, as that animal does the ſkin; a little above this it has two horns which ſeem a kind of continuation of the ſhell; the neck is as ſtrongly provided for the ſervice of the creature as the head, being furniſhed with ſeveral ſtrong muſcles; the reſt of the body is only covered by a very thin and tranſparent ſkin, through which the motion of the inteſtines is plainly ſeen by the naked eye; and by means of the microſcope ſeveral other very remarkable particulars become viſible there. This creature is wonderfully minute when newly excluded from the egg, but it grows to the length of four or ſix inches, and ſometimes more.

When the bottom of a veſſel, or any piece of wood which is conſtantly under water, is inhabited by theſe worms, it is full of ſmall holes; but no damage appears till the outer parts are cut away: Then their ſhelly habitations come into view; in which there is a large ſpace for incloſing the animal, and ſurrounding it with water. There is an evident care in theſe creatures never to injure one another's habitations; by this means each caſe or ſhell is preſerved entire; and in ſuch pieces of wood as have been found eaten by them into a ſort of honeycomb, there never is ſeen a paſſage or communication between any two of the ſhells, tho' the woody matter between them often is not thicker than a piece of writing-paper.

They penetrate ſome kinds of wood much more eaſily than others. They make their way moſt quickly into fir and alder, and grow to the greateſt ſize. In the oak they make ſmall progreſs, and appear ſmall and feeble, and their ſhells much diſcoloured.

Since each of theſe animals is lodged in a ſolitary cell, and has no acceſs to thoſe of its own ſpecies, it has been matter of ſurpriſe how they ſhould increaſe to ſo vaſt a multitude. Upon diſſecting them, it appears that every individual has the parts of both ſexes, and is therefore ſuppoſed to propagate by itſelf.

The ſea-worms, which are pernicious to our ſhipping, appear to have the ſame office allotted them in the waters which the termites have on the land (ſee Termes). They will appear, on a very little conſideration, to be moſt important beings in the great chain of creation, and pleaſing demonſtrations of that infinitely wiſe and gracious Power which formed, and ſtill preſerves, the whole in ſuch wonderful order and beauty: for if it was not for the rapacity of theſe and ſuch animals, tropical rivers, and indeed the ocean itſelf, would be choked with the bodies of trees which are annually carried down by the rapid torrents, as many of them would laſt for ages, and probably be productive of evils, of which, happily, we cannot in the preſent harmonious ſtate of things form any idea (A); whereas now being conſumed by theſe animals, they are more eaſily broken in pieces by the waves; and the fragments which are not devoured become ſpecifically lighter, and are conſequently more readily and more effectually thrown on ſhore, where the ſun, wind, inſects, and various other inſtruments, ſpeedily promote their entire diſſolution.

Phil. Tranſ. for 1781.

TERENCE, or Publius Terentius Afer, a celebrated comic poet of ancient Rome, was born at Carthage in Africa. He was ſlave to Terentius Lucanus the ſenator; who gave him his liberty on account of his wit, his good mien, and great abilities. Terence, on his becoming a freed man, applied himſelf to the writing of comedies; in the execution of which he imitated Menander and the other celebrated comic poets of Greece. Cicero gives him the moſt pompous eulogiums, both for the purity of his language and the perſpicuity and beauty of his compoſitions, which he conſiders as the rule and ſtandard of the Latin tongue; and obſerves, that they were eſteemed ſo fine and elegant, that they were thought to have been written by Scipio and Lelius, who were then the greateſt perſonages and the moſt eloquent of the Roman people. Terence died while on a voyage into Greece, about the 15th year before the Chriſtian era. There are ſix of his comedies extant, of which the beſt editions are the Elzevir one 1635, 12mo; that *cum integris notis Donati, et ſelectis variorum*, 1686, 8vo; Weſterhovius's, in two vols 4to 1726; and that of Bentley the ſame year 4to. Madam Dacier has given a beautiful French verſion of this author; and a very good Engliſh tranſlation was publiſhed in 4to, 1768, by Mr Colman.

TERM, in law, is generally taken for a limitation of time or eſtate; as, a leaſe for term of life or years.

Term, however, is more particularly uſed for that time wherein our courts of juſtice are open; in oppoſition to which, the reſt of the year is called *vacation*.

Term, in grammar, denotes ſome word or expreſſion in a language.

The word *term*, *terminus*, is borrowed metaphorically, by the grammarians and philoſophers, from the meaſurers or ſurveyors

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(B) That wood will endure in water for many centuries, is apparent from the oak ſtakes which were driven into the bed of the river Thames on the invaſion of Britain by Julius Cæſar, one of which is to be ſeen in Sir Aſhton Lever's muſeum, and likewiſe from thoſe bodies of trees which are daily found in the bogs and Moraſſes of Great Britain and Ireland, which after a duration, the former of eighteen hundred, the latter of upwards of two thouſand years are found in a perfect ſtate of preſervation.

veyors of lands: as a field is defined and diſtinguiſhed by its *termini*, or limits, ſo is a thing or matter ſpoken of by the word or term it is denoted by.

Term in the Arts, or *Term of Art*, is a word which, beſides the literal and popular meaning which it has or may have in common language, bears a further and peculiar meaning in ſome art or ſcience.

Terms, the ſeveral times or ſeaſons of the year, wherein the tribunals, or courts of judicature, are open to all who think fit to complain of wrong, or to ſeek their rights by due courſe of law, or action; and during which the courts in Weſtminſter-hall ſit and give judgment. But the high court of parliament, the chancery, and inferior courts do not obſerve the terms; only the courts of king's-bench, common-pleas, and exchequer, which are the higheſt courts at common law. In contradiſtinction to theſe, the reſt of the year is called *vacation*.

Of theſe terms there are four in every year, during which time matters of juſtice are diſpatched. *Hilary-term*, which, at London, begins the 23d day of January, or if that be Sunday, the next day after; and ends the 12th of February following. *Eaſter-term*, which begins the Wedneſday fortnight after Eaſter-day, and ends the Monday next after Aſcenſion-day. *Trinity-term*, beginning the Friday next after Trinity-Sunday, and ending the Wedneſday fortnight after. *Michaelmas-term*, which begins the ſixth day of November, and ends the 28th of November following. Each of theſe terms have alſo their returns. Theſe terms are ſuppoſed by Mr Selden to have been inſtituted by William the Conqueror; but Sir H. Spelman hath ſhewn, that they were gradually formed from the canonical conſtitutions of the church; being no other than thoſe leiſure ſeaſons of the year which were not occupied by the great feſtivals or faſts, or which were not liable to the general avocations of rural buſineſs. Throughout all Chriſtendom, in very early times, the whole year was one continual term for hearing and deciding cauſes. For the Chriſtian magiſtrates, in order to diſtinguiſh themſelves from the heathens, who were very ſuperſtitious in the obſervation of their *dies faſti* and *nefaſti*, adminiſtered juſtice upon all days alike; till at length the church interpoſed, and exempted certain holy ſeaſons from being profaned by the tumult of forenſic litigations; as, particularly, the time of Advent and Chriſtmas, which gave riſe to the winter vacation; the time of Lent and Eaſter, which created that in the ſpring; the time of Pentecoſt, which produced the third; and the long vacation, between midſummer and Michaelmas, which was allowed for the hay-time and harveſt. All Sundays alſo, and ſome peculiar feſtivals, as the days of the purification, aſcenſion, &c. were included in the ſame prohibition, which was eſtabliſhed by a canon of the church, A. D. 517, and fortified by an imperial conſtitution of the younger Theodoſius, comprized in the Theodoſian code. Afterwards, when our own legal conſtitution was eſtabliſhed, the commencement and duration of our law terms were appointed, with a view to theſe canonical prohibitions; and it was ordered by the laws of king Edward the Confeſſor, that from Advent to the octave of the Epiphany, from Septuageſima to the octave of Eaſter, from the Aſcenſion to the octave of Pentecoſt, and from three in the afternoon of all Saturdays till Monday morning, the peace of God and holy church ſhall be kept throughout the whole kingdom.

And ſo extravagant was afterwards the regard paid to theſe holy times, that though the author of the Mirror mentions only one vacation of conſiderable length, containing the months of Auguſt and September, yet Britton ſays, that in the reign of king Edward I. no ſecular plea could be held, nor any man ſworn on the Evangeliſts, in the time of Advent, Lent, Pentecoſt, harveſt, and vintage, the days of the great litanies, and all ſolemn feſtivals. He adds, that the biſhops and prelates granted diſpenſations for taking aſſizes and juries in ſome of theſe holy ſeaſons, upon reaſonable occaſions; and ſoon after a general diſpenſation was eſtabliſhed in parliament by ſtat. Weſtm. 1. 3. Edw. I. cap. 51. that aſſizes of novel diſſeiſin, *mort d' anceſtor*, and darrein preſentment, ſhould be taken in Advent, Septuageſima, and Lent, as well as inqueſts; at the ſpecial requeſt of the king to the biſhops. The portions of time that were not included within theſe prohibited ſeaſons fell naturally into a fourfold diviſion; and from ſome feſtival, or ſaint's day, that immediately preceded their commencement, were denominated the terms of *St Hilary*, of *Eaſter*, of the *Holy Trinity*, and of *St Michael*: which terms have been ſince regulated and abbreviated by ſeveral acts of parliament; particularly Trinity-term by ſtat. 32 Hen. VIII. cap. 2. and Michaelmas-term by ſtat. 16 Car. I. cap. 6. and again by ſtat. 24 Geo. II. cap. 48.

Terms, *Oxford*. Hilary or Lent-term begins January 14th, and ends the Saturday before Palm-Sunday. Eaſter-term begins the tenth day after Eaſter, and ends the Thurſday before Whitſunday. Trinity-term begins the Wedneſday after Trinity-Sunday, and ends after the act, or 6th of July, ſooner or later, as the vice-chancellor and convocation pleaſe. Michaelmas-term begins October the 10th, and ends December the 17th.

Terms, *Cambridge*. Lent term begins January the 14th, and ends Friday, before Palm-Sunday. Eaſter-term begins the Wedneſday after Eaſter-week, and ends the week before Whitſunday. Trinity-term begins the Wedneſday after Trinity-Sunday, and ends the Friday after the commencement, or 2d of July. Michaelmas-term begins October the 10th, and ends December the 16th.

Terms, *Scottiſh*. The court of ſeſſion has two terms, the winter and ſummer. The winter begins on 12th November, and ends 11th March, only there is a receſs of three weeks at Chriſtmas. The ſummer term commences 12th May, and ends 11th July. The court of exchequer has four terms: 1. Candlemas term begins 15th January, and ends 3d February; 2. Whitſuntide term begins 12th May, and ends 2d June; 3. Lammas term begins 17th June, and ends 5th July; 4. Martinmas term begins 24th November, and ends 20th December.

Terms, *Iriſh*. In Ireland the terms are the ſame as at London, except Michaelmas-term, which begins October the 13th, and adjourns to November the 3d, and thence to the 6th.

TERMES, in etymology; a genus of inſects belonging to the order of *aptera*, according to Linnæus, but by others it is arranged more properly under the *neuroptera*. The mouth has two horny jaws; the lip is horny and quadrifid, the laciniæ being linear and acute: there are four feelers, which are equal and filiform. The antennæ are moniliform in moſt ſpecies, and the eyes two. There are eight ſpecies, according to Gmelin; the *fatale*, *deſtructor*, *arda*, *mordax*, *capenſe*, *fatidicum*, *pulſatorium*, and *divinatorium*. But as Gmelin has followed the claſſification of Linnæus in arranging the termes under the order of aptera, it is not improbable that ſeveral of theſe which are mentioned as ſpecies of the termes may belong to a different genus. It will be ſufficient, in the preſent article, to deſcribe the fatale, which we are enabled to do from very accurate information.

The *termes fatale*, *belliceſus*, or white ant, is of a yellow colour above; the wings alſo yellowiſh; the coſta is ferruginous; the ſtemmata are near the eyes, the central point being ſomewhat prominent. Of the white ant we have a very curious and intereſting deſcription, in the Philoſophical Tranſactions for 1781, by Mr Henry Smeathman of Clement's Inn. According to this account, the works of theſe inſects ſurpaſs thoſe of the bees, waſps, beavers, and other animals, as much at leaſt as thoſe of the moſt poliſhed European nations excel thoſe of the leaſt cultivated ſavages. And even with regard to man, his greateſt works, the boaſted pyramids, fall comparatively far ſhort, even in ſize alone, of the ſtructures raiſed by theſe inſects. The labourers among them employed in this ſervice are not a quarter of an inch in length; but the ſtructures which they erect riſe to 10 or 12 feet and upwards above the ſurface of the earth. Suppoſing the height of a man to be ſix feet, the author calculates, that the buildings of theſe inſects may be conſidered, relatively to their ſize and that of a man, as being raiſed to near five times the height of the greateſt of the Egyptian pyramids; that is, correſponding with conſiderably more than half a mile. We may add, that, with reſpect to the interior conſtruction, and the various members and diſpoſitions of the parts of the building, they appear greatly to exceed that or any other work of human conſtruction.

The moſt ſtriking parts of theſe ſtructures are, the royal apartments, the nurſeries, magazines of proviſions, arched chambers and galleries, with their various communications; the ranges of Gothic ſhaped arches, projected, and not formed by mere excavation, ſome of which are two or three feet high, but which diminiſh rapidly, like the arches of ailes in perſpectives; the various roads, ſloping ſtaircaſes, and bridges, conſiſting of one vaſt arch, and conſtructed to ſhorten the diſtance between the ſeveral parts of the building, which would otherwiſe communicate only by winding paſſages. In ſome parts near Senegal, their number, magnitude, and cloſeneſs of ſituation, make them appear like the villages of the natives. But theſe and many other curious inſtances of the great ſagacity and powers of theſe inſects cannot be underſtood, without viewing the plates in which their feeble frames, and comparatively ſtupendous works, are delineated. See Phil. Tranſ. above referred to.

The economy of theſe induſtrious inſects appears to have been very attentively obſerved by the ingenious author, as well as their buildings. There are three diſtinct ranks or orders among them, conſtituting a well-regulated community. Theſe are, firſt, the *labourers*, or working inſects; next the *ſoldiers*, or fighting order, who do no kind of labour, and are about twice as long as the former, and equal in bulk to about 15 of them; and laſtly, the winged or perfect inſects, which may be called the *nobility* or *gentry* of the ſtate; for they neither labour nor fight, being ſcarcely capable even of ſelf-defence. "Theſe only are capable of being elected *kings* or *queens*; and nature has ſo ordered it, that they emigrate within a few weeks after they are elevated to this ſtate, and either eſtabliſh new kingdoms, or periſh within a day or two."

The firſt order, the working inſects, are moſt numerous, being in the proportion of 100 to 1 of the ſoldiers. In this ſtate they are about $\frac{1}{4}$ of an inch long, and 25 of them weigh about a grain, ſo that they are not ſo large as ſome of our ants. See Plate DI. fig. 1. and 2.

The ſecond order, or ſoldiers, have a very different form from the labourers, and have been by ſome authors ſuppoſed to be the males, and the former neuters; but they are, in fact, the ſame inſects as the foregoing, only they have undergone a change of form, and approached one degree nearer to the perfect ſtate. They are now much larger, being half an inch long, and equal in bulk to fifteen of the labourers, (fig. 3. and 4.)

The third order or the inſect in its perfect ſtate, varies its form ſtill more than ever. The head, thorax, and abdomen, differ almoſt entirely from the ſame parts in the labourers and ſoldiers; and, beſides this, the animal is now furniſhed with four fine large browniſh, tranſparent, wings, with which it is at the time of emigration to wing its way in ſearch of a new ſettlement. It differs ſo much from the other two, that they have not hitherto been ſuppoſed to belong to the ſame community. In fact, they are not to be diſcovered in the neſt till juſt before the commencement of the rainy ſeaſon; when they undergo the laſt change, which is preparative to the formation of new colonies. They are equal in bulk to two ſoldiers or about 30 labourers (ſee fig. 5.), and by means of the wings with which they are furniſhed they roam about for a few hours; at the end of which time they loſe their wings, and become the prey of innumerable birds, reptiles, and inſects: while probably not a pair out of many millions of this unhappy race get into a place of ſafety, fulfil the firſt law of nature, and lay the foundation of a new community. In this ſtate many fall into the neighbouring waters, and are eaten with avidity by the Africans. The author found them delicate, nouriſhing, and wholeſome, without ſauce or other help from cookery than merely roaſting them in the manner of coffee.

The few fortunate pairs who happen to ſurvive this annual maſſacre and deſtruction, are repreſented by the author as being caſually found by ſome of the labourers, that are continually running about on the ſurface of the ground, and are elected kings and queens of new ſtates. Thoſe who are not ſo elected and preſerved certainly periſh, and moſt probably in the courſe of the following day. By theſe induſtrious creatures the king and queen elect are immediately protected from their innumerable enemies, by incloſing them in a chamber of clay; where the buſineſs of propagation ſoon commences. Their "voluntary ſubjects" then buſy themſelves in conſtructing wooden nurſeries, or apartments entirely compoſed of wooden materials, ſeemingly joined together with gums. Into theſe they afterwards carry the eggs produced from the queen, lodging them there as faſt as they can obtain them from her. The author even furniſhes us with plauſible reaſons to believe, that they here form a kind of garden for the cultivation of a ſpecies of microſcopical muſhroom; which Mr Konig (in an Eſſay on the Eaſt Indian Termites, read before the Society of Naturaliſts of Berlin) conjectures to be the food of the young inſects. But perhaps the moſt wonderful, and at the ſame time beſt authenticated, part of the hiſtory of theſe ſingular inſects, is that which relates to the queen or mother of the community in her pregnant ſtate.

After impregnation, a very extraordinary change begins to take place in her perſon, or rather in her abdomen only. It gradually increaſes in bulk, and at length becomes of ſuch an enormous ſize as to exceed the bulk of the reſt of her body 1500 or 2000 times. She becomes 1000 times heavier than her conſort, and exceeds 20,000 or 30,000 times the bulk of one of the labourers. In this ſtate, the matrix has a conſtant periſtaltic or undulating motion; the conſequence of which is (as the author has counted them) (fig. 8.) the protruſion of 80,000 eggs in 24 hours.

Theſe eggs, ſays the author, "are inſtantly taken from her body by her attendants (of whom there always are, in the royal chamber and the galleries adjacent, a ſufficient number in waiting) and carried to the nurſeries, which are ſometimes four or five feet diſtant in a ſtraight line.—Here, after they are hatched, the young are attended and provided with every thing neceſſary, until they are able to ſhift for themſelves, and take their ſhare of the labours of the community."

Many curious and ſtriking particulars are related of the great devaſtations committed by this powerful community; which conſtruct roads, or rather covered ways, diverging in all directions from the neſt, and leading to every object of plunder within their reach. Though the miſchiefs they commit are very great, ſuch is the economy of nature, that it is probably counterbalanced by the good produced by them; in quickly deſtroying dead trees and other ſubſtances, which, as the author obſerves, would, by a tedious decay, ſerve only to encumber the face of the earth. Such is their alacrity and diſpatch in this office, that the total deſtruction of deſerted towns is ſo effectually accompliſhed, that in two or three years a thick wood fills the ſpace; and not the leaſt veſtigate of a houſe is to be diſcovered.

From the many ſingular accounts here given of the police of theſe inſects, we ſhall mention one reſpecting the different functions of the labourers and ſoldiers, or the civil and military eſtabliſhments in this community, on an attempt to examine their neſt or city.

On making a breach in any part of the ſtructure with a hoe or pick-axe, a ſoldier immediately appears, and walks about the breach, as if to ſee whether the enemy is gone, or to examine whence the attack proceeds. In a ſhort time he is followed by two or three others, and ſoon afterwards by a numerous body, who ruſh out as faſt as the breach will permit them; their numbers increaſing as long as any one continues to batter the building. During this time they are in the moſt violent buſtle and agitation; while ſome of them are employed in beating with their forceps upon the building, ſo as to make a noiſe that may be heard at three or four feet diſtance. On ceaſing to diſturb them, the ſoldiers retire, and are ſucceeded by the labourers, who haſten in various directions towards the breach, each with a burden of mortar in his mouth ready tempered. Though there are millions of them, they never ſtop or embarraſs each other; and a wall gradually ariſes that fills up the chaſm. A ſoldier attends every 600 or 1000 of the labourers, ſeemingly as a director of the works; for he never touches the mortar, either to lift or carry it. One in particular places himſelf cloſe to the wall which they are repairing, and frequently makes the noiſe abovementioned; which is conſtantly anſwered by a loud hiſs from all the labourers within the dome: and at every ſuch ſignal, they evidently redouble their pace, and work as faſt again.

The work being completed, a renewal of the attack conſtantly produces the ſame effects. The ſoldiers again ruſh out, and then retreat, and are followed by the labourers loaded with mortar, and as active and diligent as before. “Thus, ſays the author, the pleaſure of ſeeing them come out to fight or to work alternately may be obtained as often as curioſity excites or time permits: and it will certainly be found, that the one order never attempts to fight, or the other to work, let the emergency be ever ſo great.” The obſtinacy of the ſoldiers is remarkable. “They fight to the very laſt, diſputing every inch of ground ſo well as often to drive away the negroes, who are without ſhoes, and make white people bleed plentifully through their ſtockings.”

Such is the ſtrength of the buildings erected by theſe puny inſects, that when they have been raiſed to little more than half their height, it is always the practice of the wild bulls to ſtand as centinels upon them, while the reſt of the herd is ruminating below. When at their full height of 10 or 12 feet, they are uſed by the Europeans as places to look out from over the top of the graſs, which here grows to the height of 13 feet upon an average. The author has ſtood with four men on the top of one of theſe buildings, in order to get a view of any veſſel that might come in ſight.

It may appear ſurpriſing how a Being perfectly good ſhould have created animals which ſeem to ſerve no other end but to ſpread deſtruction and deſolation wherever they go. But let us be cautious in ſuſpecting any imperfection in the Father of the Univerſe. What at firſt ſight may ſeem only productive of miſchief, will, upon mature deliberation, be found worthy of that wiſdom which planned the moſt beautiful parts of the world. Many poiſons are valuable medicines; the ſtorms are beneficial; and diſeaſes often promote life. Theſe termites, indeed, are frequently pernicious to mankind, but they are alſo very uſeful and even neceſſary; one valuable purpoſe which they ſerve is, to deſtroy decayed trees and other ſubſtances, which, if left on the ſurface of the ground in hot climates, would in a ſhort time pollute the air. In this reſpect they reſemble very much the common flies, which are regarded by mankind in general as noxious, and at beſt as uſeleſs beings in the creation; but this is certainly for want of conſideration. There are not probably in all nature animals of more importance; and it would not be difficult to prove, that we ſhould feel the want of one or two ſpecies of large quadrupeds much leſs than of one or two ſpecies of theſe deſpicable-looking inſects. Mankind in general are ſenſible that nothing is more diſagreeable, or more peſtiferous, than putrid ſubſtances; and it is apparent to all who have made obſervation, that thoſe little inſects contribute more to the quick diſſolution and diſperſion of putreſcent matter than any other. They are ſo neceſſary in all hot climates, that even in the open fields a dead animal or ſmall putrid ſubſtance cannot be laid upon the ground two minutes before it will be covered with flies and their maggots, which inſtantly entering quickly devour one part, and perforating the reſt in various directions, expoſe the whole to be much ſooner diſſipated by the elements. Thus it is with the termites; the rapid vegetation in hot climates, of which no idea can be formed by any thing to be ſeen in this, is equalled by as great a degree of deſtruction from natural as well as accidental cauſes (A). It ſeems apparent that when any thing whatever is arrived at its laſt degree of perfection, the Creator has decreed it ſhall be totally deſtroyed as ſoon as poſſible, that the face of nature may be ſpeedily adorned with freſh productions in the bloom of ſpring or the pride of ſummer: ſo when trees, and even woods, are in part deſtroyed by tornadoes or fire, it is wonderful to obſerve how many agents are employed in haſtening the total diſſolution of the reſt; but in the hot climates there are none ſo expert, or who do their buſineſs ſo expeditiouſly and effectually, as theſe inſects, who in a few weeks deſtroy and carry away the bodies of large trees, without leaving a particle behind, thus clearing the place for other vegetables, which ſoon fill up every vacancy; and in places where two or three years before there has been a populous town, if the inhabitants, as is frequently the caſe, have choſen to abandon it, there ſhall be a very thick wood, and not the veſtige of a poſt to be ſeen, unleſs the wood has been of a ſpecies which, from its hardneſs, is called *iron wood*.

(A) The Guinea graſs, which is ſo well known and ſo much eſteemed by the planters in the Weſt Indies, grows in Africa, as we have already mentioned, thirteen feet high upon an average, which height it attains in about five or ſix months; and the growth of many other plants is as quick.

Tænia

Fig. 8.

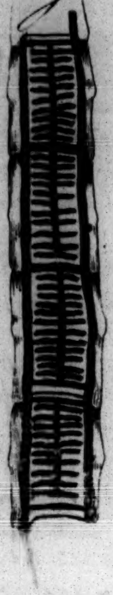


Fig. 6.

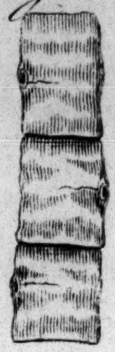


Fig. 5.

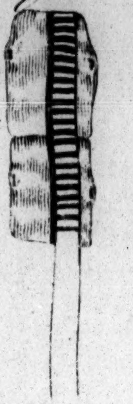


Fig. 4.

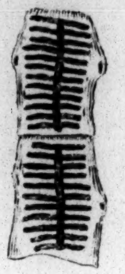


Fig. 3.

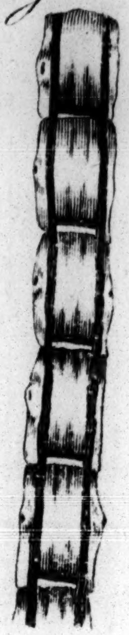


Fig. 1.

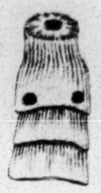


Fig. 2.

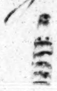


Fig. 7.

Termes

Fig. 6.

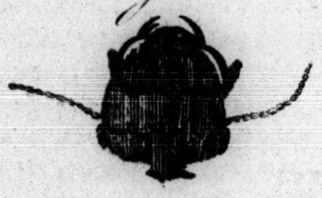


Fig. 4.

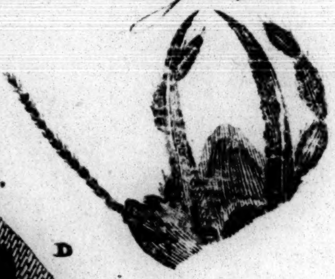


Fig. 2.

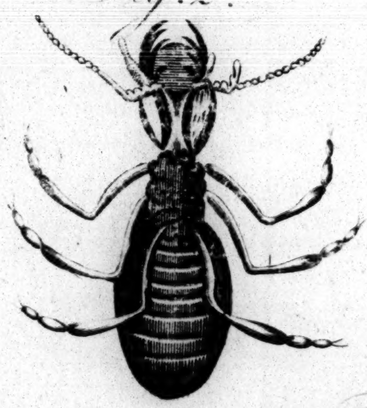
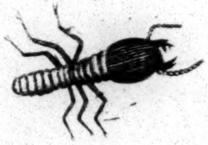


Fig. 1.

Fig. 3.



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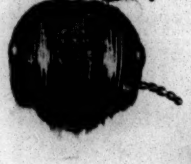
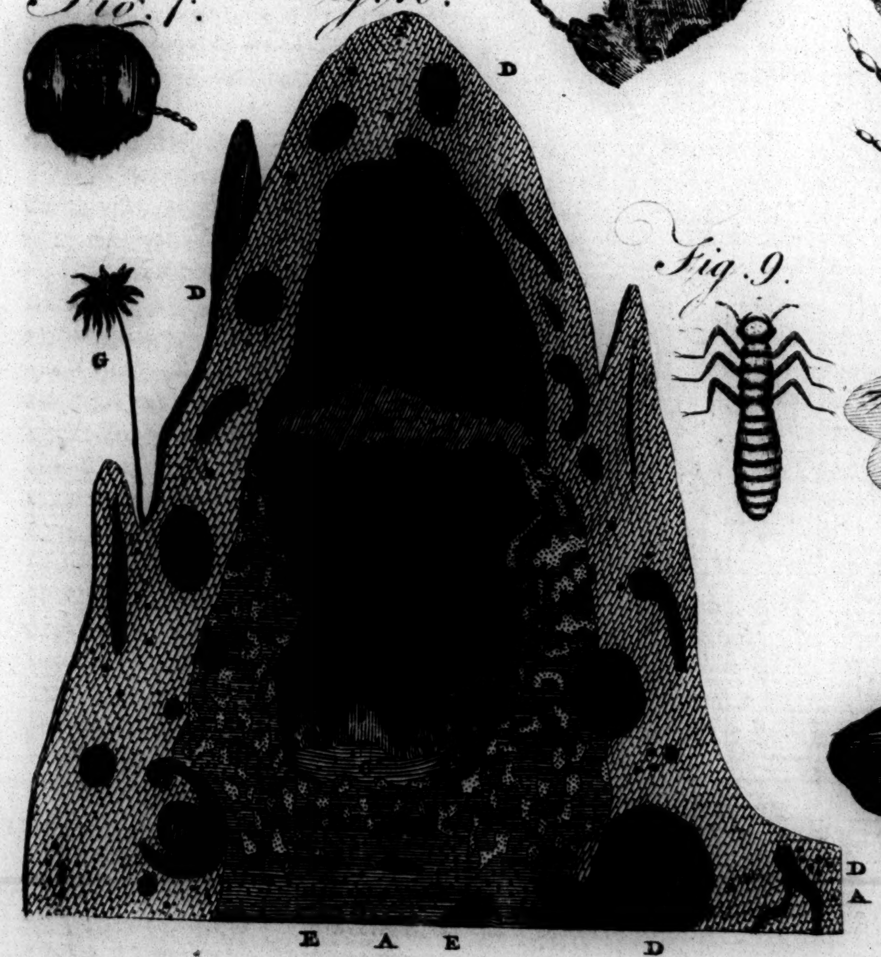


Fig. 10.



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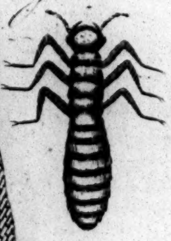


Fig. 5.

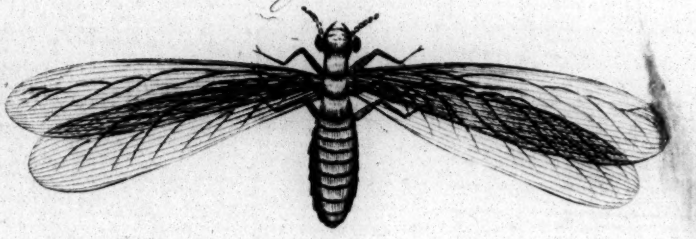
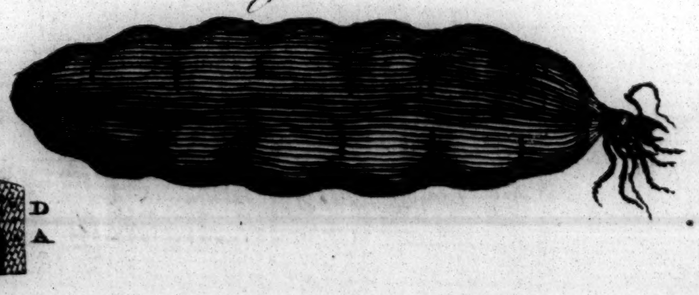


Fig. 8.



BRITISH MUSEUM

Fig. 1. repreſents a labourer. Fig. 2. a labourer magnified. Fig. 3. a ſoldier. Fig. 4. a ſoldier, forceps, and part of his head magnified. Fig. 5. a perfect termes bellicoſus. Fig. 6. the head of a perfect inſect magnified. Fig. 7. a head with ſtemmata magnified. Fig. 8. a queen. Fig. 9. a king. Fig. 10. is a ſection of the building raiſed by theſe inſects, as it would appear on being cut down through the middle from the top a foot lower than the ſurface of the ground. AA, an horizontal line from A on the left, and a perpendicular line from A at the bottom, will interſect each other at the royal chamber. The darker ſhades near it are the empty apartments and paſſages, which it ſeems are left ſo for the attendants on the king and queen, who, when old, may require near 100,000 to wait on them every day. The parts which are the leaſt ſhaded and dotted are the nurſeries, ſurrounded, like the royal chamber, by empty paſſages, on all ſides, for the more eaſy acceſs to them with the eggs from the queen, the proviſion for the young, &c. *N. B.* The magazines of proviſions are ſituated without any ſeeming order among the vacant paſſages which ſurround the nurſeries. B, the top of the interior building, which often ſeems, from the arches carrying upward, to be adorned on the ſides with pinnacles. C, the floor of the area or nave. DDD, the large galleries which aſcend from under all the buildings ſpirally to the top. EE, the bridges.

TERMINALIA, in antiquity, feaſts celebrated by the Romans in honour of the god Terminus.

TERMINALIA, in botany; a genus of plants belonging to the claſs of *polygamia*, and order of *monœcio*. The male calyx is quinquepartite; there is no corolla; the ſtamina are ten in number. The hermaphrodite flower is the ſame with that of the male; there is one ſtyle; the fruit, which is a drupe or plum, is below, and ſhaped like a boat. There are two ſpecies; the catappa, and anguſtifolia or benzoin. This ſpecies does not, however, yield benzoin. See STYRAX.

TERMINI, in architecture, denotes a kind of ſtatues or columns, adorned on the top with the figure of a man's, woman's, or ſatyr's head, as a capital; and the lower part ending in a kind of ſheath or ſcabbard.

TERMINUS, in Pagan worſhip, an ancient deity among the Romans, who preſided over the ſtones or land marks, called *termini*, which were held ſo ſacred, that it was accounted ſacrilege to move them; and as the criminal became devoted to the gods, it was lawful for any man to kill him. The worſhip of this deity was inſtituted by Numa Pompilius, who, to render land marks, and conſequently the property of the people, ſacred, erected a temple on the Tarpeian mount to Terminus.

TERN, in ornithology. See STERNA.

TERNATE, the moſt northerly of the Molucca or Clove Iſlands in the Eaſt Indies. It abounds in cocoa-nuts, bananas, citrons, oranges, almonds, and other fruit proper to the torrid zone; but cloves are the moſt valuable produce. It is in the poſſeſſion of the Dutch. Malaya is the capital town. E. Long. 129. 0. N. Lat 1. 0.

TERNI, a town of Italy in the Pope's territories, and in the duchy of Spoletto, with a biſhop's ſee. It is but a ſmall place; though there are very beautiful ruins of antiquity, it having been a very conſiderable Roman colony. It is ſituated on the top of a high mountain, and to the weſt of it are fields which are extremely fertile. E. Long. 12. 40. N. Lat. 42. 34.

TERNSTROMIA, in botany; a genus of plants belonging to the claſs of *polyandria*, and order of *monogynia*. The calyx is monophyllous and quinquepartite: the corolla is monopetalous, quinquepartite or ſexpartite, globular, and bell-ſhaped: the berry is dry, bilocular, and valveleſs. There is only one ſpecies, the meridionalis.

TERPANDER, a celebrated Greek poet and muſician. The Oxford marbles tell us that he was the ſon of Derdeneus of Leſbos, and that he flouriſhed in the 381ſt year of theſe records; which nearly anſwers to the 27th Olympiad, and 671ſt year B. C. The marbles inform us likewiſe, that he taught the *nomes*, or airs, of the lyre and flute, which he performed himſelf upon this laſt inſtrument, in concert with other players on the flute. Several writers tell us that he added three ſtrings to the lyre, which before his time had but four; and in confirmation of this, Euclid and Strabo quote two verſes, which they attribute to Terpander himſelf.

> The tetrachord's reſtraint we now deſpiſe,
> The ſeven-ſtring'd lyre a nobler ſtrain ſupplies.

Among the many ſignal ſervices which Terpander is ſaid to have done to muſic, none was of more importance than the notation that is aſcribed to him for aſcertaining and preſerving melody, which before was traditional, and wholly dependent on memory. The invention, indeed, of muſical characters has been attributed by Alypius and Gaudentius, two Greek writers on muſic, and upon their authority by Boethius, to Pythagorus, who flouriſhed full two centuries after Terpander. But Plutarch, from Heraclides of Pontus, aſſures us that Terpander, the inventor of nomes for the cithara, in hexameter verſe, ſet them to muſic, as well as the verſes of Homer, in order to ſing them at the public games: And Clemens Alexandrinus, in telling us that this muſician wrote the laws of Lycurgus in verſe, and ſet them to muſic, makes uſe of the ſame expreſſion as Plutarch; which ſeems clearly to imply a written melody.

After enumerating the airs which Terpander had compoſed, and to which he had given names, Plutarch continues to ſpeak of his other compoſitions; among which he deſcribes the proems, or hymns for the cithara, in heroic verſe. Theſe were uſed in after times by the Rhapſodiſts, as prologues or introductions to the poems of Homer and other ancient writers. But Terpander rendered his name illuſtrious, no leſs by his performances both upon the flute and cithara than by his compoſitions. This appears by the marbles already mentioned; by a paſſage in Athenæus, from the hiſtorian Hellanicus, which informs us that he obtained the firſt prize, in the muſical conteſts at the Carnean games; and by the teſtimony of Plutarch, who ſays, that "no other proof need be urged of the excellence of Terpander in the art of playing upon the cithara, than what is given by the regiſter of the Pythic games, from which it appears that he gained four prizes ſucceſſively at thoſe ſolemnities.

Of the works of this poet only a few fragments are now remaining.

TERRA AUSTRALIS INCOGNITA, a name for a large unknown continent, ſuppoſed to lie towards the South Pole, and which for a long time was ſought after by navigators. The late voyages of Captain Cook have aſcertained this matter as much as it probably ever will be. (See *South-Sea*, *Cook's Diſcoveries*, n° 47, 48, 68, 69. and AMERICA, n° 4). On this ſubject Captain Cook expreſſes himſelf as follows: "I had now made the circuit of the Southern Ocean in a high latitude, and traverſed it in ſuch a manner as to leave not the leaſt room for the poſſibility of there being a continent, unleſs near the pole, and out of the reach of navigation. By twice viſiting the tropical ſea, I had not only ſettled the ſituation of ſome old diſcoveries, but made there many new ones, and left, I conceive, very little more to be done even in that part. Thus I flatter myſelf, that the intention of the voyage has in every reſpect been fully anſwered; the ſouthern hemiſphere ſufficiently explored; and a final end put to the ſearching after a ſouthern continent, which has at times engroſſed the attention of ſome of the maritime powers for near two centuries paſt, and been a favourite theory amongſt the geographers of all ages. That there may be a continent, or large tract of land near the pole, I will not deny: on the contrary, I am of opinion there is; and it is probable that we have ſeen a part of it. The exceſſive cold, the many iſlands, and vaſt floats of ice, all tend to prove that there muſt be land to the ſouth; and for my perſuaſion that this ſouthern land muſt lie or extend fartheſt to the north, oppoſite to the Southern Atlantic and Indian Oceans, I have already aſſigned ſome reaſons; to which I may add, the greater degree of cold experienced by us in theſe ſeas than in the Southern Pacific Ocean under the ſame parallels of latitude."

Terra Firma, in geography, is ſometimes uſed for a continent, in contradiſtinction to iſlands.

Terra Firma, otherwiſe called *New Caſtile* or *Caſtella del Oro*, a country of America, bounded on the north by the North Sea and part of the Atlantic Ocean, by the ſame ſea and Guiana on the eaſt, by the country of the Amazons and Peru on the ſouth, and by the Pacific Ocean and Veragua on the weſt. It lies between 62 and 83 degrees of weſt longitude, and between the equator and 12 degrees of north latitude; being upwards of 1200 miles in length from eaſt to weſt, and 800 in breadth from north to ſouth. It had the name of *Caſtella del Oro* from the quantities of gold found in the diſtricts of Uraba and other parts; and was firſt diſcovered by the celebrated Columbus in his third voyage.

The climate is neither pleaſant nor healthy; the inhabitants one part of the year being ſcorched by the moſt intenſe and burning heat, and the other almoſt drowned with perpetual floods of rain, pouring from the ſky with ſuch violence as if a general deluge was to enſue.

In ſo large a tract of country the ſoil muſt neceſſarily vary. Accordingly, in ſome parts it is a barren ſand, or drowned mangrove land, that will ſcarce produce any kind of grain; in others it yields Indian corn, balms, gums, and drugs, almoſt all manner of Fruits as well of Old as of New Spain, ſugar, tobacco, Braſil wood, and ſeveral other kinds of dyeing woods; a variety of precious ſtones, particularly emeralds and ſapphires; veniſon and other game. The plantations of cacao, or chocolate nuts, in the diſtrict of the Caraccas, are eſteemed the beſt in America. The mountains abound with tygers, and, according to ſome, with lions, and great numbers of other wild beaſts. The rivers, ſeas, and lakes, teem with fiſh, and alſo with alligators; and the bowels of the earth were once furniſhed with the richeſt treaſures, now almoſt exhauſted. The ſame may be ſaid of the pearl-fiſheries on the coaſt, which are far from being ſo profitable now as formerly.

Terra Firma is a very mountainous country. Terra Firma Proper, in particular, conſiſts of prodigious high mountains, and deep valleys flooded more than half the year. The mountains in the provinces of Carthagena and St Martha, according to Dampier, are the higheſt in the world; being ſeen at ſea 200 miles off: from theſe run a chain of hills of almoſt equal height, quite through South America, as far as the Straits of Magellan, called the *Cordilleras des Andes*. The province of Venezuela alſo, and diſtrict of the Caraccas, the moſt northerly parts of South America, are almoſt a continued chain of hills, ſeparated by ſmall valleys, pointing upon the coaſt of the North Sea. A chain of barren mountains, almoſt impaſſable, runs through the province of Popayan from north to ſouth, ſome whereof are volcanoes; but towards the ſhores of the Pacific Ocean it is a low country, flooded great part of the year.

The principal rivers of Terra Firma are, the Darien, Chagtre, Santa Maria, Conception, Rio Grande or Magdalena, Maricaibo, and Oroonoko.

Terra Firma contains the provinces of Terra Firma Proper or Darien, of Carthagena, St Martha, Rio de la Hacha, Venezuela, Comana, New Andaluſia or Paria, New Granada, and Popayan.

Terra Firma Proper lies in the form of a creſcent, about the ſpacious bay of Panama, being the iſthmus which joins South and North America; and extending in length between the two ſeas 300 miles, but in breadth, where the iſthmus is narroweſt, only 60. Here are found gold mines, gold ſands, and fine pearls; and though the land is generally rough, there are ſome fruitful valleys, watered by rivers, brooks, and ſprings. The chief places are Panama and Porto Bello.

The inhabitants of Terra Firma have never been thoroughly ſubdued, and in all probability never will; as they are a brave and warlike people, have retreats inacceſſible to Europeans, and bear an inveterate enmity to the Spaniards. See Darien.

Terra Japonica, more commonly called *catechu*, a drug formerly ſuppoſed to be an extract from the ſeeds of the areca catechu, but lately diſcovered by Mr Kerr, aſſiſtant ſurgeon to the civil hoſpital at Bengal, to be obtained from the *mimoſa catechu*. Mr Kerr gives the following account of the manner in which the extract is made: "After felling the trees, the manufacturer carefully cuts off all the exterior white part of the wood. The interior coloured wood is cut into chips, with which he fills a narrow-mouthed unglazed earthen pot, pouring water upon them until he ſees it among the upper chips; when this is half evaporated by boiling, the decoction, without ſtraining, is poured into a flat earthen pot, and boiled to one third part; this is ſet in a cool place for one day, and afterwards evaporated by the heat of the ſun, ſtirring it ſeveral times in the day. When it is reduced to a conſiderable thickneſs, it is ſpread upon a mat or cloth, which has previouſly been covered with the aſhes of cow-dung; this maſs is divided into ſquare or quadrangular pieces by a ſtring, and completely dried by turning them frequently in the ſun until they are fit for ſale (A)."

Med. Obſ. and Inquiries, vol. v.

This extract is called *cutt* by the natives, by the Engliſh

(A) "In making the extract, the pale brown wood is preferred, as it produces the fine whitiſh extract; the darker the wood is, the blacker the extract, and of leſs value. They are very careful in drying their pots upon the fire before they are uſed; but very negligent in cutting their chips upon the ground, and not ſtraining the decoction; by which, and the dirty aſhes they uſe, there muſt be a conſiderable quantity of earth in the extract, beſides what avarice may prompt them to put into it.

"The antiſeptic quality of catechu appears from the experiments made by Sir John Pringle. Huxham employed it ſucceſsfully in caſes where a putrid diſſolved ſtate of the blood prevailed. This extract is the principal ingredient in an ointment of great repute in India, compoſed of catechu four ounces, alum nine drams, white reſin four ounces; theſe are reduced liſh *cutch*, and by different authors *terra japonica*, *catechu*, *khaath*, *cate*, *cachou*, &c. "In its pureſt ſtate it is a dry pulverable ſubſtance, outwardly of a reddiſh colour, internally of a ſhining dark brown, tinged with a reddiſh hue; in the mouth it diſcovers conſiderable aſtringency, ſucceeded by a ſweetiſh mucilaginous taſte." According to Lewis, "it diſſolves almoſt totally in water, excepting the impurities; which are uſually of the ſandy kind, and amounting in the ſpecimens I examined to about one eighth of the maſs. Of the pure matter, rectified ſpirit diſſolves about ſeven eighths into a deep red liquor: the part which it leaves undiſſolved is an almoſt inſipid mucilaginous ſubſtance."

oodvil- 's Medi- l Botany, ol. ii.

Uſes. Catechu may be uſefully employed for moſt purpoſes where an aſtringent is indicated, provided the moſt powerful be not required. But it is particularly uſeful in alvine fluxes; and where theſe require the uſe of aſtringents, we are acquainted with no one equally beneficial. Beſides this, it is employed alſo in uterine profluvia, in laxity and debility of the viſcera in general, in catarrhal affections, and various other diſeaſes where aſtringents are neceſſary. It is often ſuffered to diſſolve leiſurely in the mouth, as a topical aſtringent for laxities and exulcerations of the gums, for apthous ulcers in the mouth, and ſimilar affections. This extract is the baſis of ſeveral fixed formulæ in our pharmacopœias, particularly of a tincture and an electuary: but one of the beſt forms under which it can be exhibited, is that of a ſimple infuſion in warm water, with a proportion of cinnamon or caſſia; for by this means it is at once freed from its impurities, and improved by the addition of the aromatic.

Terra Puzzolana. See Puzzolana.

Terræ Filius, *Son of the Earth*, a ſtudent of the univerſity of Oxford, formerly appointed in public acts to make ſatirical and jeſting ſpeeches againſt the members thereof, to tax them with any growing corruptions, &c.

Terra Sigillata Lemnia. See Adansonia.

TERRACE, a walk or bank of earth, raiſed in a garden or court to a due elevation for a proſpect. The name is alſo given to the roofs of houſes that are flat, and whereon we may walk.

TERRAQUEOUS, in geography, a name given to our globe, becauſe conſiſting of land and water.

TERRAS, or Traas, in mineralogy, a ſpecies of argillaceous earth. It differs but little in its principles from puzzolana, but is much more compact and hard, porous and ſpungy. It is generally of a whitiſh yellow colour, and contains more heterogeneous particles, as ſpar, quartz, ſhoerl, &c. and ſomething more of calcareous earth; it efferveſces with acids, is magnetic, and fuſible *per ſe*. When pulverized, it ſerves as a cement, like puzzolana. It is found in Germany and Sweden.

irwan's Minera- gy.

A ſpecies of red earth has been found in the pariſh of St Elizabeth in Jamaica, which turns out to be an excellent ſubſtitute for terras or puzzolana earth, and may therefore be of great value to the inhabitants of the Weſt Indies.

ociety for rts, &c. ol. v.

One meaſure of this earth, mixed with two of well ſlaked lime and one of ſand, form a cement that anſwers extremely well for building any dam or bridge, or any ſtructure in water, for it will ſoon harden and become like a ſtone.

TERRASSON (Abbé John), a French writer born at Lyons in 1669. He diſtinguiſhed himſelf in the diſpute concerning Homer, between La Motte and Madam Dacier, by writing a *Diſſertation contre l'Iliade*. He wrote a political and moral romance called *Sethos*, full of learning and philoſophy; and another capital work of his is a French tranſlation of Diodorus Siculus. He died in 1750.

TERRE *Verte*, in the colour-trade, the name of a green earth much uſed by painters, both ſingly for a good ſtanding green, and in mixture with other colours. The name is French, and ſignifies "green earth."

It is an indurated clay, of a deep bluiſh green colour, and is found in the earth, not in continued ſtrata or beds, as moſt of the other earths are, but in large flat maſſes of different ſizes, imbedded in other ſtrata; theſe break irregularly in the cutting, and the earth is generally brought out of the pit in lumps of different ſizes. It is of a fine, regular, and even ſtructure, and not very hard. It is of an even and gloſſy ſurface, very ſmooth to the touch, and in ſome degree reſembling the morochthus or French chalk, but adhering firmly to the tongue. It does not ſtain the hands in touching it; but being drawn along a rough ſurface, it leaves an even white line, with a greeniſh caſt.

It does not ferment with acids, and it burns to a duſky brown colour. It is dug in the iſland of Cyprus, and in many parts of France and Italy. That from the neighbourhood of Verona has been eſteemed the beſt in the world; but of late there has been ſome dug in France that equals it. There is alſo an earth dug on Mendip Hills, in the ſinking for coal, which, though wholly unobſerved, is nearly, if not wholly, of equal value. When ſcraped, and the finer parts ſeparated, it is ready to be made up with oil for the uſe of the painters, and makes the moſt true and laſting green of any ſimple body they uſe.

TERRESTRIAL, ſomething partaking of the nature of earth, or belonging to the globe of earth; thus we ſay, the terreſtrial globe, &c.

TERRIER, a ſmall hound to hunt the fox or badger; ſo called becauſe he creeps into the ground, as ferrets do into the coney-burrows, after the fox, &c.

TERRITORY, in geography, denotes an extent or compaſs of land, within the bounds or belonging to the juriſdiction of any ſtate, city, or other ſubdiviſion of a country.

TERROR. See Fear and Fright.

TERTIAN fever. See Medicine, n° 126.

TERTULLIAN, or Quintus Septimus Florens Tertullianus, a celebrated prieſt of Carthage, was the ſon of a centurion in the militia, who ſerved as proconſul of Africa. He was educated in the Pagan religion; but being convinced of its errors, embraced Chriſtianity, and became a zealous defender of the faith. He married, it is thought, after his baptiſm. Afterwards he took orders, and went to Rome; where, during the perſecution under the emperor Severus, he publiſhed his Apology for the Chriſtians, which is, in its kind, a maſterpiece of eloquence and learning; and at the beginning of the third century he embraced the ſect of the Montaniſts. He lived to a very great age, and died under the reign of Antoninus Caracalla, about the year 216. Many of his works are ſtill extant, in all of which he diſcovers a great knowledge of the Holy Scriptures, a lively imagination, a ſtrong, elevated, and impetuous ſtyle, great eloquence and ſtrength of reaſoning; but is ſome-

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reduced to a fine powder, and mixed with the hand, adding olive oil ten ounces, and a ſufficient quantity of water, to bring the maſs to the conſiſtence of an ointment. To all ſores and ulcers in warm climates aſtringent applications of this kind are found to be peculiarly uſeful."

ſometimes obſcure. His Apology and Preſcriptions are moſt eſteemed. The beſt editions of his works are thoſe of Rigault; eſpecially that of Venice in 1746, folio. Pamelius and Alix, Mr Thomas, and the Sieur du Foſſé, have written his life; and Rigault, M. de l'Aube Epine, Father Petau, and other learned men, have publiſhed notes on his works.

TERUNCIUS, in antiquity, a very ſmall braſs coin in uſe among the Romans.

The inconvenience of ſuch very ſmall pieces being ſoon found, the teruncius became diſuſed, but its name is ſtill retained in reckoning, and thus it became a money of account. The teruncius at firſt was a quarter of the as, or libra; hence, as the as contained twelve ounces, the teruncius contained three, whence the name, which is formed of the Latin *tres unciæ*. Teruncius was alſo uſed for the quarter of the denarius; ſo that when the denarius was at ten aſes, the teruncius was worth two and a half; and when the denarius was riſen to ſixteen, the teruncius was worth four. See Denarius.

TESSELATED PAVEMENTS, thoſe of rich Moſaic work made of curious ſquare marbles, bricks, or tiles, called *teſſelæ* from their reſembling dice.

TESSERA, in Roman antiquity, denoted in its primary ſenſe a cube or die; ſo called from the Greek word τεσσαρα, or τεσσερα, *four;* reſpect being had to its number of ſides, diſtinct from the two horizontal planes above and below. And it was thus diſtinguiſhed from the talus, which being round at each end, contained only four planes or faces on which it could ſtand; and therefore when thrown had no more than two ſide faces in view. Hence *ludere talis et ludere teſſeris* are ſpoken of by Roman writers as two different games. The ſyllable TES. occurs often in Roman inſcriptions. The word *teſſera* was applied to many other things, not ſo much from a ſimilitude in the figure, as from the relation they bore to ſome other thing of which they were the ſign or token; as the points on the upper plane of the die denoted the good or ill ſucceſs of the caſt.

The *teſſera hoſpitalis* was either public or private. As to the former, we find among the inſcriptions publiſhed by Gruter inſtances of two municipal towns which put themſelves under the patronage of the Roman governor; and the reciprocal engagement between them, engraved on two copper plates, in the form of an oblong ſquare, with a pediment at the top, is called in both *teſſera hoſpitalis*. The deſign of it was to cultivate or maintain a laſting friendſhip between private perſons and their families; and gave a mutual claim to the contracting parties and their deſcendants of a reception and kind treatment at each other's houſes, as occaſion offered. For which end thoſe teſſeræ were ſo contrived as beſt to preſerve the memory of that tranſaction to poſterity. And one method of doing this was by dividing one of them lengthwiſe into two equal parts; upon each of which one of the parties wrote his name, and interchanged it with the other. From this cuſtom came the prevailing expreſſion *teſſeram hoſpitalem confringere*, applied to perſons who violated their engagements.

The *teſſeræ frumentariæ* were ſmall tallies given by the emperors to the populace at Rome, entitling them to the reception of a quantity of corn from the public at ſtated ſeaſons. The perſon who had the inſpection of theſe was called *teſſerarius*. They were made of wood and of ſtone.

There was another kind of teſſera which intitled perſons to a ſight of the public games and other diverſions, uſually made in the form of an oblong ſquare.

The *teſſera militaris* was a ſignal given by the general, or chief commander of an army, as a direction to the ſoldiers for executing any duty or ſervice required of them. This, upon urgent occaſions, was only vocal; but, in ordinary caſes, it was written on a tablet, commonly made of wood. Beſide theſe civil and military teſſeræ, there are others which relate to religious affairs, and may be called *ſacred*.

TESSON, or TESTON. See TESTER.

TESSOUWA, a conſiderable town in Africa, ſituated eaſt of Mourzouk, the capital of the kingdom of Fezzan. Near this town a deep and rapid ſtream is ſaid to have exiſted, but was overwhelmed by the moving ſands ſo frequent in Africa.

TEST, a veſſel uſed in metallurgy for abſorbing the ſcoriæ of metallic bodies when melted. See CUPEL.

Some of the German writers recommend, both for teſts and cupels, a ſort of friable opake ſtone, called *white ſpath*, which appears to be a ſpecies of gypſum, or of the ſtones from which plaſter of Paris is prepared. The ſpath is directed to be calcined with a gentle fire, in a covered veſſel, till the ſlight crackling, which happens at firſt, has ceaſed, and the ſtone has fallen in part into powder: the whole is then reduced into ſubtle powder, which is paſſed through a fine ſieve, and moiſtened with ſo much of a weak ſolution of green vitriol as is ſufficient for making it hold together. Gellert, however, finds, that if the ſtone is of the proper kind, which can be known only by trials, calcination is not neceſſary. Scheffer obſerves, that theſe kinds of teſts are liable to ſoften or fall aſunder in the fire, and that this inconvenience may be remedied by mixing with the uncalcined ſtone ſomewhat leſs than equal its weight, as eight-ninths of ſuch as has been already uſed and is penetrated by the ſcoria of the lead, taking only that part of the old teſt which appears of a green-grey colour, and rejecting the red cruſt on the top. Teſts or cupels made of the ſpath are ſaid not to require ſo much caution in nealing and heating them as the common ones; it appears, however, from Scheffer's account, that they are leſs durable than thoſe made of the aſhes of bones, though greatly ſuperior to thoſe of wood-aſhes. Vegetables aſhes, which ſtand pretty well the teſting of ſilver, can ſcarcely bear any great quantity of gold, this metal requiring a conſiderably ſtronger fire than the other; but bone-aſhes anſwer ſo effectually, and are among us ſo eaſily procurable, that it is not needful for the refiner to ſearch for any other materials; though thoſe who work off large quantities of lead, in order to gain a little ſilver or gold contained in it, may poſſibly, in places remote from populous cities, avail themſelves of ſubſtances ſimilar to the ſpath abovementioned.

The teſt, for its greater ſecurity, is fixed in the mould in which it was formed; which is ſometimes a ſhallow veſſel made of crucible earth or caſt-iron, more commonly an iron hoop, with three bars arched downwards acroſs the bottom, about two inches deep, and of different widths, from three or four inches to fifteen or more, according to the quantity of metal to be teſted at once. The aſhes or earthy powder, moiſtened as for making cupels, are preſſed down in the mould ſo as to completely fill it or riſe a little above the ſides; with care to make the maſs equally ſolid, and to put in at once, or at leaſt after the bottom has been preſſed cloſe, as much of the matter as will be ſufficient for the whole; for any additional quantity will not unite thoroughly with the reſt, but be apt to part from it in the fire. The edges are pared ſmooth, and a portion cut out from the middle with a bent knife, ſo as to leave a proper cavity, which is ſmoothed by ſtrewing ſome dry powder on the ſurface, and rolling on it a wooden, or rather a glaſs ball.

The proceſs of teſting is often performed in the ſame manner as that of cupellation: but where great quantities of baſe metal are to be worked off from a little gold, recourſe is had to a more expeditious method, that of teſting before the bellows.

An oval teſt is placed in a cavity, made in a hearth of a convenient height, and ſome moiſtened ſand or aſhes preſſed round it to keep it ſteady: the noſe of a bellows is directed along its ſurface, in ſuch a manner, that if aſhes are ſprinkled in the cavity of the teſt, the bellows may blow them completely out: ſome have an iron plate fixed before the bellows, to direct the blaſt downwards. To keep the ſurface of the teſt from being injured in putting in the metal, ſome cloths or pieces of paper are interpoſed. The fuel conſiſts of billets of barked oak laid on the ſides of the teſt, with others laid croſswiſe on theſe: the bellows impel the flame on the metal, clear the ſurface of aſhes or ſparks of coal, haſten the ſcorification of the lead, and blow off the ſcoria, as faſt it forms, to one end of the teſt, where it runs out through a notch made for that purpoſe. About two-thirds of the ſcorified lead may thus be collected; the reſt being partly abſorbed by the teſt, and partly diſſipated by the action of the bellows. Care muſt be taken not to urge the blaſt too ſtrongly, leſt ſome portion of the gold ſhould be carried away by the fumes impetuouſly forced off from the lead, and ſome minute particles of it entangled and blown off with the ſcoriæ.

Teſt-Act, in law, is the ſtatute 25 Car. II. cap. 2. which directs all officers, civil and military, to take the oaths, and make the declaration againſt tranſubſtantiation, in the court of King's Bench or Chancery, the next term, or at the next quarter-ſeſſions, or (by ſubſequent ſtatutes) within ſix months after their admiſſion; and alſo within the ſame time to receive the ſacrament of the Lord's Supper, according to the uſage of the church of England, in ſome public church, immediately after divine ſervice or ſermon, and to deliver into court a certificate thereof, ſigned by the miniſter and church warden, and alſo to prove the ſame by two credible witneſſes, upon forfeiture of 500l. and diſability to hold the ſaid office.

The avowed object of this act was to exclude from places of truſt all members of the church of Rome; and hence the diſſenters of that age, if they did not ſupport the bill when paſſing through the two houſes of parliament, gave it no oppoſition. For this part of their conduct they have been often cenſured with ſeverity, as having betrayed their rights from reſentment to their enemies. But is this a fair ſtate of the caſe? Were any rights in reality betrayed? That the dread of a popiſh ſucceſſor and of popiſh influence was the immediate and urgent cauſe of paſſing the *teſt-act*, is indeed true; but that the legiſlature, when guarding againſt an impending evil, had not likewiſe a retroſpect to another from which they had ſo recently been delivered, is not ſo evident. If it be proper to ſupport an eſtabliſhed church as a branch of the conſtitution, and if the teſt-act be calculated to afford that ſupport to the church of England, it is probable that the deliberations of parliament were as much influenced by the dread of puritanic fury, and a renewal of the covenant, as by apprehenſions of a perſecution from a popiſh king and popiſh councils. That the members of the church eſtabliſhed by law in England had as much reaſon to dread the effects of power in the hands of Puritans as in the hands of Papiſts, no impartial man will controvert, who is not a ſtranger to that period of our national hiſtory; and that it was the duty of the legiſlature by every method in their power to provide for the ſecurity of the conſtitution againſt the machinations of both its enemies, will be admitted by all but ſuch as are in love with anarchy on the one hand, or with deſpotiſm on the other.

Many people, when they talk or write of the *teſt-act*, ſeem to think that it was framed in oppoſition to the *religious* opinions of the church of Rome; and finding the Proteſtant diſſenters, who abhor thoſe opinions, deprived by it of their civil rights, they ſpeak with indignation of a law which confounds the innocent with the guilty. But all this proceeds from a palpable miſtake of the purpoſe of the teſt. As the legiſlature had no authority to make laws againſt *any opinions whatever*, on account of their being falſe in theology; ſo it is not to be ſuppoſed that, in their deliberations on the TEST-ACT, the members of that auguſt body took into their conſideration the comparative orthodoxy of the diſtinguiſhing tenets of the Catholics and Puritans. As a religious ſect they might eſteem the latter much more than the former; but if they found that both had combined with their theological doctrines opinions reſpecting civil and eccleſiaſtical government, inconſiſtent with the fundamental principles of the Engliſh conſtitution, they had an undoubted right to enact a law, by which none ſhould be admitted to offices, in the execution of which they could injure the conſtitution, without previouſly giving ſecurity that their adminiſtration ſhould ſupport it in all its branches. It had not then been doubted, nor is there reaſon to doubt yet, (ſay the advocates for the Church of England), that an eſtabliſhed religion is neceſſary, in conjunction with civil government, to preſerve the peace of ſociety; and therefore in every well regulated ſtate an eſtabliſhed religion muſt be ſupported, not becauſe it is the duty of the civil magiſtrate to conduct his ſubjects to future happineſs, but becauſe he cannot without ſuch an eſtabliſhment preſerve among them preſent tranquillity. The eſtabliſhment which muſt beſt anſwer this purpoſe, is that which, teaching the great and unchangeable duties of morality, is moſt acceptable in its government and forms of worſhip to the majority of the people; and therefore in giving a legal eſtabliſhment to one conſtitution of the church in preference to all others, it is only this circumſtance, and not the comparative purity of the rival churches, viewed merely as eccleſiaſtical corporations, to which it is the buſineſs of the legiſlature to pay attention. At the time when the *teſt-act* paſſed the two houſes of parliament, the eſtabliſhed church of England was certainly more acceptable to the great body of the people and to all ranks in the ſtate, than any one of the ſects, whether Catholic or Proteſtant, which diſſented from her; and therefore it was the duty of the legiſlature to preſerve to that church all her privileges and immunities, and to prevent thoſe hoſtile ſectaries from doing her injury in the diſcharge of any civil office with which they might be entruſted. It was with this view that the *teſt-act* was formed; and it is with the ſame view that the legiſlature has hitherto rejected every petition for its repeal. In doing ſo, it deprives no man of his *rights*, far leſs of rights which *conſcience* calls upon him to maintain at every hazard; for the rights of individuals to hold civil offices are not inherent, but derived from the legiſlature, which of courſe muſt be the judge upon what terms they are to be held. The legiſlature of England has excluded from many offices, civil and military, every man who will not give ſecurity, that in the diſcharge of his public duty he will ſupport the church eſtabliſhed by law; and as the teſt of his intention, it requires him, before he enters upon his office, to renounce the doctrine of tranſubſtantiation, and receive the ſacrament of the Lord's Supper in ſome public church, according to the liturgy of the church or England. Whether this be the moſt proper teſt that could have been exacted, may well be queſtioned; but that in a country abounding with ſectaries of various denominations, who agree in nothing but venomous hoſtility to the religious eſtabliſhment, *ſome* teſt is neceſſary, ſeems incontrovertible, if it be the buſineſs of the legiſlature to preſerve the public peace.

To this it will be replied, That the public peace in Scotland is preſerved without a teſt, and that therefore a teſt cannot be neceſſary in England. This is plauſible, but not concluſive. For forty years after the Revolution, there was in Scotland no denomination of Chriſtians but thoſe of the Preſbyterian church, eſtabliſhed by law, the Proteſtant Epiſcopalians, whoſe church had been eſtabliſhed prior to that event, and the adherents to the church of Rome. The Epiſcopalians and Papiſts were effectually excluded from every office in which they could injure the eccleſiaſtical eſtabliſhment, by the ſeveral reſtrictions under which they were laid, on account of their attachment, real or ſuppoſed, to the abdicated family of Stuart. The penal laws operated upon them more powerfully than a religious teſt. It is to be obſerved too, that in the church of Scotland, though her clergy are better provided for than any other parochial clergy perhaps in Europe (A), there is nothing of that ſplendor and temporal power which in England excite envy to clamour againſt the eſtabliſhment, under the pretence of maintaining the cauſe of religious liberty. Yet even in Scotland a religious teſt is occaſionally exacted of civil officers. In the royal boroughs of that part of the united kingdom, no man can hold the office of a magiſtrate without previouſly ſwearing the burgeſs-oath (ſee SECEDER, nº 8.); and every inſtructor of youth, whether in ſchools or colleges, may be called upon to qualify himſelf for his office, by ſubſcribing the eſtabliſhed Confeſſion of Faith. The burgeſs-oath is a more effectual teſt than that which is required of magiſtrates in England; for a man might with a ſafe conſcience receive the ſacrament of the Lord's Supper occaſionally in a church, "at which he would not ſwear to abide and defend the ſame to his *life's end.*" This teſt appears to us to be neceſſary in boroughs, where faction is commonly blended with fanaticiſm; and if thoſe ſectaries which, at their firſt appearance in 1732, were inſignificant, if not contemptible, continue to multiply, and to imbibe principles much more pernicious than thoſe which were held by their fathers, it may perhaps be found expedient to extend ſome teſt over the whole country.

We do not, however, by any means, wiſh to ſee the ſacramental teſt introduced into Scotland. A teſt, ſay they, may be neceſſary to ſecure to the church all her rights and immunities; but to receive the ſacrament can give her no ſuch ſecurity, whilſt it leads inevitably to the profanation of a ſacred ordinance. A much better teſt would be, to require every man, before he be admitted to an executive office, to ſwear that in the diſcharge of it he will be careful to maintain all the rights and privileges of the church eſtabliſhed by law. Such an oath no ſenſible and peaceable diſſenter could refuſe; for it would not bind him to communicate with the eſtabliſhed church; and he cannot be ignorant that it belongs not to the executive government, but to the legiſlature, to determine what ſhall be the religion of the ſtate. On this account, we cannot help thinking that the members of the legiſlative body ſhould be ſubjected to no religious teſt whatever, that they may be at freedom to reform the corruptions of the church, or to exchange one eſtabliſhment for another, ſhould they find ſuch exchange expedient. If this reaſoning be juſt, it will be difficult to vindicate that clauſe of 25 Car. II. and of 1 Geo. I. in which it is enacted, that no member ſhall vote or ſit in either houſe of parliament till he hath, in the preſence of the houſe, ſubſcribed and repeated the declaration againſt tranſubſtantiation, the invocation of ſaints, and the ſacrifice of the maſs. The church of Rome is indeed a very corrupt ſociety; but if it be not for the purity of her doctrines and government that any church is eſtabliſhed in perference to all others, why ſhould that particular church be precluded from the poſſibility of obtaining a legal eſtabliſhment in Great Britain, even though ſhe were to become moſt acceptable to the majority of all ranks in the kingdom? The Engliſh Catholics have unqueſtionably greater reaſon to complain of this teſt, than either they or the diſſenters have to complain of the law which requires every civil and military officer to receive the Lord's Supper in the eſtabliſhed church.

TEST for Acids and Alkalis. See CHEMISTRY, p. 595, nº 1549.

TEST Liquors for Wines. See LEAD, p. 741. col. 2. and ARSENIC, nº 16.

TESTACEA, in the Linnæan ſyſtem of natural hiſtory, the third order of vermes. This order comprehends all ſhell-fiſh arranged by Linnæus under 36 genera. Shell-fiſh are animals with a ſoft body, covered by or incloſed in a firm, hard, and as it were ſtony habitation, compoſed, according to their three ſeparate orders, 1ſt, Of many parts which are ranged under the name of *multivalves*; 2d, Of two parts which are called *bivalves*; 3d, Of one part or piece only, which we call *univalves*. Thoſe parts, pieces, or valves, are more or leſs moveable at the animal's pleaſure. The animals included in theſe hard habitations have moſt of them the characters of one or other of the genera vermium, and might be reduced under the ſame genera with the moluſca: but as theſe characters are few, and the ſhells very numerous, and different in their form and ſtructure, it will tend more to make this part of natural hiſtory eaſy, to arrange the ſubjects according to the diſtinctions of the ſhells themſelves.

Barbut's Genera Vermium.

There is this farther conſideration in favour of this arrangement, viz. that the animals themſelves are rarely ſeen, and never can be preſerved in cabinets; whereas the ſhells make a figure in them, and great numbers have been met with empty of the animal.

TESTACEOUS, in natural hiſtory, an epithet ſynonymous with TESTACEA.

In medicine, all preparations of ſhells, and ſubſtances of the like kind, are called *teſtaceous*. Such are powders of crabs claws and eyes, pearl, &c. Dr Quincy and others ſuppoſe the virtue of all teſtaceous medicines to be alike; that they ſeldom or never enter the lacteals, but that the chief

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(A) There are indeed many livings in the church of England, and probably in other churches, to which nothing in the church of Scotland can be compared in reſpect of emolument; but theſe rich benefices bear no proportion to the number of thoſe which, in this age of unavoidable expence, cannot afford to the incumbents the means of decent ſubſiſtence as gentlemen. In the church of Scotland many livings amount to L. 200 each annually; and we have reaſon to hope, that when the preſent plan for augmenting the ſtipends of the clergy has been extended over Scotland, very few will be below L. 100; whilſt in England the vicarages and ſmall rectories, from which we have reaſon to believe that the incumbents reap not L. 80 a-year, greatly exceed in number all the livings in Scotland: Nay we doubt if there be not upwards of a thouſand livings in England and Wales from which the rector or vicar derives not above L. 50 annually.

chief of their action is in the firſt paſſages; in which, however, they are of great uſe in abſorbing acidities. Hence they become of uſe in fevers, and eſpecially in rectifying the many diſtempers in children, which generally owe their origin to ſuch acidities.

Blackſt. Comment. vol. ii.

TESTAMENT, or LAST WILL. Teſtaments both Juſtinian and Sir Edward Coke agree to be ſo called, becauſe they are *teſtatio mentis:* an etymon which ſeems to ſavour too much of conceit; it being plainly a ſubſtantive derived from the verb *teſtari*, in like manner as *juramentum*, *incrementum*, and others, from other verbs. The definition of the old Roman lawyers is much better than their etymology; *voluntatis noſtræ juſta ſententia de eo, quod quis poſt mortem ſuam fieri velit:* which may be thus rendered into Engliſh, "the legal declaration of a man's intentions, which he wills to be performed after his death." It is called *ſententia*, to denote the circumſpection and prudence with which it is ſuppoſed to be made: it is *voluntatis noſtræ ſententia*, becauſe its efficacy depends on its declaring the teſtator's intention, whence in Engliſh it is emphatically ſtyled his *will;* it is *juſta ſententia;* that is, drawn, atteſted, and publiſhed, with all due ſolemnities and forms of law: it is *de eo, quod quis poſt mortem ſuam fieri velit*, becauſe a teſtament is of no force till after the death of the teſtator.

Theſe teſtaments are divided into two ſorts; written, and verbal or nuncupative: of which the former is committed to writing: the latter depends merely upon oral evidence, being declared by the teſtator in *extremis*, before a ſufficient number of witneſſes, and afterwards reduced to writing.

But as nuncupative wills and CODICILS (which were formerly more in uſe than at preſent when the art of writing is become more general) are liable to great impoſitions, and may occaſion many perjuries, the ſtatute of frauds, 29 Car. II. c. 3. enacts, 1. That no written will ſhall be revoked or altered by a ſubſequent nuncupative one, except the ſame be in the lifetime of the teſtator reduced to writing, and read over to him, and approved; and unleſs the ſame be proved to have been ſo done by the oaths of three witneſſes at the leaſt, who, by ſtatute 4 & 5 Anne, c. 16. muſt be ſuch as are admiſſible upon trials at common law. 2. That no nuncupative will ſhall in anywiſe be good, where the eſtate bequeathed exceeds 30 l. unleſs proved by three ſuch witneſſes, preſent at the making thereof (the Roman law requiring ſeven), and unleſs they or ſome of them were ſpecially required to bear witneſs thereto by the teſtator himſelf; and unleſs it was made in his laſt ſickneſs, in his own habitation or dwelling-houſe, or where he had been previouſly reſident ten days at the leaſt, except he be ſurpriſed with ſickneſs on a journey, or from home, and dies without returning to his dwelling. 3. That no nuncupative will ſhall be proved by the witneſſes after ſix months from the making, unleſs it were put in writing within ſix days. Nor ſhall it be proved till fourteen days after the death of the teſtator, nor till proceſs hath firſt iſſued to call in the widow, or next of kin, to conteſt it if they think proper. Thus hath the legiſlature provided againſt any fraud in ſetting up nuncupative wills, by ſo numerous a train of requiſites, that the thing itſelf has fallen into diſuſe; and hardly ever heard of, but in the only inſtance where favour ought to be ſhown to it, when the teſtator is ſurpriſed by ſudden and violent ſickneſs. The teſtamentary words muſt be ſpoken with an intent to bequeath, not any looſe idle diſcourſe in his illneſs; for he muſt require the byſtanders to bear witneſs of ſuch his intention: the will muſt be made at home, or among his family or friends, unleſs by unavoidable accident, to prevent impoſitions from ſtrangers: it muſt be in his laſt ſickneſs; for if he recovers, he may alter his diſpoſitions, and have time to make a written will: it muſt not be proved at too long a diſtance from the teſtator's death, leſt the words ſhould eſcape the memory of the witneſſes; nor yet too haſtily and without notice, leſt the family of the teſtator ſhould be put to inconvenience or ſurpriſed.

As to written wills, they need not any witneſſes of their publication. We ſpeak not here of deviſes of lands, which are entirely another thing, a conveyance by ſtatute, unknown to the feodal or common law, and not under the ſame juriſdiction as perſonal teſtaments. But a teſtament of chattels written in the teſtator's own hand though it has neither his name nor ſeal to it, nor witneſſes preſent at its publication, is good; provided ſufficient proof can be had that it is his hand-writing. And though written in another man's hand, and never ſigned by the teſtator, yet if proved to be according to his inſtructions and approved by him, it hath been held a good teſtament of the perſonal eſtate. Yet it is the ſafer and more prudent way, and leaves leſs in the breaſt of the eccleſiaſtical judge, if it be ſigned or ſealed by the teſtator, and publiſhed in the preſence of witneſſes; which laſt was always required in the time of Bracton; or rather he in this reſpect has implicitly copied the rule of the civil law.

No teſtament is of any effect till after the death of the teſtator; *Nam omne teſtamentum morte conſummatum eſt, et voluntas teſtatoris eſt ambulatoria uſque ad mortem.* And therefore, if there be many teſtaments, the laſt will overthrows all the former; but the republication of a former will revoke one of a later date, and eſtabliſhes the firſt again.

Regularly, every perſon hath full power and liberty to make a will, that is not under ſome ſpecial prohibition by law or cuſtom: which prohibitions are principally upon three accounts; for want of ſufficient diſcretion; for want of ſufficient liberty and free-will; and on account of criminal conduct.

1. In the firſt ſpecies are to be reckoned infants, under the age of 14 if males, and 12 if females; which is the rule of the civil law. For though ſome of our common lawyers have held that an infant of any age (even four years old) might make a teſtament, and others have denied that under 18 he is capable; yet as the eccleſiaſtical court is the judge of every teſtator's capacity, this caſe muſt be governed by the rules of the eccleſiaſtical law. So that no objection can be admitted to the will of an infant of 14, merely for want of age; but if the teſtator was not of ſufficient diſcretion, whether, at the age 14 or 24, that will overthrow his teſtament. Madmen, or otherwiſe *non compotes*, idiots or natural fools, perſons grown childiſh by reaſon of old age or diſtemper, ſuch as have their ſenſes beſotted with drunkenneſs,—all theſe are incapable, by reaſon of mental diſability, to make any will ſo long as ſuch diſability laſts. To this claſs alſo may be referred ſuch perſons as are born deaf, blind, and dumb; who, as they have always wanted the common inlets of underſtanding, are incapable of having *animum teſtandi*, and their teſtaments are therefore void.

2. Such perſons as are inteſtable for want of liberty or freedom of will, by the civil law are of various kinds; as priſoners, captives, and the like. But the law of England does not make ſuch perſons abſolutely inteſtable; but only leaves it to the diſcretion of the court to judge upon the conſideration of their particular circumſtances of dureſs, whether or no ſuch perſons could be ſuppoſed to have *liberum animum teſtandi*. And, with regard to feme-coverts, our laws differ ſtill more materially from the civil. Among the Romans there was no diſtinction; a married woman was as capable of bequeathing as a feme-ſole. But with us a

married woman is not only utterly incapable of deviſing lands, being excepted out of the ſtatute of wills, 34 & 35 Hen. VIII. c. 5. but alſo ſhe is incapable of making a teſtament of chattels, without the licence of her huſband. For all her perſonal chattels are abſolutely his own; and he may diſpoſe of her chattels real, or ſhall have them to himſelf if he ſurvives her: it would be therefore extremely inconſiſtent to give her a power of defeating that proviſion of the law, by bequeathing thoſe chattels to another. The queen-conſort is an exception to this general rule, for ſhe may diſpoſe of her chattels by will, without the conſent of her lord; and any feme-covert may make her will of goods which are in her poſſeſſion *in auter droit*, as executrix or adminiſtratrix; for theſe can never be the property of the huſband: and if ſhe has any pin-money or ſeparate maintenance, it is ſaid ſhe may diſpoſe of her ſavings thereout by teſtament, without the control of her huſband. But if a feme-ſole makes her will, and afterwards marries, ſuch ſubſequent marriage is eſteemed a revocation in law, and entirely vacates the will.

3. Perſons incapable of making teſtaments on account of their criminal conduct, are in the firſt place all traitors and felons, from the time of conviction; for then their goods and chattels are no longer at their own diſpoſal, but forfeited to the king. Neither can a *felo de ſe* make a will of goods and chattels, for they are forfeited by the act and manner of his death; but he may make a deviſe of his lands, for they are not ſubject to any forfeiture. Outlaws alſo, though it be but for debt, are incapable of making a will ſo long as the outlawry ſubſiſts, for their goods and chattels are forfeited during that time. As for perſons guilty of others crimes, ſhort of felony, who are by the civil law precluded from making teſtaments (as uſurers, libellers, and others of a worſe ſtamp), at the common law their teſtaments may be good. And in general the rule is, and has been ſo at leaſt ever ſince Glanvil's time, *quod libera ſit cujuſcunque ultima voluntas*.

Teſtaments may be avoided three ways: 1. If made by a perſon labouring under any of the incapacities before-mentioned; 2. By making another teſtament of a later date; and, 3. By cancelling or revoking it. For though I make a laſt will and teſtament irrevocable in the ſtrongeſt words, yet I am at liberty to revoke it; becauſe my own act or words cannot alter the diſpoſition of law, ſo as to make that irrevocable which is in its own nature revocable. For this, ſaith lord Bacon, would be for a man to deprive himſelf of that which, of all other things, is moſt incident to human condition; and that is, alteration or repentance. It hath alſo been held, that, without an expreſs revocation, if a man, who hath made his will, afterwards marries and hath a child, this is a preſumptive or implied revocation of his former will which he made in his ſtate of celibacy. The Romans were alſo wont to lay aſide teſtaments as being *inofficioſa*, deficient in natural duty, if they diſinherited or totally paſſed by (without aſſigning a true and ſufficient reaſon) any of the children of the teſtator. But if the child had any legacy, though ever ſo ſmall, it was a proof that the teſtator had not loſt his memory or his reaſon, which otherwiſe the law preſumed; but was then ſuppoſed to have acted thus for ſome ſubſtantial cauſe: and in ſuch caſe no *querela inofficioſi teſtamenti* was allowed. Hence probably has ariſen that groundleſs vulgar error of the neceſſity of leaving the heir a ſhilling, or ſome other expreſs legacy, in order to diſinherit him effectually; whereas the law of England makes no ſuch wild ſuppoſition of forgetfulneſs or inſanity; and therefore, though the heir or next of kin be totally omitted, it admits no *inofficioſi* to ſet aſide ſuch a teſtament.

Testament, in Scots law. See Law, nº clxxxi. 2. &c.

Testament (Old and New). See Bible and Scripture.

TESTATOR, the perſon who makes his will and teſtament.

TESTER, Teston, the name of a coin ſtruck in France by Louis XII. in 1513, and in Scotland in the time of Francis II. and Mary queen of Scotland, ſo called from the head of the king, which was engraved upon it. The ſilver it contained was 11 deniers 18 grains, its weight 7 deniers 11¼ grains, and its value 10 ſoles. The coinage of it was prohibited by Henry III. in 1575, when the value of it was augmented to 14 ſoles ſix deniers. The teſton or teſter in England was rated at 12d. in the reign of Henry VIII. and afterwards reduced to 6d.

TESTES, in anatomy, the teſticles. See the next article.

TESTICLE (*teſtis*,) a double part in animals of the male kind, ſerving for the office of generation.—See Anatomy, nº 107. They are called *teſticles*, by diminution of *teſtes*, "witneſſes;" as giving teſtimony of virility. The Greeks call them *didymi*, or "twins."

In man and moſt animals, the teſticles are exterior; in ſome, as fowls, interior. Some men have only one, ordinarily they have two; ſome have naturally had three; nay, anatomiſts aſſure us they have known four.

TESTIMONY. See Logic, nº 29. and Metaphysics, nº 135—138.

Testimony, in law. See Evidence.

TESTUDO, the Tortoise, in zoology; a genus belonging to the claſs of *amphibia*, and order of *reptilia*. The body has a tail, and is defended with a bony or coriaceous covering. The mouth has naked mandibles without teeth. There are 33 ſpecies, of which the *midas* or common ſea-turtle is the moſt remarkable. It is found in the iſland of Aſcenſion and other places in the South Sea. The ſhell is ſo very ſtrong that it can carry more than 600 lbs. on its back, or as many men as can ſtand on it loaded. It digs round holes in the ſand in which it lays a vaſt number of eggs yearly, to the amount of 1000, it is ſaid. It broods on them during the night. Its fleſh is of a greeniſh colour, makes excellent food, and is the favourite diſh of ſailors as well as of epicures. It lives on cuttle and ſhell-fiſh, and grows to a prodigious ſize, ſome having been found to weigh 480 lbs.

The Americans find ſo good account in catching turtle, that they have made themſelves very expert at it: they watch them from their neſts on ſhore, in moon-light nights; and, before they reach the ſea, turn them on their backs, and leave them till morning; when they are ſure to find them, ſince they are utterly unable to recover their former poſture: at other times they hunt them in boats, with a peculiar kind of ſpear, ſtriking them with it through the ſhell; and as there is a cord faſtened to the ſpear, they are taken much in the ſame manner as the whales.

Mr White, in his Natural Hiſtory of Selborne, mentions a land-tortoiſe which had been kept for 30 years at Ringmer near Lewes. It retired under ground about the middle of November, and came forth again about the middle of April. At its firſt appearance in ſpring it ſhowed little inclination for food; in the height of ſummer it became voracious; its appetite again diminiſhed toward autumn, ſo that for the laſt ſix weeks it ſcarcely ate any thing at all. It lived chiefly on milky plants, ſuch a lettuces, dandelions, and ſow-thiſtles. Nothing ſurpriſed Mr White more than the extreme timidity it always ſhowed for rain; for though it had a ſhell that would ſecure it againſt the wheel of a loaded cart, yet it diſcovered as much ſolicitude about rain as a fine lady dreſſed in her beſt attire, ſhuffling away on the firſt ſprinklings,

lings, and running its head up in a corner. It not only ſlept during winter, but for a great part of the ſummer; for it went to bed in the longer days at four in the evening, and often did not ſtir in the morning till it was late. There was one ſeaſon uſually about the beginning of June when its exertions were remarkable. It then roſe by five in the morning, and walked on tip toe, traverſing the garden, examining every wicket and interſtice in the fences. The motives that led it to theſe rambles ſeemed to be of the amorous kind. Mr White ſays it was an excellent weather-glaſs; for whenever it walked upright and fed with great avidity in the morning, it rained before night. It ſhowed great ſagacity in diſcerning thoſe who did it kind offices; for whenever the old lady who had fed it for 30 years came in ſight, it hobbled towards her with awkward alacrity.

Testudo, in antiquity, was particularly uſed among the poets, &c. for the ancient lyre; becauſe it was originally made by its inventor Mercury, of the back or hollow of the teſtudo aquatica, or ſea-tortoiſe, which he accidentally found on the banks of the river Nile. See Lyre.

Testudo, in the military art of the ancients, was a kind of cover or ſcreen which the ſoldiers, *e. gr.* a whole company, made themſelves of their bucklers, by holding them up over their heads, and ſtanding cloſe to each other. This expedient ſerved to ſhelter them from darts, ſtones, &c. thrown upon them, eſpecially thoſe thrown from above, when they went to the aſſault.

Testudo, was alſo a kind of large wooden tower which moved on ſeveral wheels, and was covered with bullock hides, ſerving to ſhelter the ſoldiers when they approached the walls to mine them, or to batter them with rams. It was called *teſtudo*, from the ſtrength of its roof; which covered the workmen as the ſhell does the tortoiſe.

TETANUS, a dreadful ſpaſmodic diſorder, in which the whole body becomes rigid and inflexible. It moſt commonly proves mortal. See Medicine, nº 279.

TETHYS, a genus of inſects belonging to the claſs of *vermes*, and order of *molluſca*. The body is oblong, fleſhy, and without feet; the mouth conſiſts of a cylindrical proboſcis under the duplicature of a lip; and there are two foramina at the left ſide of the neck. The ſpecies are two, both inhabitants of the ocean.

TETRACERA, in botany; a genus of plants belonging to the claſs of *polyandria*, and order of *tetragynia*, and in the natural ſyſtem ranging under the doubtful. The calyx is hexaphyllous, and the capſules four. There is only one ſpecies, the volubilis.

TETRADYNAMIA, (τεσσαρες "four," and δυναμις "power"), four powers; the name of the 15th claſs in Linnæus's Sexual Syſtem, conſiſting of plants with hermaphrodite flowers, having ſix ſtamina, four of which are long, and two ſhort; it correſponds to the *ſiliquoſæ* of Ray, and *cruciformes* of Tournefort. All the ſpecies belonging to this claſs are diſtinguiſhed by cruciform flowers. It comprehends two orders, *gymnoſpermia*, thoſe plants which have naked ſeeds, being four in number, (except phryma which is monoſpermous); and *angioſpermia*, which contains thoſe plants the ſeeds of which are incloſed in a capſule. See Botany, p. 430.

TETRAGONIA, in botany; a genus of plants belong to the claſs of *icoſandria*, and order of *monogynia*; and in the natural ſyſtem ranging under the 13th order, *ſucculentæ*. The calyx is divided into three, four, or five parts. There is no corolla; the drupe is beneath, and the nut three or eight-celled. There are ſeven ſpecies; the puticoſa, decumbens, herbacea, echinata, expanſa, cryſtallina, and the japonica.

TETRAGRAMMATON, τετραγραμματον, a denomination given by the Greeks to the Hebrew name of God יהוה, "*Jehova*," becauſe in the Hebrew it conſiſts of four letters.

TETRAGYNIA, (τεσσαρες, "four," and γυνη "a woman"); the name of an order, or ſecondary diviſion in the 4th, 5th, 6th, 8th, and 13th claſſes in the Sexual Syſtem; conſiſting of plants which, to the claſſic character, whatever it is, add the circumſtance of having four ſtyles or female organs. Herb-paris and graſs of Parnaſſus furniſh examples.

TETRANDRIA, (τεσσαρες "four," and ανηρ "a man or huſband"); the name of the fourth claſs in Linnæus's Sexual Syſtem, conſiſting of plants with hermaphrodite flowers, which have four ſtamina or male organs that are of equal length. In this laſt circumſtance conſiſts the main difference, according to Linnæus, between the plants of the claſs in queſtion and thoſe of the 14th claſs *didynamia*, in which the four ſtamina are of unequal length, two of them being long, and two ſhort.—The orders of this numerous claſs are three, founded upon the number of ſtyles or female organs. Scabious, teazel, barren wort, the ſtarry plants of Ray, and the greater number of genera in this claſs, have one ſtyle; dodder and hypecoum have two; holly and a few others have four.

TETRAO, in ornithology; a genus of birds belonging to the order of *gallinæ*, and is thus characterized by Linnæus: There is a ſpot near the eyes naked or papilloſe, or covered, though more rarely, with feathers. Gmelin has enumerated about 66 ſpecies. The genus tetrao comprehended both the grous, partridge, and quail; but Dr Latham, with great judgment and propriety, has made two genera of them, under the names of *tetrao*, comprehending the grous; and *perdix*, comprehending the partridge and quail. Dr Latham thus diſtinguiſhes the genus *tetrao*: The bill is like a crooked cone, with a naked ſcarlet ſkin above each eye, and the feet feathered to the toes. The *perdix* he characterizes by a bill convex, ſtrong, and ſhort; the noſtrils are covered above with a callous prominent rim; the orbits are papilloſe; the feet naked, and moſt of the ſpecies are furniſhed with ſpurs. He reckons 20 ſpecies under the *tetrao*, and 48 under the *perdix*. As we highly approve of this new arrangement of Dr Latham, we are diſpoſed to follow it; but as a reference has been made from Perdix to this place, it is proper that we ſhould alſo give ſome account of that genus.

I. Tetrao. Of this genus the following ſpecies are found in Britain: 1. The *urogallus*, or wood-cock, inhabits woody and mountainous countries; in particular, foreſts of pines, birch-trees, and junipers; feeding on the tops of the former and berries of the latter; the firſt often infects the fleſh with ſuch a taſte as to render it ſcarcely eatable. In the ſpring it calls the females to its haunts with a loud and ſhrill voice; and is at that time ſo very inattentive to its ſafety, as to be very eaſily ſhot. It ſtands perched on a tree, and deſcends to the females on their firſt appearance. They lay from 8 to 16 eggs; eight at the firſt, and more as they advance in age.

This bird is common to Scandinavia, Germany, France, and ſeveral parts of the Alps.—It is found in no other part of Great Britain than the Highlands of Scotland north of Inverneſs; and is very rare even in thoſe parts. It is there known by the name of *capercalzie*, *auer-calzie*, and in the old law-books *caperkally*; the laſt ſignifying the horſe of the woods: this ſpecies being, in compariſon of others of the genus, pre-eminently large.

The length of the male is two feet nine inches; its weight ſometimes 14 pounds. The female is much leſs, the length being only 26 inches. The ſexes differ alſo greatly in colours. The bill of the male is of a pale yellow; the head, neck, and back, are elegantly marked, ſlender lines of grey and black running tranſverſely. The upper part of the breaſt is of a rich gloſſy green; the reſt of the breaſt and the belly black, mixed with ſome white feathers; the ſides are marked like the neck; the coverts of the wings croſſed with undulated lines of black and reddiſh brown; the exterior webs of the greater quill-feathers are black: the tail conſiſts of 18 feathers, the middle of which is the longeſt; theſe are black, marked on each ſide with a few white ſpots. The legs are very ſtrong, and covered with brown feathers; the edges of the toes are pectinated.—Of the female, the bill is duſky; the throat red; the head, neck, and back, are marked with tranſverſe bars of red and black: the breaſt has ſome white ſpots on it, and the lower part is of a plain orange colour: the belly is barred with pale orange and black; the tips of the feathers are white. The tail is of a deep ruſt-colour barred with black, tipped with white, and conſiſts of 16 feathers.

2. The *tetrix*, black grous, or black-cock, like the former ſpecies, is fond of woody and mountainous ſituations; feeding on bilberries and other mountain fruits, and in the winter on the tops of the heath. In the ſummer they frequently deſcend from the hills to feed on corn. They never pair: but in the ſpring the male gets upon ſome eminence, crows and claps his wings; on which ſignal all the females within hearing resort to him. The hen lays ſeldom more than ſix or ſeven eggs. When the female is obliged, during the time of incubation, to leave her eggs in queſt of food, ſhe covers them up ſo artfully with moſs or dry leaves, that it is very difficult to diſcover them. On this occaſion ſhe is extremely tame and tranquil, however wild and timorous at other times. She often keeps to her neſt, though ſtrangers attempt to drag her away. As ſoon as the young ones are hatched, they are ſeen running with extreme agility after the mother, though ſometimes they are not entirely diſengaged from the ſhell. The hen leads them forwards for the firſt time into the woods, to ſhow them ant's eggs and the wild mountain-berries, which, while young, are their only food. As they grow older their appetites grow ſtronger, and they then feed upon the tops of heather and the cones of the pine-tree. In this manner they ſoon come to perfection: they are hardy birds, their food lies every where before them, and it would ſeem that they ſhould increaſe in great abundance. But this is not the caſe; their numbers are thinned by rapacious birds and beaſts of every kind, and ſtill more by their own ſalacious conteſts.—As ſoon as the hatching is over, which the female performs in the manner of an hen, the whole brood follows the mother for about a month or two; at the end of which the young males entirely forſake her, and keep in great harmony together till the beginning of ſpring. At this ſeaſon they begin for the firſt time to feel the amorous paſſions; and then adieu to all their former friendſhips! They begin to conſider each other as rivals; and the rage of concupiſcence quite extinguiſhes the ſpirit of ſociety. They fight each other like game-cocks; and at that time are ſo inattentive to their own ſafety, that it often happens that two or three of them are killed at a ſhot. It is probable, that in theſe conteſts the bird which comes off victorious takes poſſeſſion of the female ſeraglio, as it is certain they have no faithful attachments.

An old black cock is in length 22 inches, and weighs near four pounds. The bill is duſky; and the plumage of the whole body black, gloſſed over the neck and rump with a ſhining blue. The coverts of the wings are of a duſky brown; the inner coverts white; the thighs and legs are covered with dark brown feathers; the toes reſemble thoſe of the former ſpecies. The tail conſiſts of 16 black feathers, and is much forked; the exterior feathers bend greatly outwards, and their ends ſeem as if cut off.—The female weighs only two pounds; and its length is one foot ſix inches. The head and neck are marked with alternate bars of dull red and black; the breaſt with duſky black and white; but the laſt predominates. The back, coverts of the wings, and tail, are of the ſame colours as the neck, but the red is deeper. The tail is ſlightly forked; it conſiſts of 18 feathers variegated with red and black. The feathers under the tail are white, marked with a few bars of black and orange. This bird hatches its young late in the ſummer. It lays from ſix to eight eggs, of a dull yellowiſh white colour, marked with numbers of very ſmall ferruginous ſpecks; and towards the ſmaller end with ſome blotches of the ſame hue.

3. The *ſcoticus*, red game, or moor-fowl, is peculiar to the Britiſh iſlands. The male weighs about 19 ounces; and is in length 15½ inches. The bill is black; the irides hazel-coloured. The throat is red. The plumage on the head and neck is of a light tawny red; each feather is marked with ſeveral tranſverſe bars of black. The back and ſcapular feathers are of a deeper red; and on the middle of each feather is a large black ſpot; the breaſt and belly are of a dull purpliſh brown, croſſed with numerous narrow duſky lines; the quill-feathers are duſky; the tail conſiſts of 16 feathers of an equal length, all of them (except the four middlemoſt) are black, and the middle feathers are barred with red: the thighs are of a pale red, barred obſcurely with black; the legs and feet clothed to the very claws with thick ſoft white feathers. The claws are whitiſh, very broad and ſtrong. The female weighs only 15 ounces.—The colours in general are duller than thoſe of the male: the breaſt and belly are ſpotted with white; and the tips of ſome of the coverts of the wings are of the ſame colour.—Theſe birds pair in the ſpring, and lay from ſix to ten eggs. The young brood follow the hen the whole ſummer; in the winter they join in flocks of 40 or 50, and became remarkably ſhy and wild; they always keep on the tops of the hills, are ſcarce ever found on the ſides, and never deſcend into the valleys. Their food is the mountain-berries and tops of the heath.

4. The *lagopus*, white game or ptarmigan, is 15 inches in length, and weighs 19 ounces. Its plumage is of a pale brown or aſh colour, elegantly croſſed or mottled with ſmall duſky ſpots and minute bars; the head and neck with broad bars of black, ruſt colour, and white: the belly and wings are white, but the ſhafts of the greater quill feathers black. In the male, the grey colour predominates, except on the head and neck, where there is a great mixture of red, with bars of white. The females and young birds have a great deal of ruſt-colour in them. The tail conſiſts of 16 feathers; the two middle of which are aſh-coloured, mottled with black, and tipped with white; the two next black, ſlightly marked with white at their ends, the reſt wholly black: the feathers incumbent on the tail are white, and almoſt entirely cover it.

Ptarmigans are found in theſe kingdoms only on the ſummits of the higheſt hills of the Highlands of Scotland, of the Hebrides, and Orkneys; and a few ſtill inhabit the lofty hills near Keſwick in Cumberland as well as the mountains of Wales. They live amidſt the rocks, perching on the grey ſtones, the general colour of the ſtrata in thoſe exalted ſituations. They are very ſilly birds; ſo tame as to bear driving like poultry; and, if provoked to riſe, take very ſhort flights, making a great circuit like pigeons.

Like the grous, they keep in ſmall packs; but never, like thoſe birds, take ſhelter in the heath, but beneath looſe ſtones. To the taſte they ſcarce differ from a grous.

Theſe birds are called by Pliny *lagopi*, their feet being clothed with feathers to the claws, as the hare's are with fur: the nails are long, broad, and hollow. The firſt circumſtance guards them from the rigour of the winter; the latter enables them to form a lodge under the ſnow, where they lie in heaps to protect themſelves form the cold. The feet of the grous are clothed in the ſame manner; but thoſe of the two firſt ſpecies here deſcribed, which perch upon trees, are naked, the legs only being feathered, not being in want of ſuch a protection.

II. PERDIX, comprehends both the partridge and quail.

The common partridge is ſo well known that a deſcription of it is unneceſſary, and we have not room the deſcribe the foreign ſpecies. We refer thoſe who wiſh complete information to the accurate and valuable Syſtem of Ornithology publiſhed by Dr Latham. The ſcientific ornithologiſt will find much ſatisfaction in his *Index Ornithologus*, publiſhed in 2 vols 4to; and he who wiſhes to be acquainted with the nature and diſpoſitions of birds, will read his *Synopſis* with pleaſure, publiſhed in 7 vols 4to.

The following general account of the partridge will ſuffice: "Theſe birds (ſays Willoughby) hold the principal place in the feaſts and entertainments of princes; without which their feaſts are eſteemed ignoble, vulgar, and of no account. The Frenchmen do ſo highly value, and are ſo fond of the partridge, that if they be wanting, they utterly ſlight and deſpiſe the beſt ſpread tables; as if there could be no feaſt without them." But however this might be in the times of our hiſtorian, the partridge is now too common in France to be conſidered as a delicacy; and this, as well as every other ſimple diſh, is exploded for luxuries of a more compound invention. In England, where the partridge is much ſcarcer, and a great deal dearer, it is ſtill a favourite delicacy at the tables of the rich; and the deſire of keeping it to themſelves has induced them to make laws for its preſervation, no way harmoniſing with the general ſpirit of Engliſh legiſlation.

The partridge ſeems to be a bird well known all over the world, as it is found in every country and in every climate; as well in the frozen regions about the pole, as the torrid tracks under the equator. It even ſeems to adapt itſelf to the nature of the climate where it reſides. In Greenland the partridge, which is brown in ſummer, as ſoon as the icy winter ſets in, begins to take a covering ſuited to the ſeaſon: it is then clothed with a warm down beneath; and its outward plumage aſſumes the colour of the ſnow among which it ſeeks its food. Thus it is doubly fitted for the place, by the warmth and the colour of its plumage; the one to defend it from the cold, the other to prevent its being noticed by the enemy. Thoſe of Barakonda, on the other hand, are longer legged, much ſwifter of foot, and chooſe the higheſt rocks and precipices to reſide in.—They all, however, agree in one character, of being immoderately addicted to venery; and, as ſome writers affirm, often to an unnatural degree. It is certain, the male will purſue the hen even to her neſt; and will break her eggs rather than not indulge his inclinations. Though the young ones have kept together in flocks during the winter when they begin to pair in ſpring their ſociety diſperſes; and combats, very terrible with reſpect to each other, enſue. Their manners in other circumſtances reſemble all thoſe of poultry in general; but their cunning and inſtinct ſeem ſuperior to thoſe of the larger kinds. Perhaps, as they live in the very neighbourhood of their enemies, they have more frequent occaſion to put their little arts in practice, and learn by habit the means of evaſion or ſafety. Whenever therefore a dog or other formidable animal approaches their neſt, the female uſes every means to draw him away. She keeps juſt before him, pretends to be incapable of flying, juſt hops up, and then falls down before him, but never goes off ſo far as to diſcourage her purſuer. At length, when ſhe has drawn him entirely away from her ſecret treaſure, ſhe at once takes wing, and fairly leaves him to gaze after her in deſpair. After the danger is over, and the dog withdrawn, ſhe then calls her young, who aſſemble at once at her cry, and follow where ſhe leads them. There are generally from 10 to 15 in a covey; and, if unmoleſted, they live from 15 to 17 years. There are ſeveral methods of taking them, as is well known; that by which they are taken in a net with a ſetting dog is the moſt pleaſant, as well as the moſt ſecure The dog, as every body knows, is trained to this exerciſe by a long courſe of education: by blows and careſſes he is taught to lie down at the word of command; a partridge is ſhown him and he is then ordered to lie down; he is brought into the field, and when the ſportſman perceives where the covey lies, he orders his dog to crouch: at length the dog, from habit, crouches wherever he approaches a covey; and this is the ſignal which the ſportſman receives for unfolding and covering the birds with his net. A covey thus caught is ſometimes fed in a place proper for their reception; but they can never be thoroughly tamed like our domeſtic poultry. See PARTRIDGE and SHOOTING,

2. The *coturnix*, or common quail, is not above half the ſize of the partidge. The feathers of the head are black, edged with ruſty brown; the breaſt is of a pale yellowiſh red, ſpotted with black; the feathers on the back are marked with lines of pale yellow and the legs are of a pale hue. Except in the colours thus deſcribed, and the ſize, it every way reſembles a partridge in ſhape, and, except that it is a bird of paſſage, it is like all others of the poultry kind in its habits and nature.

The quail ſeems to ſpread entirely throughout the old world, as well as the new; is ſeen from the Cape of Good Hope quite to Iceland, and is ſaid to be found in Falkland Iſles; alſo in New Zealand, throughout Ruſſia, Tartary, and China*; and in ſhort is mentioned by ſo many travellers, and in ſo many places, that we may almoſt call it an inhabitant of all. It is obſerved to ſhift quarters according to the ſeaſon, coming northward in ſpring, and departing ſouth in autumn, and in vaſt flocks, like other migrating birds. Twice in a year it comes in ſuch vaſt quantities into Capri, that the biſhop of the iſland draws the chief part of his revenue from them; hence he is called the *quail Biſhop*. But this does not ſtand alone; almoſt all the iſlands in the Archipelago, on the oppoſite coaſts, are at times covered with theſe birds, and ſome of them obtain a name from this circumſtance. On the weſt coaſt of the kingdom of Naples, within the ſpace of four or five miles, an hundred thouſand have been taken in a day, which have been ſold for eight livres *per* hundred to dealers who carry them for ſale to Rome. Great quantities alſo ſometimes alight in ſpring on the coaſts of Provence, eſpecially in the dioceſe of the biſhop of Frejus, which is near the ſea, and appear, at their firſt landing, ſo much fatigued that they are often taken by the hand. Theſe circumſtances then leave not a doubt of their being the ſame kind of birds which the divine hand of providence thought right to direct in ſuch quantities as to cover the camp of the murmuring Iſraelites.

Latham's Synopſis, vol. iv.

"In the autumn, great quantities are frequently imported into England from France for the table; which we have frequently ſeen (ſays Dr Latham) on their paſſage to London by the ſtage-coaches, about an hundred in a large ſquare box, divided into five or ſix partitions one above another, juſt high enough to admit of the quails ſtanding upright; theſe boxes have wires on the fore part, and each partition furniſhed with a little trough for food; and I have been told, ſays our author, they may be conveyed thus to great diſtances without difficulty."

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* See Forſter's Obſ. p. 199.

In Scotland they may be ſaid not to be plenty at any time. They breed there and the major part migrate ſouth in autumn; the reſt only ſhift their quarters, as they have been met with on the coaſts of Eſſex, and in Hampſhire, in the winter-ſeaſon, retiring thither in October.

It feeds like the partridge, and like that bird makes no neſt, except a few dry leaves or ſtalks ſcraped together may be called ſo, and ſometimes an hollow on the bare ground ſuffices. In this the female lays her eggs to the number of ſix of ſeven, of a whitiſh colour, marked with irregular ruſt-coloured ſpots: the young follow the mother as ſoon as hatched, like young partridges. They have but one brood in a year.

Quail-fighting was a favourite amuſement among the Athenians. They abſtained from the fleſh of this bird, deeming it unwholeſome, as ſuppoſing that it fed upon the white hellebore; but they reared great numbers of them for the pleaſure of ſeeing them fight; and ſtaked ſums of money, as we do with regard to cocks, upon the ſucceſs of the combat. Faſhion, however, has at preſent changed with regard to this bird: we take no pleaſure in its courage, but its fleſh is conſidered as a very great delicacy.—Quails are eaſily caught by a call: the fowler early in the morning having ſpread his net, hides himſelf under it among the corn; he then imitates the voice of the female with his quail-pipe, which the cock hearing, approaches with the utmoſt aſſiduity; when he has got under the net, the fowler then diſcovers himſelf, and terrifies the quail, who attempting to get away, entangles himſelf the more in the net, and is taken.

TETRODON, in ichthyology; a genus of fiſhes arranged by Linnæus under the claſs of *amphibia*, and order of *nantes*; but placed by Gmelin under the claſs of *piſces*, and order of *branchioſtegi*. The jaws are bony, ſtretched out, and cloven at the point; the aperture of the gills is linear; the body is muricated beneath, and there are no ventral fins. There are 13 ſpecies; of which the moſt remakable is the lineatus, called by Mr Haſſelquiſt *fahaka*, which is the Egyptian and Arabic name. It has of late been found in the Nile about Cairo, but was never known in former times. It is ſaid to grow to a prodigious ſize. When juſt caught, it pricks the ſkin if it is taken in the bare hands, and produces ſmall puſtules in the ſame manner as nettles. The fleſh is poiſonous. Mr Forſter confirms the account of the poiſonous nature of a ſpecies of tetrodon, in his account of New Caledonia.

TETRARCH, a prince who holds and governs a fourth part of a kingdom. Such originally was the import of the title *tetrarch*; but it was afterwards applied to any petty king or ſovereign; and became ſynonymous with ethnarch, as appears from the following conſiderations: 1. That Pliny makes mention of ſix tetrarchies within the city of Decapolis. 2. That Herod's kingdom was only divided into three parts, which yet were called *tetrarchies*, and the ſovereigns thereof, Luke iii. 1. *tetrarchs*. 3. Joſephus tells us, that, after the battle of Philippi, Antony, going into Syria, conſtituted Herod *tetrarch*; and on medals the ſame Herod is called *ethnarch*.

Joſephus's Antiq B. xiv. c. 23.

TETRASTYLE, in the ancient architecture, a building, and particularly a temple, with four columns in its front.

TETUAN, an ancient and pleaſant town of Africa, in the kingdom of Fez, and in the province of Habata. It is pretty well built, and the inhabitants are about 15,000 in number, who call themſelves *Andaluſians*, and almoſt all ſpeak Spaniſh; but they are great pirates. Some ſay there are 30,000 Mooriſh inhabitants, and 5000 Jews. W. Long. 5. 26. N. Lat. 35. 27.

TEUCRIUM, GERMANDER, in botany: A genus of plants belonging to the claſs of *didynamia*, and order of *gymnoſpermia*; and in the natural ſyſtem ranging under the 42d order, *Verticillatæ*. The corolla has no upper lip, is divided into two parts beyond the baſe, and is divaricated where the ſtamina iſſue out. There are 30 ſpecies; of which the ſcorodonia, ſcordium, and chamædrys, are natives of Great Britain.

1. The *ſcorodonia*, wood-ſage, or germander, is diſtinguiſhed by leaves which are heart-ſhaped ſerrated, and petiolated; by racemi, which are lateral and ranged in one row; and by an erected ſtem. The flowers are ſtraw coloured, and the filaments red. The plant has a bitter taſte, and ſmells like hops with a little mixture of garlic. It is uſed in brewing in the iſle of Jerſey inſtead of hops. 2. The *ſcordium*, or common water-germander, hath creeping perennial roots, ſending up many ſquare, procumbent, or trailing ſtalks, branching diffuſely; oblong, indented, ſerrated, cloſe-fitting, oppoſite leaves; and ſmall reddiſh flowers, generally two together, from the ſides of the ſtalks and branches, in July and Auguſt. This plant was formerly conſidered as medicinal, but has now fallen into diſuſe. It grows naturally in marſhy places, in the iſle of Ely and other parts of England, and moſt parts of Europe; and is ſometimes admitted into gardens, in moiſt places, for variety and as a medical plant. 3. The *chamædrys*, or ſmaller creeping germander, hath fibrous, very creeping, ſpreading roots; many four-cornered, very branchy, trailing ſtalks, near a foot long; oval, cuneiform, cut, crenated leaves on ſhort footſtalks; and reddiſh flowers, growing almoſt in a verticillus, or whorls, round the ſtalk, three on each peduncle; appearing in June and July.

TEUTHIS, in ichthyology, a genus of fiſhes belonging to the order of *abdominales*. The head is ſomewhat truncated on the forepart; the branchil membrane has five rays; the teeth equal, rigid near each other, forming a regular ſeries. There are two ſpecies, the hepatus and java.

TEUTONES, or TEUTONI, (anc. geog.) a people always by hiſtorians joined with the Cimbri; both ſeated, according to Mela, beyond the Elbe, on the Sinus Codanus, or Baltic; and there, it is ſuppoſed, lay the country of the Teutones, now *Ditmarſh*; diverſity of dialects producing the different terms *Tuet*, *Tut*, *Dit*, *Tid*, and *Thod*, which in the ancient German language ſignified *people*. Of theſe Teutones, Virgil is to be underſtood in the epithet *Teutonicus*, an appellation which more lately came to the applied to the Germans in general, and later ſtill the appellation *Alemanni*.

The Teutones, in conjunction with the Cimbri and Ambrones, made war on the Romans, and marched towards Italy in the year 101 B. C. We are told, that the Teutones alone were ſo numerous, that they were ſix whole days without intermiſſion in paſſing by the Roman camp. In Tranſalpine Gaul they engaged the Roman conſul Marius; but were defeated with incredible ſlaughter; 100,000 of them, according to the loweſt calculations, being killed on the ſpot. According to others, the number of thoſe killed and taken priſoners amounted to 290,000. The inhabitants of the neighbouring country made fences for vineyards of their bones. Their king Teutobochus, ſaid to be a monſtrous giant, was taken priſoner and carried to Rome. See the article GIANT.

TEUTONIC, ſomething belonging to the Teutones.

The Teutonic language is ſuppoſed to have been the language of the ancient Germans, and hence is reckoned amongſt the mother-tongues. See PHILOLOGY, n° 219.

TEUTONIC *Order*, an order of military knights, eſtabliſhed towards the cloſe of the twelfth century, on the following occaſion.—When the emperor Barbaroſſa engaged in a cruſade for the recovery of the Holy Land out of the hands of Saladin, he was followed by great numbers of German volunteers, who from various motives enliſted under his banners. After the death of Barbaroſſa, the Germans, who had ſignalized themſelves before Acre or Ptolemais, reſolved to chooſe another leader; and at laſt fixed their choice upon Frederic duke of Suabia, ſecond ſon to the emperor, and Henry duke of Brabant. Under theſe generals they behaved with ſo much bravery, that Henry king of Jeruſalem, the patriarch, and ſeveral other princes, determined to reward their valour by inſtituting an order of knighthood in their favour. This was accordingly done; and our new knights had at firſt the title of the *knights of St. George;* afterwards it was thought proper to put them under the tutelage of the Virgin Mary, to whom there was already an hoſpital dedicated on Mount Zion, for the relief of German pilgrims. From this time they were called *Equites Mariani*, or knights of St Mary. Laws, regulations, and ſtatutes, were drawn up for them by the Chriſtian kings in Syria and the patriarch; and among other obligations it was required, that every perſon admitted to the privileges of the order ſhould be of noble parentage; that the order ſhould defend the Chriſtian religion and the Holy Land; that they ſhould exerciſe hoſpitality towards the Chriſtians in general, but particularly thoſe of their own country; and that they ſhould with all their power endeavour to propagate and extend the Chriſtian faith and the religion of JESUS. In the year 1190, having become rich by donations from the ſuperſtitious, they elected their firſt grandmaſter, Henry Walpot, a German, who had diſtinguiſhed himſelf by his zeal and valour; and their choice was confirmed by the emperor. The following year, Pope Celeſtine III. confirmed their privileges already granted, giving them the title of the *Teutonic knights of the hoſpital of St Mary the Virgin*. By the conditions of this bull, they vowed perpetual continence, obedience, and poverty; obligations which it may well be imagined were not very ſtrictly kept. See POLAND, n° 59, 61, 67—69. and PRUSSIA, n° 3, 4.

TEWKESBURY, a town in Glouceſterſhire, formerly noted for its monaſtery. It is now a large handſome corporation, containing about 500 houſes, with a magnificent church. It is ſeated at the confluence of the rivers Severn and Avon, has a cotton manufactory, and ſends two members to parliament. W. Long. 2. 13. N. Lat. 52. 0.

TEXEL, a town of the United Provinces, in north Holland, ſeated at the mouth of the Zuyder-Zee, with a good harbour, and a ſtrong fort. It is ſeated in a fruitful iſland, known all over the world by the great number of ſhips that paſs this way every day from all parts; it is about ſix miles long, and five broad, lying a little northward to the continent of Holland, between which and the iſland is one of the principal paſſages out of the Zuyder-Zee into the ocean. It is defended from the ſea by ſand-hills and ſtrong banks. Moſt of the ſoil is applied to feed ſheep, of which they have great flocks; and the cheeſe made of their milk is ſaid to vie with the Parmeſan. This iſland contains ſeveral fair villages, and a town on the eaſt ſide, called *Burch*, ſtrongly fortified and garriſoned, and inhabited chiefly by fiſhermen. N. Lat. 53. 8. E. Long. 4. 51.

Nugent's Grand Tour. vol. i.

TEXT, a relative term, contradiſtinguiſhed to gloſs or commentary, and ſignifying an original diſcourſe excluſive of any note or interpretation. This word is particularly uſed for a certain paſſage of ſcripture, choſen by a preacher to be the ſubject of his ſermon.

TEXTURE, properly denotes the arrangement and coheſion of ſeveral ſlender bodies or threads interwoven or entangled among each other, as in the webs of ſpiders, or in the cloths, ſtuffs, &c.

Texture is alſo uſed in ſpeaking of any union or conſtituent particles of a concrete body, whether by weaving, hooking, knitting, tying, chaining, indenting, intruding, compreſſing, attracting, or any other way. In which ſenſe we ſay, a cloſe compact texture, a lax porous texture, a regular or irregular texture, &c.

TEWIT, in ornithology. See TRINGA.

THABOR. See TABOR.

THALES, a celebrated Greek philoſopher, and the firſt of the ſeven wiſe men of Greece, was born at Miletus about 640 B. C. In order to improve himſelf in the knowledge of the ſciences, he travelled into Egypt, where he diſcourſed with the prieſts and other learned men. Some ſay that he married; but others obſerve, that he eluded the ſolicitations of his mother on this head, by telling her, when he was young, that it was too ſoon; and afterwards, that it was too late. Thales acquired great reputation by his wiſdom and learning: he was the firſt among the Greeks who foretold eclipſes of the ſun, and made extraordinary diſcoveries in aſtronomy. Thales was the author of the Ionian ſect of philoſophers, who were thus called from his being born at Miletus, a city of Ionia. He maintained that water was the principle of which all the bodies in the univerſe are compoſed; that the world was the work of God; and that God ſees the moſt ſecret thoughts in the heart of man. He ſaid, "That the moſt difficult thing in the world is to know ourſelves; the moſt eaſy to adviſe others; and the moſt ſweet to accompliſh our deſires. That, in order to live well, we ought to abſtain from what we find fault with in others. That the bodily felicity conſiſts in health, and that of the mind in knowledge. That the moſt ancient of beings is God, becauſe he is uncreated: that nothing is more beautiful than the world, becauſe it is the work of God; nothing more extenſive than ſpace, quicker than ſpirit, ſtronger than neceſſity, wiſer than time." It was alſo one of his ſentences, "That we ought never to ſay that to any one that may be turned to our prejudice; and that we ſhould live with our friends as with perſons that may become our enemies." He thanked God for three things; that he was born of the human, not of the brute ſpecies; a man, and not a woman; a Greek, and not a barbarian. None of the ancient philoſophers ever applied themſelves more earneſtly to the ſtudy of aſtronomy than Thales. Diogenes Laertius reports, that leaving his lodging with an old woman to contemplate the ſtars, he fell into a ditch; on which the good woman cried, "How canſt thou know what is doing in the heavens, when thou canſt not perceive what is at thy feet?" He went to ſee Crœſus, who was marching with a powerful army into Cappadocia, and enabled him to paſs the river Halys without making a bridge. Thales died ſoon after, at about 90 years of age. He compoſed ſeveral treatiſes in verſe, on meteors, the equinoxes, &c. but they are all loſt.

THALIA, in Pagan mythology, one of the nine muſes. She preſided over Comedy; and is repreſented crowned with a garland of ivy, holding a maſk in her hand, and wearing buſkins on her feet.

THALIA, in botany: A genus of plants belonging to the claſs of *monandria*, and order of *monogynia*; and in the natural ſyſtem ranging under the 8th order, *Scitamineæ*. The corolla is pentapetalous and undulated; and the drape has a

Thalictrum. Thames.

bilocular kernels. There is only one ſpecies, the geniculata.

THALICTRUM, meadow rue, in botany: A genus of plants belonging to the claſs of *polyandria*, and order of *polygynia;* and in the natural ſyſtem ranging under the 26th order, *Multiſiliqua*. There is no calyx; the petals are four or five in number, and the ſeeds are naked and without a tail. There are 15 ſpecies; three of which are indigenous, the *flavum, minus*, and *alpinum*.

1. The *flavum*, or common meadow-rue, has a leafy ſurrowed ſtalk, and a manifold erect panicle. It has commonly 24 ſtamina, and from 10 to 16 piſtils. The root and leaves of this plant dye a yellow colour, and cattle are fond of it. It grows on the banks of ſome rivers: It is found at North Queen's ferry, Fifeſhire. 2. The *minus*, or ſmall meadow-rue, has ſexpartite leaves, and bending flowers. The ſtalk is ſtriated, and about a foot high; the leaves are lax and divaricated, having rigid footſtalks; they are ſmooth and glaucous, and their lobes generally trifid; the panicle is branched and open, and the flowers nod: the petals are pale green, tinged with red; the ſtamina are from 15 to 20; the ſeeds deeply ſtriated, and from two to ſeven in number. This plant is frequent in ſandy ſoils and mountainous paſtures. 3. The *alpinum*, or alpine meadow-rue, has a very ſimple ſtalk, and almoſt naked; and a racemus ſimple and terminal. It is a pretty little plant, about a finger's-length in height; the leaves all riſe from the root, the ſtalk being naked and branched; the flowers nod, and have 4 petals, 12 ſtamina, and 8 piſtils. It is frequent on the ſides of rivulets in the highland mountains and other places.

THAMES, the fineſt river in Great Britain, which takes its riſe from a copious ſpring, called *Thames Head*, two miles ſouth-weſt of Cirenceſter in Glouceſterſhire. It has been erroneouſly ſaid, that its name is Iſis till it arrives at Dorcheſter, 15 miles below Oxford, when, being joined by the Thame or Tame, it aſſumes the name of the Thames, which, it has been obſerved, is formed from a combination of the words Thame and Iſis. What was the origin of this vulgar error, cannot now be traced. Poetical fiction, however, has perpetuated this error, and inveſted it with a kind of claſſical ſanctity. "It plainly appears (ſays Camden), that the river was always called *Thames* or *Tems*, before it came near the Thame; and in ſeveral ancient charters granted to the abbey of Malmſbury, as well as that of Enſham, and in the old deeds relating to Cricklade, it is never conſidered under any other name than that of *Thames*." He likewiſe ſays, that it occurs nowhere under the name of Iſis. All the hiſtorians who mention the incurſions of Ethelwold into Wiltſhire in the year 905, or of Canute in 1016, concur likewiſe in the ſame opinion, by declaring, that they paſſed over the Thames at Cricklade in Wiltſhire. It is not probable, moreover, that Thames Head, an appellation by which the ſource has uſually been diſtinguiſhed, ſhould give riſe to a river of the name of Iſis; which river, after having run half its courſe, ſhould reaſſume the name of Thames, the appellation of its parent ſpring. About a mile below the ſource of the river is the firſt corn-mill, which is called *Kemble Mill*. Here the river may properly be ſaid to form a conſtant current; which, though not more than nine feet wide in the ſummer, yet in the winter becomes ſuch a torrent as to overflow the meadows for many miles around. But, in the ſummer, the Thames Head is ſo dry, as to appear nothing but a large dell, interſperſed with ſtones and weeds. From Somerford the ſtream winds to Cricklade, where it unites with many other rivulets. Approaching Kemsford, it again enters its native country, dividing it from Berkſhire at Ingleſham. It widens conſiderably in its way to Lechlade; and being there joined by the Lech and Coln, at the diſtance of 138 miles from London, it becomes navigable for veſſels of 90 tons. At Enſham, in its courſe north-eaſt, to Oxford, is the firſt bridge of ſtone; a handſome one, of three arches, built by the earl of Abingdon. Paſſing by the ruins of Godſtow nunnery, where the celebrated Fair Roſamond was interred, the river reaches Oxford, in whoſe academic groves its poetical name of Iſis has been ſo often invoked. Being there joined by the Charwell, it proceeds ſouth-eaſt to Abingdon, and thence to Dorcheſter, where it receives the Tame. Continuing its courſe ſouth-eaſt by Wallingford to Reading, and forming a boundary to the counties of Berks, Bucks, Surry, Middleſex, Eſſex, and Kent, it waſhes the towns of Henley, Marlow, Maidenhead, Windſor, Eton, Egham, Staines, Laleham, Chertſey, Weybridge, Shepperton, Walton, Sunbury, Eaſt and Weſt Mouſey, Hampton, Thames Ditton, Kingſton, Teddington, Twickenham, Richmond, Iſleworth, Brentford, Kew, Mortlake, Barnes, Chiſwick, Hammerſmith, Putney, Fulham, Wandſworth, Batterſea, Chelſea, and Lambeth. Then, on the north bank of the river, are Weſtminſter and London, and, on the oppoſite ſide, Southwark; forming together one continued city, extending to Limehouſe and Deptford; and hence the river proceeds to Greenwich, Erith, Greenhithe, Gray's Thurrock, Graveſend, and Leigh, into the ocean. It receives in its courſe from Dorcheſter the rivers Kennet, Loddon, Coln, Wey, Mole, Wandle, Lea, Roding, Darent, and Medway. The juriſdiction of the lord mayor of London over the Thames extends from Coln Ditch, a little to the weſt of Staines, to Yendal or Yenleet to the eaſt, including part of the rivers Medway and Lea; and he has a deputy, named the water-bailiff, who is to ſearch for and puniſh all offenders againſt the laws for the preſervation of the river and its fiſh. Eight times a year the lord mayor and aldermen hold courts of conſervance for the four counties of Surry, Middleſex, Eſſex, and Kent. Though the Thames is ſaid to be navigable 138 miles above the bridge, yet there are ſo many flats, that in ſummer the navigation weſtward would be intirely ſtopped, when the ſprings are low, were it not for a number of locks. But theſe are attended with conſiderable expence; for a barge from Lechlade to London pays for paſſing through them 13l. 15s. 6d. and from Oxford to London 12l. 18s. This charge, however, is in ſummer only, when the water is low; and there is no lock from London Bridge to Bolter's Lock; that is, for 51½ miles above the bridge. The plan of new cuts has been adopted, in ſome places, to ſhorten and facilitate the navigation. There is one near Lechlade, which runs nearly parallel to the old river, and contiguous to St John's Bridge; and there is another a mile from Abingdon, which has rendered the old ſtream toward Culham Bridge uſeleſs. But a much more important undertaking has lately been accompliſhed; namely, the junction of this river with the Severn. A canal had been made, by virtue of an act of parliament in 1730, from the Severn to Wall Bridge, near Stroud. A new canal now aſcends by Stroud, through the vale of Chalford, to the height of 343 feet, by means of 28 locks, and thence to the entrance of a tunnel near Sapperton, a diſtance of near eight miles. The canal is 42 feet in width at top and 30 at the bottom. The tunnel (which is extended under Sapperton Hill, and under that part of earl Bathurſt's grounds called *Haley Wood*, making a diſtance of two miles and three furlongs) is near 15 feet in width, and can navigate barges of 70 tons. The canal deſcending hence 134 feet, by 14 locks, joins the Thames at Lechlade, a diſtance of above 20 miles. In the courſe of this vaſt undertaking, the canal, from the Severn at Froomlade to Ingleſham, where it joins the Thames, is a diſtance of more than 30 miles.

Brookes's Gazetteer.

The expence of it exceeded the ſum of 200,000l. of which 3000l. are ſaid to have been expended in gunpowder alone, uſed for the blowing up of the rock. This new canal was completed in 1789, in leſs than ſeven years from its commencement. A communication, not only with the Trent, but with the Merſey, has likewiſe been effected by a canal from Oxford to Coventry; and an act of parliament has paſſed to extend another canal from this, at Braunſton, to the Thames at Brentford. This is to be called *The Grand Junction Canal.* On the extenſive advantages reſulting from theſe navigable communications from the metropolis with the ports of Briſtol, Liverpool, Hull, &c. and the principal manufacturing towns in the inland parts of the kingdom, it is needleſs to expatiate. The tide flows up the Thames as high as Richmond, which, following the winding of the river, is 70 miles from the ocean; a greater diſtance than the tide is carried by any other river in Europe. The water is eſteemed extremely wholeſome, and fit for uſe in very long voyages, during which it will work itſelf perfectly fine.

Thames is alſo the name of a river in the ſtate of Connecticut in America. See the article Connecticut.

THANE, or Thanus, a name given to the nobility in Britain before the time of William the Conqueror. It ſignifies a miniſter or honourable retainer, from the verb *thenian* "to miniſter." There were ſeveral degrees of nobility among the Anglo-Saxons; but thoſe moſt commonly mentioned are the king's thanes and the alderman's thanes. The king's thanes ſeem to have been of three different degrees, according to their different degrees of wealth or favour at court. The alderman's thanes ſeem to have been of the loweſt degree of nobility, and next to them thoſe who were promoted to that dignity from their advancement in the church, from their valour, ſucceſs in agriculture or commerce: for if a ceorl or farmer applied to learning and attained to prieſts orders, if he acquitted himſelf ſo well as to obtain from a nobleman five hythes of land, or a gilt ſword, helmet, and breaſt-plate, the reward of his valour; or if by his induſtry he had acquired the property of five hythes of land; or if he applied to trade, and made three voyages beyond ſea in a ſhip of his own, and a cargo belonging to himſelf—he was denominated a *thane*.

The thanes, who were the only nobility among the Anglo-Saxons, were a very numerous body of men, comprehending all the conſiderable landholders in England, and filling up that ſpace in ſociety between the ceorls or yeomanry on the one hand, and the royal family on the other; which is now occupied both by the nobility and gentry. In times of war, they conſtituted the flower of their armies, and in times of peace they ſwelled the trains of their kings, and added greatly to the ſplendour of their courts, eſpecially at the three great feſtivals of Chriſtmas, Eaſter, and Whitſuntide. From this body all the chief officers, both civil and military, as aldermen, greeves, earls, heretogens, &c. were taken; and to obtain ſome of theſe offices was the great object of their ambition. Before they obtained an office, their lands were their only ſupport; and they lived in greater or leſs affluence, according to the extent of their eſtates. Theſe they divided into two parts; one of which they called their *inlands*, and the other their *outlands*. Their inlands they kept in their own immediate poſſeſſion, and cultivated them by the hands of their ſlaves and villains, in order to raiſe proviſions for their families; their outlands they granted to ceorls or farmers, either for one year, or for a term of years; for which they received a certain ſtipulated proportion of their produce annually. Theſe cuſtoms had long prevailed among their anceſtors in Germany, and were adhered to by their poſterity in England till the conqueſt.

Henry's Hiſtory of Great Britain. vol. ii.

The thanes were under no obligations on account of their lands, except the three following, which were indiſpenſably neceſſary to the defence and improvement of their country: To attend the king with their followers in military expeditions, to aſſiſt in building and defending the royal caſtles, and in keeping the bridges and highways in proper repair. To theſe obligations all proprietors of land (even the churchmen for a long time not excepted) were ſubjected; and theſe ſervices were conſidered as due to their country, rather than to the perſons of their kings; and were agreed to by all as being neceſſary to their own preſervation and conveniency.

This title of thane was aboliſhed in England at the conqueſt, upon the introduction of the feudal ſyſtem by William. The titles of earl and baron were about the ſame period introduced into Scotland by Malcom Canmore, and the title of thane fell into diſuſe.

THANET, an iſland of the county of Kent, ſurrounded by the ſea except on the north-eaſt ſide, where it is bounded by the branches of the river Stour, now inconſiderable to what they were formerly. It contains ſeveral villages, and the ſea-port towns of Margate and Ramſgate, and has the title of an earldom. It is celebrated for being the ſpot through which arts, ſciences, and divine knowledge, came into this happy iſle. The Britons called it *Richborough*, from its vicinity to the city of that name, now only a venerable ruin; but the Saxons called it *Thanet*, from fire, having ſo many beacons erected on it. It is in the north-eaſt, part of the country, lies open to the ſea on the north and eaſt, with the river Wantſum on the weſt and ſouth, is about 10 miles long from the North Foreland to Sarre-Bridge, and about 8 broad from Weſtgate to Sandwich-Ferry. The north part of it is all arable, except ſome barren land, that is ſown with ſaintfoin, which produces a load and ſometimes two loads of hay upon an acre; by which means, the land that otherwiſe is not worth half-a crown an acre, yields 30s. or 40s. The ſouth and weſt parts of the iſland are moſt of them marſh or paſture lands. The ſoil is generally very fertile, eſpecially in the beſt of barley, and other ſorts of grain, of which it is computed about 20,000 quarters are ſent hence to London in a year, beſides what is ſold to other places. The *alga marina*, or ſea-ore, as they call it, is their chief manure. This they dry on the ſhore, and burn, in order to make kelp, which the potters uſe in glazing their ware. But the ſmell of the rotten ore upon the ſoil, and the ſmoke of it when burning, is very noiſome. The gentlemen's families are for the moſt part gone from this part of the country, having ſold their eſtates; ſo that their manſion ſeats are converted into farm-houſes; but then, on the other hand, many of the yeomen and farmers have good eſtates, on which they live very genteelly. In this iſland are ten pariſhes, but ſeven pariſh-churches, and one chapel.

Nucomb's England's Gazetteer.

THAPSIA, the deadly carrot, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *digynia*; and in the natural ſyſtem ranging under the 45th order, *umbellatæ*. The fruit is oblong and girt with a membrane. There are five ſpecies; the villoſa, fœtida, aſclepium, garganica, and trifoliata. The roots of the fœtida were formerly ordered in medicine, but are now intirely diſuſed; a ſmall doſe operating with extreme violence both upwards and downwards.

THAWING, the reſolution of ice into its former fluid ſtate by the warmth of the air. See Congelation and Froſt.

THEA, in botany. See Tea.

Theatines, Theatre.

THEATINES, a religious order in the Romiſh church, ſo called from their principal founder John Peter Caraffa, then biſhop of Theate, or Chieti, in the kingdom of Naples, and afterwards pope, under the name of *Paul* IV. The names of the other founders were Gaetan, Boniface, and Conſiglieri. Theſe four pious men deſiring to reform the eccleſiaſtical ſtate, laid the foundation of an order of regular clerks at Rome in the year 1524. Pope Clement VII. approved the inſtitution, and permitted the brethren to make the three religious vows, to elect a ſuperior every three years, and to draw up ſtatutes for the regulation of the order. They firſt endeavoured, by their example, to revive among the clergy the poverty of the apoſtles and firſt diſciples of our Saviour, and were the firſt who aſſumed the title of *regular clerks*.

THEATRE, a place in which ſhows or dramatic repreſentations are exhibited.

For the origin of the dramatic art we always turn our eyes to Greece, the nurſery of the arts and ſciences. It may indeed have been known among more ancient nations, but no records remain ſufficient to ſupport this opinion. The different ſtates of Greece aſſerted their claim to the honour of having given it birth, but the account of the Athenians is moſt generally received. It derived its origin from the hymns which were ſung in the feſtivals of Bacchus in honour of that deity. While theſe reſounded in the ears of the multitude, choruſes of Bacchants and Fauns, ranged round certain obſcene images which they carried in triumphal proceſſion, chanted laſcivious ſongs, and ſometimes ſacrificed individuals to public ridicule.

This was the practice in the cities; but a ſtill greater licentiouſneſs reigned in the worſhip paid to the ſame divinity by the inhabitants of the country, and eſpecially at the ſeaſon when they gathered the fruits of his beneficence. Vintagers, beſmeared with wine-lees, and intoxicated with joy and the juice of the grape, rode forth in their carts and attacked each other on the road with groſs ſarcaſms, revenging themſelves on their neighbours with ridicule, and on the rich by publiſhing their injuſtice.

Anacharſis's Travels, vol. i.

Among the poets who flouriſhed at that time, ſome celebrated the great actions and adventures of gods and heroes, and others attacked with aſperity the vices and abſurdities of individuals. The former took Homer for their model, and ſupported themſelves by his example, of which they made an improper uſe. Homer, the moſt tragic of poets, the model of all who have ſucceeded him, had in the Iliad and the Odyſſey brought to perfection the heroic poem, and in his Margites had employed pleaſantry. But as the charm of his works depends in a great meaſure on the paſſions and motion with which he knew to animate them, the poets who came after him endeavoured to introduce into theirs an action which might excite emotion or mirth in the ſpectators: ſome even attempted to produce both, and ventured certain rude eſſays, which have ſince been ſtyled indifferently either tragedies or comedies, becauſe they unite the characters of thoſe two dramas. The authors of theſe ſketches have been diſtinguiſhed by no diſcovery; they only form in the hiſtory of the art a ſucceſſion of names which it would be uſeleſs to recal to light.

The neceſſity and power of theatrical intereſt was already known. The hymns in honour of Bacchus, while they deſcribed his rapid progreſs and ſplendid conqueſts, became imitative; and in the conteſts of the Pythian games, the players on the flute who entered into competition were enjoined by an expreſs law to repreſent ſucceſſively the circumſtances that had preceded, accompanied, and followed the victory of Apollo over Python.

Theatre.

Some years after this regulation, Suſarion and Theſpis, both born in a ſmall borough of Attica, named *Icaria*, appeared each at the head of a company of actors, the one on a kind of ſtage, the other in a cart (A). The former attacked the vices and abſurdities of his time; and the latter treated more noble ſubjects, which he took from hiſtory.

The comedies of Suſarion were in the ſame taſte with thoſe indecent and ſatirical farces which were afterwards performed in ſome of the cities of Greece. They were long the favourite entertainment of the country people. Athens did not adopt this ſpecies of exhibition until after it was brought to perfection in Sicily.

Theſpis had more than once ſeen in the feſtivals, in which as yet hymns only were ſung, one of the ſingers, mounted on a table, form a kind of dialogue with the chorus. From this hint he conceived the idea of introducing into the tragedies an actor who, by ſimple recitals introduced at intervals, ſhould give relief to the chorus, divide the action, and render it more intereſting. This happy innovation, together with ſome other liberties in which he had allowed himſelf, gave alarm to the legiſlator of Athens who was more able than any other perſon to diſcern the value or danger of the novelty. Solon condemned a ſpecies of compoſition in which the ancient traditions were diſguiſed by fictions. "If we applaud falſehood in our public exhibitions (ſaid he to Theſpis), we ſhall ſoon find that it will inſinuate itſelf into our moſt ſacred engagements."

The exceſſive approbation and delight with which both the city and country received the pieces of Theſpis and Suſarion, at once juſtified and rendered uſeleſs the ſuſpicious foreſight of Solon. The poets, who till then had only exerciſed their genius in dithyrambics and licentious ſatire, ſtruck with the elegant forms which theſe ſpecies of compoſition began to aſſume, dedicated their talents to tragedy and comedy. Soon after a greater variety was introduced in the ſubjects of the former of theſe poems. Thoſe who judge of their pleaſures only from habit exclaimed, that theſe ſubjects were foreign to the worſhip of Bacchus; but the greater number thronged with ſtill more eagerneſs after the new pieces.

Phrynichus, the diſciple of Theſpis, made choice of that kind of verſe which is moſt ſuitable to the drama, was the author of ſome other changes, and left tragedy in its infancy.

Æſchylus received it from his hands enveloped in a rude veſtment, its viſage covered with falſe colours, or a maſk inexpreſſive of character, without either grace or dignity in its motions, inſpiring the deſire of an intereſt which it with difficulty excited, ſtill attached to the buffooneries which had amuſed its infant years, and expreſſing its conceptions ſometimes with elegance and dignity, but frequently in a feeble and low ſtyle, polluted with groſs obſcenities.

In his firſt tragedies he introduced a ſecond actor; and afterward, copying the example of Sophocles, who had juſt entered on his theatrical career, he admitted a third, and ſometimes even a fourth. By this multiplicity of perſonages, one of his actors became the hero of the piece, and attracted to himſelf the principal intereſt; and as the chorus now held only a ſubaltern ſtation, Æſchylus took care to ſhorten

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(A) Suſarion repreſented his firſt pieces towards the year 580 before Chriſt. Some years after, Theſpis made his firſt attempts in tragedy, and acted his Alceſtis in 536.

ſhorten its part, and perhaps even carried this precaution too far.

He is cenſured for having admitted mute characters into his drama. Achilles, after the death of his friend, and Niobe, after the deſtruction of her children, appear on the ſtage, and remain during ſeveral ſcenes motionleſs, with their heads covered with a veil, and without uttering a word; but if their eyes had overflown with tears, and they had poured forth the bittereſt lamentations, could they have produced an effect ſo terrible as this veil, this ſilence, and this abandonment to grief?

It was not ſufficient that the noble and elevated ſtyle of tragedy ſhould leave in the minds of the auditors a ſtrong impreſſion of grandeur; to captivate the multitude, it was requiſite that every part of the ſpectacle ſhould concur to produce the ſame effect. It was then the general opinion that nature, by beſtowing on the ancient heroes a more lofty ſtature, had impreſſed on their perſons a majeſty which procured them as much reſpect from the people as the enſigns of dignity by which they were attended. Æſchylus therefore raiſed his actors on high ſtilts or buſkins. He covered their features, which were frequently diſagreeable, with a maſk that concealed their irregularity. He clothed them in flowing and magnificent robes, the form of which was ſo decent, that the prieſts of Ceres have not bluſhed to adopt it. The inferior actors were alſo provided with maſks and dreſſes ſuited to their parts.

Inſtead of thoſe wretched ſcaffolds which were formerly erected in haſte, he obtained a theatre furniſhed with machines, and embelliſhed with decorations. Here the ſound of the trumpet was reverberated, incenſe was ſeen to burn on the altars, the ſhades of the dead to ariſe from the tomb, and the furies to ruſh from the gulphs of Tartarus. In one of his pieces theſe infernal divinities appeared, for the firſt time, with maſks of a horrid paleneſs, torches in their hands, ſerpents intertwined in their hairs, and followed by a numerous retinue of dreadful ſpectres. It is ſaid that, at the ſight of them, and the ſound of their terrific howlings, terror ſeized on the whole aſſembly, women miſcarried, and children expired with fear; and that the magiſtrates, to prevent ſimilar accidents in future, commanded that the chorus ſhould conſiſt only of fifteen actors inſtead of fifty.

The effect of ſo many new objects could not but aſtoniſh the ſpectators; nor were they leſs ſurpriſed and delighted at the intelligence diſplayed in the performance of the actors, whom Æſchylus almoſt always exerciſed himſelf. He regulated their ſteps, and taught them to give additional force to the action by new and expreſſive geſtures.

The progreſs of the art was extremely rapid. Æſchylus was born 525 years before Chriſt, 11 years after Theſpis had acted his Alceſtis. He had for competitors Chœrilus Pratenas, and Phrynichus, whoſe glory he eclipſed, and Sophocles, who rivalled his own. Sophocles was born about the year 497 B. C. about 14 years before Euripides. Theſe carried tragedy to the higheſt perfection to which it attained among the Greeks. Æſchylus painted men greater than they can be, Sophocles as they ought to be, and Euripides as they are.

Invented towards the 50th Olympiad (about 580 B. C.), and adapted to the rude manners of the ruſtics, comedy ventured not to approach the capital; and if by chance ſome companies of actors, who were unconnected with any others, found their way into the city, and performed their indecent farces, they were leſs authoriſed than tolerated by the government. It was not till after a long infancy that this ſpecies of drama began ſuddenly to make a rapid improvement in Sicily. Inſtead of a ſucceſſion of ſcenes without connection or tendency, the philoſopher Epicharmus introduced an action, all the parts of which had a dependence on each other; and conducted his ſubject, without wandering from it, through a juſt extent to a determinate end. His pieces, ſubjected to the ſame laws as tragedy, were known in Greece, where they were conſidered as models; and comedy ſoon ſhared with her rival the ſuffrages of the public, and the homage due to genius. The Athenians, eſpecially, received her with the ſame tranſports as they would have teſtified at the news of a victory: many of their poets exerciſed their genius in this novel ſpecies of compoſition; and their names adorn the numerous liſt of writers who have been diſtinguiſhed in comedy from the time of Epicharmus. Such were, among the more ancient, Magnes, Cratinus, Crates, Pherecrates, Eupolis, and Ariſtophanes. They all flouriſhed in the age of Pericles.

If we peruſe the comic pieces which have come down to us, we ſhall be convinced that the ſole object of the authors was to pleaſe the multitude. The gods and heroes were traveſtied, groſs and obſcene language was often employed, and virulent invectives were often thrown out againſt individuals of the firſt rank for genius and virtue. Towards the end of the Peloponneſian war the licentiouſneſs of comedy was reſtrained. The chorus was laid aſide, becauſe the rich citizens were alarmed, and would no longer contribute money to ſupport it, nor provide maſks with portraits for expoſing individuals.

The poets being thus reſtrained from mentioning names of living perſons on the ſtage, invented falſe names. They ſtill expoſed real and known characters; and thus gave a more exquiſite gratification to the ſpectators, who were highly amuſed with finding out the perſons intended. The conſequence of the law was only to make that done with delicacy which was formerly done in the moſt indecent and ſcurrilous manner. Ariſtophanes, in ſome of his lateſt pieces, has given us ſome good examples of this kind of comedy, which is ſometimes called the middle comedy.

Comedy was ſtill liable to abuſe, and therefore required farther reformation. As the uſe of real names had formerly been prohibited, real ſubjects were alſo forbidden; and comedy from that time was no longer a fury armed with torches, or a firebrand ſcattering miſchief, but a pleaſing and inſtructive companion. This is called the new comedy. The moſt eminent among the Greeks in this improved ſpecies was Menander. His writings are now loſt; but we may form a good eſtimate of their merit from the comedies of Terence, which are ſaid to have been borrowed from Menander, and to have nearly reſembled the original, though inferior in that *vis comica* by which the elegant Grecian was diſtinguiſhed. The comedy of Menander is that which has been cultivated in modern times.

To give ſome idea of a Grecian theatre, we ſhall deſcribe very ſhortly the theatre of Bacchus in Athens, which was built by the famous architect Philos in the time of Pericles. The part intended for the ſpectators was of a ſemicircular form, at the diameter of which was erected the ſtage. The orcheſtra occupied the ſpace where the pit in modern theatres is ſituated, where the muſic, the chorus, and the mimi were placed. It was four feet elevated above the ground. The ſpectators were arranged in three galleries round all the ſides of the orcheſtra except that next the ſtage, each gallery containing eight rows of ſeats. At the farther end of the orcheſtra, where the ſtage is erected in modern theatres, ſtood the thymele or logeon, but projecting a little towards the audience. It was a little higher than the orcheſtra, and did not extend the whole breadth of it. In ſome theatres it was only ſix feet ſquare. Here the principal part of the chorus made their recitations, and in comical interludes the mimi performed. Behind the thy-

Gentleman's Magazine for 1760.

mele appeared the ſtage or proſcenion, conſiderably elevated. No part of this theatre was covered except the ſtage, and a high gallery called *circys* ſet apart for the women. The Athenians, being expoſed to the weather, came uſually with great cloaks, to ſecure them from the rain or the cold; and for defence againſt the ſun, they had the *ſciadion*, a kind of paraſol, which the Romans uſed alſo in their theatres by the name of *umbellæ*; but when a ſudden ſtorm aroſe, the play was interrupted, and the ſpectators diſperſed.

A ſort of tent-work over the entire area of the edifice might have been contrived as a ſhelter from the rain and a ſhade from the ſun. Such a covering would have obviated the inconveniences of roofed theatres, which obſtruct the free communication of the air, and of unroofed theatres, which do not keep out the weather. At Athens the plays were always repreſented in the day-time, which made the unroofed theatres leſs inconvenient.

Plays were repreſented only during the three feſtivals ſolemnized in honour of Bacchus. The firſt of theſe was celebrated at the Piræus, where ſome of Euripides's pieces were firſt performed. The ſecond, which laſted only one day, was kept at the end of January or beginning of February. The third, called the greater *Dionyſia*, was celebrated a month after. It continued ſeveral days, and attracted a great multitude of ſpectators. In the feſtivals which laſted only one day, five or ſix dramatic pieces, either tragedies or comedies, were performed. But in the greater Dionyſia, which continued longer, 12 or 15, and ſometimes more, were acted. The performance began early in the morning, and ſometimes laſted the whole day.

The chorus, according as the ſubject demanded, was compoſed of men and women, old men or youths, citizens or ſlaves, prieſts, ſoldiers, &c. to the number of 15 in tragedy, and 24 in comedy. The chorus came upon the ſtage preceded by a flute-player, who regulated their ſteps; ſometimes one after the other, but in tragedy more frequently three in front and five in depth, or five in front and three in depth.

The ſame perſons performed both in tragedy and comedy; but, as among ourſelves, it was rare to meet with any who excelled in both. The pay of thoſe who had acquired great reputation was conſiderable. Polus gained a talent in two days (equal to L. 225 Sterling*). Players of eminence were ſolicited by different actors of Greece to attend their feſtivals. If, after making an engagement, they failed, they were obliged to pay a certain ſum of money; and if they were abſent during the feſtivals of their own republic, they were condemned to a heavy fine.

The actors had habits and ſymbols ſuited to their parts. Kings wore a diadem, leaned on a ſceptre which ſupported an eagle on its top, and were dreſſed in long robes of purple or other ſplendid colours ornamented with gold. Heroes, beſides having their ſtature frequently increaſed to ſix feet Engliſh ||, and their bulk in proportion, were frequently covered with the ſkin of a lion or a tyger, and armed with ſwords, quivers, and clubs. All who ſuffered miſfortunes wore a black, brown, or dirty white garment, which frequently hung in tatters. There were various kinds of maſks for tragedy, comedy, and ſatire. Theſe certainly took away the pleaſure ariſing from the expreſſion of the countenance; but at any rate, little pleaſure could be derived from this circumſtance in a Grecian theatre, from its immenſe ſize, and the great diſtance of the audience from the ſtage.

Dramatic entertainments were introduced at Rome in the year of the city 391. They were called *ludi ſcenici*, becauſe they were firſt acted in a ſhade formed by the branches and leaves of trees. They were borrowed immediately from Etruria, whence alſo they received their firſt players. Theſe Etrurians at firſt only danced to a flute, without either ſinging or acting. The Roman youth ſoon imitated them at their ſolemn feſtivals, adding raillery in rude verſes, and geſtures adapted to the ſubject. Theſe verſes were called *Feſcennia*, from Feſcennia, a city of Etruria. Livius Andronicus was the firſt poet who wrote a regular play in Latin. This happened in the year of Rome 512 or 514, about 160 years after the death of Sophocles and Euripides, and 52 after that of Menander. The Grecian model was afterwards introduced and cultivated much by ſucceeding dramatic writers. This was the model of Menander, for the old and middle comedy was unknown at Rome. As the Romans were only imitators of the Greeks in the dramatic art, as well as in moſt of the arts and ſciences, nothing more is neceſſary to be ſaid in addition to the account which we have already given of the Grecian ſtage.

The origin of the Engliſh ſtage is hid in obſcurity. It was not, however, copied from the Grecian or Roman; for it was evidently different in form as well as in matter, and may with more propriety be deduced from a Gothic original. It appears that there were theatrical entertainments in England almoſt as early as the conqueſt; for we are told by William Stephanides or Fitz-Stephen, a monk, who in the reign of Henry II. wrote his *Deſcriptio Nobiliſſimæ Civitatis Londoniæ*, that "London, inſtead of the common interludes of the theatre, had plays of a more holy kind; repreſentations of the miracles of confeſſors, and the ſufferings of martyrs. At this time there were alſo certain ſets of idle people, who travelled the countries and were called *Mummers*, a kind of vagrant comedians, whoſe excellence conſiſted altogether in mimickry and humour.

Gentleman's Magazine for 1761.

It is probable that, ſoon after this time, the dramatic repreſentations called *Myſteries* were exhibited: Theſe myſteries were taken from ſcripture-hiſtory: ſome repreſented the creation of the world, with the fall of Adam and Eve; ſome the ſtory of Joſeph; and others even the incarnation and ſufferings of the Son of God. Theſe pieces were exhibited in a manner ſo ridiculous as to favour libertiniſm and infidelity, as appears by a petition of the chaunters of St Paul's cathedral to Richard II. in 1378, praying, that "ſome unexpert people might be prohibited from repreſenting the hiſtory of the Old Teſtament to the prejudice of the ſaid clergy, who had been at great expence to repreſent it publicly at Chriſtmas."

Cibber's Apology for his Life.

In the year 1390, the pariſh clerks of London are ſaid to have played interludes at Skinner's-well on three ſucceſſive days in July; and, in 1409, to have acted for eight days ſucceſſively a play concerning the creation of the world, at the ſame place which thence acquired the name of *Clerkenwell*.

Theſe Myſteries were ſucceeded by Moralities, in which there were ſome rude traces of a fable and a moral; and ſome alſo of poetry, the virtues, vices, and other affections of the mind being frequently perſonified.

After theſe Moralities came what were called Interludes, which made ſome approaches to wit and humour. Many of theſe pieces were written by John Heywood, jeſter to Henry VIII.

In the time of Henry VIII. one or two pieces had been publiſhed under the claſſical names of *Comedy* and *Tragedy*, but they appear not to have been intended for popular uſe. It was not till the religious ferments had ſubſided that the public had leiſure to attend to dramatic poetry. In the reign of Elizabeth, tragedies and comedies began to appear in form, and could the poets have perſevered, the firſt models were good. *Gorboduc*, a regular tragedy, was acted in 1561; and Gaſcoigne, in 1566, exhibited *Jocaſta*, a tranſlation from Euripides, as alſo *The ſuppoſes*, a regular comedy,

Percy's Relics of Ancient Engliſh Poetry.

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* Plut. in X. Rhet.

|| Ariſt. in Ran. v. 1046. Athen. lib. v. cap. 7.

comedy, from Arioſto, near thirty years before any of Shakeſpeare's were printed.

The people however ſtill retained a reliſh for their old myſteries and moralities, and the popular dramatic poets ſeem to have made them their models. The graver ſort of moralities appear to have given birth to our modern tragedy; as our comedy evidently took its riſe from the lighter interludes of that kind. And as moſt of theſe pieces contain an abſurd mixture of religion and buffoonery, an eminent critic has well deduced from thence the origin of our unnatural tragi-comedies. Even after the people had been accuſtomed to tragedies and comedies, moralities ſtill kept their ground. One of them, intitled *The New Cuſtom*, was printed ſo late as 1573. At length they aſſumed the name of *maſques*, and, with ſome claſſical improvements, became in the two following reigns the favourite entertainments of the court.

As for the old myſteries, which ceaſed to be acted after the reformation, they ſeem to have given riſe to a third ſpecies of ſtage exhibition; which, though now confounded with tragedy or comedy, were by our firſt dramatic writers conſidered as quite diſtinct from them both: theſe were hiſtorical plays, or hiſtories; a ſpecies of dramatic writing which reſembled the old myſteries in repreſenting a ſeries of hiſtorical events ſimply in the order of time in which they happened, without any regard to the three great unities. Theſe pieces ſeem to differ from tragedy juſt as much as hiſtorical poems do from epic: as the Pharſalia does from the Æneid. What might contribute to make dramatic poetry take this turn was, that ſoon after the myſteries ceaſed to be exhibited, there was publiſhed a large collection of poetical narratives, called *the Mirror for Magiſtrates*, wherein a great number of the moſt eminent characters in Engliſh hiſtory are drawn relating their own misfortunes. This book was popular and of a dramatic caſt; and therefore, as an elegant writer has well obſerved, might have its influence in producing hiſtoric plays. Theſe narratives probably furniſhed the ſubjects, and the ancient myſteries ſuggeſted the plan.

That our old writers conſidered hiſtorical plays as ſomewhat diſtinct from tragedy and comedy, appears from numberleſs paſſages of their works. "Of late days (ſays Stow in his Survey of London), inſtead of thoſe ſtage plays have been uſed comedies, tragedies, interludes, and hiſtories, both true and fained." Beaumont and Fletcher, in the prologue to the *Captain*, ſay,

"This is nor comedy, nor tragedy,
"Nor *hiſtory*."——

Polonius in *Hamlet* commends the actors as the beſt in the world, either for tragedie, comedie, hiſtorie, paſtorall, &c. And Shakeſpeare's friends, Heminge and Condell, in the firſt folio edition of his plays, in 1623, have not only intitled their book "Mr. William Shakeſpeare's Comedies, Hiſtories, and Tragedies," but, in their table of contents, have arranged them under thoſe three ſeveral heads; placing in the claſs of hiſtories, "King John, Richard II. Henry IV. 2 pts, Henry V. Henry VI. 3 pts, Richard III. and Henry VIII."

This diſtinction deſerves the attention of the critics: for if it be the firſt canon of ſound criticiſm to examine any work by thoſe rules the author preſcribed for his firſt obſervance; then we ought to try Shakeſpeare's hiſtories by the general laws of tragedy and comedy. Whether the rule itſelf be vicious or not, is another enquiry; but certainly we ought to examine a work only by thoſe principles according to which it was compoſed. This would ſave much impertinent criticiſm.

Not fewer than 19 playhouſes had been opened before the year 1633, when Prynne publiſhed his *Hiſtriomaſtix*. From this writer we learn that tobacco, wine, and beer, were in thoſe days the uſual accommodations in the theatre, as now at Sadlers Wells. With regard to the ancient prices of admiſſion, the playhouſe called the *Hope* had five different priced ſeats, from ſixpence to half-a-crown. Some houſes had penny benches. The two-penny gallery is mentioned in the prologue to Beaumont and Fletcher's *Woman Hater*; and ſeats of threepence and a groat in the paſſage of Prynne laſt referred to. But the general price of what is now called the *Pit* ſeems to have been a ſhilling. The time of exhibition was early in the afternoon, their plays being generally acted by day light. All female parts were performed by men, no actreſs being ever ſeen on the public ſtage before the civil wars. And as for the playhouſe furniture and ornaments, they had no other ſcenes nor decorations of the ſtage, but only old tapeſtry, and the ſtage ſtrewed with ruſhes, with habits accordingly; as we are aſſured in a ſhort Diſcourſe on the Engliſh Stage, ſubjoined to Flecknoe's *Love's-Kingdom*, 1674, 12mo.

(B) For the ſtate of the theatre during the time of Shakeſpeare, ſee PLAYHOUSE; where a full account of it is given from the late valuable edition of our illuſtrious poet's works by Mr Malone. During the whole reign of James I. the theatre was in great proſperity and reputation: dramatic authors abounded, and every year produced a number of new plays; it became a faſhion for the nobility to celebrate their weddings, birth-days, and other occaſions of rejoicing, with maſques and interludes, which were exhibited with ſurpriſing expence; our great architect, Inigo Jones, being frequently employed to furniſh decorations, with all the luxuriance of his invention and magnificence of his art. The king and his lords, and the queen and her ladies, frequently performed in theſe maſques at court, and the nobility at their private houſes; nor was any public entertainment thought complete without them. This taſte for theatrical entertainments continued during great part of the reign of king Charles the firſt; but, in the year 1633, it began to be oppoſed by the Puritans from the preſs; and the troubles that ſoon after followed entirely ſuſpended them till the reſtoration of king Charles the ſecond in 1660.

The king, at his reſtoration, granted two patents, one to Henry Killigrew, Eſq. and the other to Sir William Davenant, and their heirs and aſſigns, for forming two diſtinct companies of comedians. Killigrew's were called the *King's Servants*, and Davenant's the *Duke's Company*. About ten of the company called the *King's Servants* were on the royal houſehold eſtabliſhment, having each ten yards of ſcarlet cloth, with a proper quantity of lace allowed them for liveries; and in their warrants from the lord chamberlain they were ſtyled *gentlemen of the great chamber*.

Till this time no woman had been ſeen upon the Engliſh ſtage, the characters of women having always been performed by boys, or young men of an effeminate aſpect, which probably

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(B) We have been anxious to give as full an account of the ancient Engliſh drama as we could: we muſt not omit, however, to inform our readers what Mr Malone ſays of the old plays, *viz.* that not one play publiſhed before 1592 will bear a ſecond reading; and that excluſive of myſteries, moralities, and tranſlations, there are but 34 pieces extant which were publiſhed before that period.

bably induced Shakeſpeare to make ſo few of his plays depend upon female characters, as they muſt have been performed to great diſadvantage. The principal characters of his women are innocence and ſimplicity, ſuch are Deſdemona and Ophelia; and his ſpecimen of fondneſs and virtue in Portia is very ſhort. But the power of real and beautiful women was now added to the ſtage; and all the capital plays of Shakeſpeare, Fletcher, and Ben Johnſon, were divided between the two companies, by their own alternate choice, and the approbation of the court.

The king's ſervants ſeem to have been allowed to be the beſt company; and when the variety of plays began to be exhauſted, they drew the greater audiences. Davenant, therefore, to make head againſt them, firſt added ſpectacle and muſic to action, and introduced a new ſpecies of plays, ſince called *dramatic operas*; among theſe were, *The Tempeſt*, *Pſyche*, and *Circe*; which, with many others, were ſet off with the moſt expenſive decorations of ſcenes and habits, and with the beſt voices and dancers.

In 1684 the two houſes united, and continued together for ten years. In 1690 the play began at four o'clock; and, we are told, the ladies of faſhion uſed to take the evening air in Hyde-park after the repreſentation; by which it appears that the exhibitions were in ſummer too. The principal actors were, Betterton, Montfort, Kynaſton, Sandford, Nokes, Underhill, and Leigh, commonly called *Tony Leigh*; the actreſſes were, Mrs Betterton, Barry, Leigh, Butler, Montford, and Bracegirdle; and to this company, in this year, old Cibber was admitted as a performer in the loweſt rank. It was a rule with the patentees, that no young perſon, who offered himſelf as an actor, ſhould be admitted into pay till after at leaſt half a year's probation; and Cibber waited full three quarters of a year before he was taken into a ſalary of 10s. a week.

In 1695 a new theatre was opened with Mr Congreve's comedy of Love for Love, which had ſuch extraordinary ſucceſs (ſays Cibber) that ſcarce any other play was acted there till the end of the ſeaſon; but when the ſeaſon ended, which appears to have begun in June, he does not tell us, and it is indeed difficult to gueſs; for though the company acted in ſummer, it ſeems improbable that they ſhould ſhut up the houſe in winter, as it is difficult to conceive any reaſon for ſo doing. Congreve was then in ſuch high reputation, that this company offered him a whole ſhare (but into how many ſhares the whole was divided Colley has not told us) upon condition he would give them a new play every year. This offer he accepted, and received the advantage, though he never fulfilled the condition; for it was three years before he produced the *Mourning Bride*, and three more before he gave them *the Way of the World*.

It is not neceſſary that we give in detail the remaining hiſtory of the Engliſh ſtage: thoſe who are anxious to be acquainted with it may conſult Cibber's hiſtory of the ſtage, continued by Victor, under the title of *A Hiſtory of the Theatres of London and Dublin from the year* 1730. We ſhall only mention a few facts reſpecting the ſalaries of the players about that period, and the riſe of the price of play-tickets.

A difference having ariſen in 1733 between the managers and actors, moſt of the actors ſet up for themſelves at the little theatre in the Haymarket. Upon this the managers publiſhed the following account of their ſalaries, to ſhew the public how little room they had to mutiny. To Mr Colley Cibber, from the time of letting his ſhare till he left the ſtage, 12l. 12s. *per* week. Mr The. Cibber 5l. and his wife's whole ſalary till her death, without doing the company any ſervice the greateſt part of the winter; and his own alſo, during the time of his being ill, who performed but ſeldom till after Chriſtmas. Mr Mills jun. 3l. under the ſame circumſtances with regard to his wife. Mr Mills ſen. 1l. *per* day for 200 days certain, and a benefit clear of all charges. Mr Johnſton 5l. Mr Miller 5l. paid him eight weeks before he acted, beſides a preſent of 10 guineas. Mr Harper 4l. and a preſent of 10 guineas. Mr Griffin 4l. and a preſent. Mr Shepard 3l. Mr Hallam, for himſelf and father (though the latter is of little or no ſervice) 3l. Mrs Heron 5l. raiſed from 40s. laſt winter, yet refuſed to play ſeveral parts aſſigned her, and acted but ſeldom this ſeaſon. Mrs Butler 3l. *per* week. By theſe and other ſalaries, with the incident charges (beſides clothes and ſcenes), the patentees are at the daily charge of 49l. odd money, each acting-day.

Gentleman's Magazine for 1733.

Till about the ſame time, the prices at the theatre were 4s. the boxes, 2s. 6d. the pit, 1s. 6d. the firſt gallery, and 1s. the ſecond, except upon the firſt run of a new play or pantomime, when the boxes were 5s. the pit 3s. the firſt gallery 2s. and the ſecond 1s. But Fleetwood thought fit to raiſe the prices for an old pantomime, which was revived without expence. This produced a riot for ſeveral nights, and at laſt a number deputed by the pit had an interview with the manager in the green room, where it was agreed, that the advanced prices ſhould be conſtantly paid at the doors, and that ſuch perſons as did not chooſe to ſtay the entertainment ſhould have the advanced part of their money returned. This was a very advantageous agreement for the manager; becauſe, when the audience had once paid their money, and were ſeated, very few went out at the end of the play, and demanded their advanced money; the few that did it at firſt, ſoon grew tired, and at laſt it ſettled in the quiet payment of the advanced price, as at this day.

It has been frequently a ſubject of debate, whether the ſtage be favourable to morals. We do not mean to enter into the controverſy; but we ſhall make an obſervation or two. It will be allowed by all, that the intention of the players in acting, is to procure money; and the intention of the audience in attending the theatre, is to ſeek amuſement. The players then will only act ſuch plays as they believe will anſwer their intention. And what ſort of plays are theſe? They are ſuch as correſpond with the opinions, manners, and taſte, of the audience. If the taſte of the audience be groſs, therefore the plays will be groſs; if delicate and refined, they will be the ſame. And if we go back to the time of Shakeſpeare, we ſhall find that this has been uniformly the caſe. The concluſion, then, which we draw, is this, if the taſte of the audience be pure, free from licentiouſneſs, the plays will be the ſame, and the ſtage will be favourable to virtue.

THEBAIC POWDER. See *PHARMACY-Index*.

THEBAID, a celebrated heroic poem of Statius, the ſubject whereof is the civil war of Thebes, between the two brothers Eteocles and Polynices; or Thebes taken by Theſeus.

THEBES, the name of a celebrated city of ancient Greece. It is ſuppoſed to have been built by Cadmus, about the year of the world 2555. This Cadmus, according to the Greeks, was the ſon of Agenor king of Sidon or of Tyre; but the Sidonians allow him to have been of no higher quality than his cook, and tell us that his wife was a muſician at court, with whom he ran away into Greece. The Greek writers tell us, that being commanded by his father to go in ſearch of his daughter Europa, whom Jupiter in the ſhape of a bull had carried off, and forbid to return without her, he built, or rebuilt, the city of Thebes, after having long ſought her in vain. He was at firſt oppoſed by the Hyantes and Aones; the former of whom he defeated in battle, and forced to retire into Locris: the

1 Account of Cadmus the founder of Thebes.

the latter ſubmitted, and were incorporated among his ſubjects.

2
Suppoſed to be one of the exiled Canaanites.

Thoſe who endeavour to extract ſome truth from the multitude of fables in which the early part of the Grecian hiſtory is obſcured, are of opinion that Cadmus was one of the Canaanites expelled by Joſhua; and that he was of the family of the Cadmonites mentioned by Moſes and Joſhua. He is univerſally allowed to have introduced the Phœnician letters into Greece, ſet up the firſt ſchools, and introduced braſs; which, from him, had the name of *Cadmean* given to it. The government of Thebes continued for a long time monarchical; and the names of a number of its kings have been tranſmitted to us, with ſome account of their tranſactions; but ſo much obſcured by fable, that little or nothing can be determined concerning them. We ſhall therefore paſs over this fabulous part of their hiſtory, and only take notice of that period of it when the Thebans emerged from their obſcurity, and for a time held the ſovereignty of Greece.

3
The Thebans a degenerate ſtupid people.

Though the Thebans had been famed in the early period of their hiſtory for their martial atchievements, yet in proceſs of time they ſeem to have degenerated. At the time of the invaſion of Xerxes, they were the firſt people in Greece who were gained over to the Perſian intereſt. On account of this miſbehaviour, they were become very obnoxious to the other ſtates, eſpecially to the Athenians, whoſe power and renown increaſed every day, and threatened at laſt to ſwallow them up altogether. The Thebans being in no condition to oppoſe ſuch a formidable power, put themſelves under the protection of the Spartans, who, out of jealouſy of the Athenians, readily forgave them; and ſo grateful were the Thebans for the kindneſs ſhown them at this time, that during the whole of the Peloponneſian war Sparta had not a more faithful ally. By theſe means they not only recovered the government of Bœotia, of which they had been formerly in poſſeſſion, till deprived of it on account of their ſiding with the Perſians, but their city became one of the firſt in Greece. By this proſperity the Thebans were ſo much elated, that, when the peace of Antalcidas came to be ſigned, they refuſed to agree to it, as they were thus once more deprived of the government of Bœotia; ſo that it was not without the utmoſt difficulty that they were overawed into it by the other ſtates. Not content with forcing them to give up this point, however, the Spartans undertook to change the form of the Theban government, which at this time was a democracy, and accompliſhed it through the treachery of thoſe who had the care of the citadel.

4
Put themſelves under the protection of the Spartans.

5
The form of government changed, and the citadel ſeized by the Spartans.

The Thebans continued under the power of the Spartans for four years; at the end of which term a conſpiracy being formed againſt them by ſome of the principal people in the city, among whom was a young nobleman named *Pelopidas*, the Spartans were maſſacred and driven out, and the citadel regained. During the tumult Epaminondas, afterwards the celebrated general, with a number of the beſt citizens, joined the party of Pelopidas; and the latter having called a general aſſembly of the Thebans, proclaimed liberty to them, and exhorted them in the ſtrongeſt manner to fight for their country. This ſpeech was received with the greateſt acclamations; Pelopidas was unanimouſly proclaimed the preſerver of Thebes, and was charged with the management of the war which was then to be declared againſt Sparta.

6
The Thebans recover their liberty under Pelopidas.

7
War with Sparta.

Theſe tranſactions ſo much exaſperated the Spartans, that they immediately ſent their king Cleombrotus againſt them, though it was then the depth of winter. The Athenians, in the mean time, who had hitherto aſſiſted the Thebans, declined any farther connection, leſt they ſhould draw upon themſelves the reſentment of the Spartans. But they were ſoon after determined to act again on the ſame ſide, by an attempt which the Spartan general, Sphadnas, had raſhly made on the Pyræum or harbour of Athens. Thus, by means of the Athenians, a powerful diverſion was made in favour of the Thebans, who gradually recovered all the towns of Bœotia, and at length began to act offenſively againſt their enemies, and made a powerful invaſion in Phocis. They had now many ſharp encounters with them; which, though they did not amount to deciſive battles, yet did not fail to raiſe their courage, and depreſs that of the Spartans. In theſe encounters Pelopidas always ſignalized himſelf; and in the battle of Tanagra, where the Lacedæmonians were entirely defeated by the Athenians and their allies, Pelopidas had a principal ſhare in the victory, and killed the Spartan general with his own hand. Soon after this, with a body of only 300 Thebans, he entirely routed and diſperſed near 1000 Spartans; which was the greateſt diſgrace the latter had ever known; for till that time, whether in war with the Greeks or Barbarians, they had never been overcome by an equal, much leſs by ſuch an inferior, number of troops.

8
The Spartans defeated by Pelopidas.

9
Platæa and Theſpia razed by the Thebans.

Theſe ſucceſſes of the Thebans greatly alarmed the Athenians, who continually ſought to oppoſe their growing power. In this oppoſition they were joined by the Platæans, who on this account became extremely obnoxious to the Thebans, ſo that they at laſt came to a reſolution to ſurpriſe their city. This they accompliſhed, and entirely deſtroyed it, together with Theſpia, another city extremely well affected to Athens. Soon after this, the Thebans, encouraged by their ſucceſs, began to think of enlarging their territories, and of making encroachments on their neighbours, as they ſaw other ſtates had done before them. This ſpirit of conqueſt is ſaid to have been raiſed by their general Pelopidas; in which he was ſeconded by Epaminondas, a perſon who, though like him endowed with all the neceſſary qualities to make a complete captain or patriot, had till then preferred a private life, and lived in a conſtant courſe of virtue and the ſtudy of philoſophy. He had as yet ſeldom appeared in public, except to get himſelf excuſed from thoſe ſtate-employments which were ſo eagerly courted by others. This, however, had not hindered him from contracting an intimate friendſhip with Pelopidas, which had been daily improved by the correſpondence of their tempers and principles, as well as by that zeal which both diſplayed for the good of their country; which laſt had made them, even before this time, appear together in action, and to ſuch advantage, that Epaminondas's merit could be no longer concealed, nor indeed ſuffer him to continue longer in his beloved retirement: ſo that he ſaw himſelf, at length, deſervedly placed at the head of the Theban troops; where he gave ſuch early proofs of his future proweſs and abilities, as juſtly gave him the next rank to Pelopidas. Both came now to be conſidered in the ſame light, as generals in the field, as governors at home, and as complete ſtateſmen in the council. When the general treaty for reſtoring peace to Greece came to be propoſed by the Athenians, and was upon the point of being executed by the reſt of the ſtates, the Thebans refuſed to agree to it, unleſs they were comprehended in it under the name of *Bœotians*. This demand was as ſtrenuouſly oppoſed by the other contracting powers as inſiſted on by Epaminondas, who was there as ambaſſador on the part of the Thebans. Ageſilaus, in particular, told him in plain terms, that the Thebans ought to evacuate Bœotia, and leave the cities of it free and independent. To which he was anſwered by him, that the Lacedæmonians would do well to ſet them the example, by reſtoring Meſſenia to its ancient proprietors, and Laconia to its ancient freedom; for that

10
Account of Epaminondas.

11
His difference with Ageſilaus king of Sparta,

that the pretenſions of the city of Thebes to Bœotia were as well ſounded, at leaſt, as thoſe of Sparta to thoſe two countries. After this he went on, and ſhowed how far Sparta had aggrandized herſelf at the expence of her neighbours: that peace might be indeed obtained, and upon a ſolid and laſting footing; but that this could not be otherwiſe than by bringing all to an equality. This bold, though juſt remonſtrance, in which not only Thebes, but Greece in general was concerned, failed not, however, to exaſperate the haughty Spartan monarch; and the Athenians, who had till now looked upon the Thebans as dependents either on them or on the Macedonians, were not a little offended to hear their ambaſſadors talk in ſuch high terms. The reſult of the conference was, that Ageſilaus ſtruck the name of *Thebes* out of the treaty, and declared war againſt them, about the year 371 B. C.

12 The Spartans declare war againſt Thebes.

The Thebans were in no ſmall conſternation to ſee themſelves engaged in a war with the powerful Spartans, without any ally to aſſiſt them; and the reſt of the Grecian ſtates having made peace with the latter, began to look upon the ruin of the former as unavoidable. However, they reſolved to make the beſt defence they could; and put their army under the command of Epaminondas, aſſigning him, at his own requeſt, ſix others to act as counſellors or aſſiſtants. The Theban army conſiſted at moſt but of 6000 men, whereas that of the enemy was at leaſt thrice that number; but Epaminondas truſted moſt to his horſe, wherein he had much the advantage both in quality and good management: the reſt he endeavoured to ſupply by the diſpoſition of his men, and the vigour of the attack. He even refuſed to ſuffer any to ſerve under him in the engagement, but ſuch as he knew to be fully reſolved to conquer or die. The two armies met at Leuctra, where the Spartans were defeated with great ſlaughter, as related under that article.

13 Are entirely defeated at Leuctra.

14 The Athenians jealous of the Thebans.

17 The Thebans invade Peloponneſus with a formidable army, but are repulſed.

The victorious general, deſirous to improve this great victory, ſent an herald, crowned with garlands, to communicate it in form to the Athenians, in hopes that this would be an effectual means to reunite them to the Theban intereſt. But it proved quite otherwiſe. Athens, which now looked upon them with a jealous eye, and had then in view the ſovereignty of Greece, choſe rather, if they could not wholly obtain it, to ſhare it with Sparta, than to let the Thebans into the whole; and therefore even declined giving their herald audience. However, the Thebans took care to ſtrengthen themſelves by alliances; and beſides the Arcadians and Eleans, had got the Phocians, Locrians, Acarnanians, Eubœans, and other ſtates, under their dependence: ſo that they were now in a condition to act offenſively againſt the Spartans. Accordingly, under pretence of aſſiſting the Arcadians, they entered Peloponneſus with a gallant army, with Epaminondas and Pelopidas at their head. Here they were joined by the Arcadian and other confederate forces; ſo that the whole amounted to 40,000, ſome ſay 50,000 men beſides great numbers of thoſe who followed the camp, rather for plunder than fighting, and were computed about 20,000 more. The army was divided into four columns, and moved ſtraight towards Sellaſia, the place of their rendezvous, from which they purſued their journey with fire and ſword towards Sparta. But here they were repulſed by Ageſilaus, who was then returned to that metropolis.

To repair, in ſome meaſure, this diſgrace, and at the ſame time to leave ſome laſting monument which ſhould redound as much to his glory as to the mortification of the Spartans, Epaminondas left not their territories till he had reſtored the poſterity of the old Meſſenians to their ancient dominions, out of which they had been baniſhed near 300 years; rebuilt their capital, and left a ſtrong garriſon for its defence. He was, however, like to have been ſtopped in his return by Iphicrates, whom the Athenians had ſent with 12,000 men to intercept him; but this laſt loitered ſo long at Corinth, that the Thebans had paſſed the defiles of Cenchreæ, the chief place where he could have obſtructed his retreat had he taken poſſeſſion of it in proper time. Epaminondas continued his march till he came in full view of the city of Corinth. He found the roads choaked up with trees, rocks, ſtones, and every thing that could render them impaſſable; and the Corinthians well fortified, and reſolute on a ſtout defence. But he came ſo furiouſly upon them, notwithſtanding all theſe difficulties, that they abandoned all their entrenchments and outworks to the Thebans, and fled into the city. Thither theſe purſued them ſword in hand, and made an horrid ſlaughter of them; inſomuch that Corinth muſt have unavoidably fallen into their hands, had their generals thought fit to purſue theſe advantages; but whether they were afraid of the Athenians falling upon them, or apprehended ſome dangerous ambuſh in a country with which they were but indifferently acquainted, or whether the army was too much weakened through ſo many fatigues, or laſtly, whether the coldneſs of the ſeaſon, it being then the depth of winter, would not permit them to proceed farther, they immediated marched towards Bœotia. This gave ſuch an handle to their enemies, that they met with a very mortifying reception at their return to Thebes, where they were both arreſted, and clapped up as ſtate-priſoners, for having preſumed to prolong their command four months longer than the time limited by law, which time took in almoſt the whole of their expedition from their firſt entrance into Peloponneſus. However, at laſt, the judges being aſhamed to proceed any farther, they were both honourably acquitted.

18 The Meſſenians reſtored to their ancient dominions.

19 The Corinthians defeated.

20 Epaminondas and Pelopidas diſgraced at Thebes.

This proſecution had been chiefly carried on and encouraged by Meneclides, a diſcontented Theban, and a bold and able ſpeaker, who, by his artful calumnies at the trial, had ſo far prevailed with the judges as to get Epaminondas deprived of the government of Bœotia for a whole year, though he could not gain the ſame advantage againſt Pelopidas, who was a greater favourite of the people, as being his ſenior.

21 War renewed with Sparta.

By this delay the Spartans, with much difficulty, had recovered themſelves from their great defeat at Leuctra, and ſettled their affairs in as good a poſture as they could: but though they had repulſed the Thebans in Peloponneſus, yet from the exploits they had performed there, eſpecially in the diſmembering the whole kingdom of Meſſenia from them, they had ſtill cauſe to fear what their forces might do under two ſuch generals; and had accordingly taken due care to ſtrengthen themſelves againſt them, and to provide themſelves with a great number of auxiliaries from other ſtates, eſpecially from that of Athens, with whom they had renewed their old treaty, and had agreed that each ſhould have the command five days alternately. Soon after this treaty the Arcadians renewed the war, and took Pallene in Laconia by ſtorm, put the garriſon to the ſword, and were preſently aſſiſted by the Argives and Eleans, and eſpecially by the Thebans, who ſent to them 7000 foot and 500 horſe under the command of Epaminondas. This ſo alarmed the Athenians likewiſe, that they immediately ſent Gobrias wirh ſome forces to oppoſe his paſſage in good earneſt; and he ſo behaved himſelf againſt the Thebans, that they were forced to abandon Peloponneſus a ſecond time. This ill ſucceſs gave freſh occaſion to the enemies of Epaminondas to blame his conduct in the higheſt terms, notwithſtanding the ſingular bravery with which he and his troops had forced the paſs. Even his friends could not but ſuſpect him of

22 The Thebans repulſed.

23 Epaminondas degraded.

of partiality for the Spartans, in not purſuing his advantage over them, and making a greater ſlaughter of them when he had it in his power; whilſt his enemies made it amount to no leſs than treachery to his country: ſo that their brave general was once more deprived of the government of Bœotia, and reduced to the condition of a private man. He did not continue long under this diſgrace, before an occaſion offered to make his ſervices again of ſuch neceſſity to the ſtate, as to give him an opportunity to retrieve his fame, and wipe off the ſtain which his enemies had thrown upon him.

24 Pelopidas ſeized by Alexander of Pheræa.

The Theſſalians, who had groaned ſome time under the tyranny of the uſurper Alexander, ſurnamed the *Pheræan*, ſent an embaſſy to Thebes to implore their aid and protection; upon which Pelopidas was immediately ſent as ambaſſador to expoſtulate with him on their behalf. He was then in Macedon, from whence he took the young prince Philip, afterwards the celebrated monarch, in order to protect and educate him; and, upon his return, marched directly to Pharſalus in Theſſaly, in order to puniſh the treachery of ſome mercenaries, who had deſerted the Thebans in that expedition; but when he came thither, he was ſurpriſed to be met by the tyrant at the head of a numerous army before that city, whilſt his own was but as an handful of men in compariſon of it. However, whether he ſuppoſed, or would be thought to do ſo, that Alexander came thither to juſtify himſelf, and anſwer to the complaints alledged againſt him, he went, with Iſmenias his colleague, to him unarmed and unattended, not doubting but his character as ambaſſador from ſo powerful a republic, joined to his own character and authority, would protect them from inſult or violence: but he found himſelf miſtaken; for Alexander had no ſooner got them in his hands, than he cauſed them to be ſeized, and ſent priſoners to Pheræa.

25 A Theban army ſent to reſcue him, defeated.

26 Epaminondas reſtored.

The Thebans, highly reſenting the indignity offered to their ambaſſadors, ſent immediately an army into Theſſaly: but the generals were repulſed with great loſs by the Pheræan uſurper; and it was owing to Epaminondas, who was among them only as a private centinel, that they were not totally cut off. For the Thebans finding themſelves in ſuch imminent danger, which they attributed to the incapacity of their generals, had immediately recourſe to him, whoſe valour and experience had been ſo often tried; and, partly by perſuaſions and intreaties, and partly by threats, obliged him to take the command. This ſoon gave a different turn to their affairs, and converted their flight into a ſafe and regular retreat; for he took the horſe and light-armed foot, and placed himſelf at their head in the rear, and charged the enemy with ſuch vigour and bravery, that he obliged them to deſiſt from their purſuit.

27 Reſcues Pelopidas.

However, as the army had ſuffered ſuch loſs before as not to be able to purſue them in their turn, he was obliged to return with them to Thebes, with their puſillanimous generals; where the latter were fined 12,000 drachms each, and the former was reinſtated in the command, and ſent with a new reinforcement to repair the late diſhonour, and proſecute their revenge. The news of his being in full march on this errand, greatly alarmed the tyrant; but Epaminondas, preferring the ſafety of his impriſoned colleague to all other conſiderations, forbore puſhing hoſtilities to extremes, for fear of provoking the enemy to wreak all his fury on him: to prevent which, he contented himſelf for a while hovering about with his army, and now and then with ſuch ſlight ſkirmiſhes as ſhould intimidate the tyrant, and bring him the ſooner to make ſome ſatisfactory offers. Alexander being fully convinced of the ſuperiority of the Theban general, was glad to accept of a truce of 30 days, and to reſtore Pelopidas and Iſmenias to him; upon which he immediately withdrew his forces, and returned with them to Thebes.

28 Succeſs of Pelopidas at the Perſian court.

By this time, Thebes was raiſed to a ſufficient height of reputation and glory to begin to aim in earneſt at the ſovereignty of Greece. The main obſtacle to it was, that the other ſtates grew ſo jealous of her preſent greatneſs, as to enter into the ſtrongeſt alliances and confederacies to prevent its farther growth; ſo that not being able now to procure many allies at home, they made no difficulty to ſeek for them abroad; and the Lacedæmonians, by leading the van, gave them a plauſible pretence to follow their ſteps, and to procure an alliance with Perſia, which at that time they found was ready to accept of the offers on any terms; the only queſtion was, which of the three ſtates ſhould be preferred, Sparta, Athens, or Thebes. At the ſame time, the Thebans propoſed to their new confederates to ſend likewiſe proper deputies to the Perſian court, in order to ſupport their reſpective intereſts; which they readily agreed to. Theſe were the Arcadians, Eleans, and Argives; at the head of whoſe deputation Pelopidas was ſent on the behalf of the Thebans; which the Athenians being appriſed of, appointed two on their part. Theſe being all arrived at the Perſian court, began to purſue each their reſpective intereſts: but Pelopidas had by that time gained ſuch credit there, both for his ſingular addreſs and his extraordinary exploits, that he was diſtinguiſhed in a particular manner from all the other deputies, and was received by the king with the moſt manifeſt marks of honour and eſteem, who freely owned himſelf convinced that the Thebans were the people on whom he could moſt ſafely depend; and after having greatly applauded the equity of his demands, ratified and confirmed them with great readineſs, to the no ſmall mortification of the other ſtates. The ſubſtance of them was, that the liberties formerly granted to the other towns of Greece ſhould be confirmed; that Meſſenia, in particular, ſhould continue free and independent on the juriſdiction of Sparta; that the Athenians ſhould lay up their fleet; and that the Thebans ſhould be looked upon as the ancient and hereditary friends of Perſia.

29 The Thebans propoſe to build a fleet.

The Thebans took advantage of the diſſenſions which prevailed among the Greeks as a pretence for increaſing their forces; and Epaminondas thought it a proper opportunity for his countrymen to make a bold effort to obtain the dominion at ſea, as they had obtained it in a great meaſure at land. He propoſed it to them in a public aſſembly, and encouraged their hopes from the experience of the Lacedæmonians, who in Xerxes' time had, with ten ſhips only, at ſea, gained the ſuperiority over the Athenians, who had no fewer than 200; and added, that it would be a diſgrace now to Thebes, to ſuffer two ſuch republics to engroſs the empire of ſo extenſive an element, without putting in at leaſt for their ſhare of it. The people readily came into his propoſal, not without extraordinary applauſe, and immediately ordered 100 galleys to be equipped; and in the meanwhile ſent him to Rhodes, Chios, and Byzantium, to ſecure thoſe ſtates in their intereſt, and get what aſſiſtance he could from them. His negotiations had all the ſucceſs that could be wiſhed for, notwithſtanding the ſtrenuous oppoſition of the Athenians, and of their admiral Laches, who was ſent with a powerful ſquadron againſt him. But what more effectually thwarted all his meaſures, was the work that they found for him at land, and the obliging the Thebans to take part in the quarrels that then reigned among their neighbours: ſo that whatever projects they had concerted, proved abortive for the preſent; and the death of Epaminondas, which happened not long after, put an effectual ſtop to them.

During the abſence of that general, and of his colleague

Pelopidas, the Orchomenians, being ſpirited up by ſome Theban fugitives, had formed a deſign to change the Theban government into an ariſtocracy; and 300 horſemen of the former had been actually ſent to put it in execution. Their project, however, was timely diſcovered by the vigilance of the magiſtrates, who cauſed them to be ſeized, and put immediately to death.

30 The city of Orchomenos razed.

They next ſent a ſufficient force againſt the city of Orchomenos, with orders to put all the men to death, and to ſell the women and children for ſlaves, which was punctually done; after which they razed that noble city to the ground.

31 Pelopidas marches againſt the Theſſalian tyrant.

Pelopidas was then on his way to Theſſaly, at the head of a powerful army, whither he had been ſent to aſſiſt the Theſſalians, who ſtill groaned under the tyranny of Alexander the Pheræan, and had made ſeveral brave efforts to recover their liberty, but had been ſtill overpowered by that uſurper. Being joined by the Theſſalians, he encamped in the face of the enemy, though far ſuperior in number, and conſiſting of above 20,000 men. A fierce engagement ſoon enſued, in which both ſides fought with uncommon bravery. The place where the battle was fought was called *Cynocephala*, from ſeveral little hills on it, between which there ran a large plain. Both ſides endeavoured at firſt to poſt themſelves on theſe eminences with their foot, whilſt Pelopidas ordered his cavalry to charge that of the enemy below; which they did with ſuch ſucceſs, that they ſoon put them to the rout, and purſued them over the plain. This obliged the tyrant to gain the tops of the hills, where he greatly annoyed the Theſſalians that endeavoured to force thoſe aſcents; ſo that Pelopidas was obliged to give over his purſuit to come to their relief. This immediately inſpired the Theſſalians with freſh courage, who began again to charge the enemy at ſeveral onſets; and ſoon threw them into ſuch diſorder, that they were forced to give way. Pelopidas no ſooner perceived the advantage, than he began to look about for Alexander, with a deſign of engaging him. Having found him out as he was commanding his right wing, and endeavouring to rally his men, he moved directly to him; and being got near enough to be heard by him, challenged him to decide the battle by ſingle combat with him. Alexander, inſtead of accepting the offer, turned about, and with all the ſpeed he could ran to ſcreen himſelf among his guards. Upon this Pelopidas charged him with ſuch furious ſpeed, that he obliged him to retire farther, and ſhelter himſelf within the thickeſt ranks; the ſight of which made him attack with freſh vigour, and fight more deſperately againſt him. He tried in vain ſeveral times to break through their ranks to reach him, cutting down great numbers of thoſe that came forward to oppoſe him:

32 Is killed.

his eagerneſs at length expoſed him ſo far to the darts that were ſhot at him at a diſtance, that ſome of them went quite through his armour, and gave him a deſperate wound or two, while the reſt advanced and ſtabbed him in the breaſt with their ſpears.

It is ſcarce poſſible for words to expreſs the grief and deſpair which not only his brave Thebans, but likewiſe the Theſſalians and other allies, ſhowed at the ſight of their ſlain general: ſome of the latter, who had perceived the danger he was expoſed to, came down the hill with all poſſible ſpeed to his relief; but when they perceived that they were come too late to ſave him, both they and the reſt of the little army thought of nothing now but to revenge his death. They rallied accordingly, both horſe and foot, as quick as poſſible, and began to charge the enemy afreſh,

33 Alexander defeated,

and with ſuch deſperate fury, that they at length gained a complete victory over them, and killed above 3000 of them in their purſuit, beſides a much greater number which they had ſlain on the field of battle, though they ſtill looked upon all theſe advantages as vaſtly too ſmall to compenſate the loſs of their brave general.

The news of his death had no ſooner reached Thebes, than the whole city was ſeen in as deep a mourning as his army. However, they ſent a reinforcement to it of 7000 foot and 700 horſe, as well to revenge the death of that general, as to improve the victory he had gained over the enemy; by the help of which they fell ſo furiouſly on them, that they quickly broke and totally defeated the ſhattered remains of Alexander's army. Hereupon he was forced to ſue for peace, and to accept it on ſuch conditions as the conquerors thought fit to impoſe.

34 And at laſt murdered.

He was at length diſpatched in his bed by his wife Thebe, aſſiſted by her brothers, about ſeven years after his defeat. His body was afterwards dragged along the ſtreets, trodden under foot, and left a prey to the dogs.

35 Ambition of the Thebans.

All this while the Thebans were watching to improve every commotion that happened, every ſucceſs they met with, to the forwarding of their then reigning and favourite project, of increaſing their power above all the reſt, and in their turn to give laws to Greece. Their late ſucceſs in Theſſaly, and the rupture between the Arcadians and Mantineans at the ſame time, about ſome conſecrated money which the former had taken out of the temple of Olympias to pay their troops employed againſt the Eleans, and which the latter called a downright ſacrilege, beſides other diſcords that reigned in the other ſtates of Greece, gave freſh encouragement to Thebes to ſet up for arbitreſs in thoſe diſputes; and ſo much the more, as thoſe who had embezzled the ſacred money, and wanted rather to embroil matters than to have them brought to light, ſent that republic word that the Arcadians were juſt upon the point of revolting to the Spartans, and adviſed them to come and put an immediate ſtop to it. At the ſame time they diſpatched ſome private directions to a Theban officer at Tegea, to apprehend ſeveral of their own people as diſturbers of the peace. This was accordingly done, and ſeveral eminent perſons were confined as priſoners of ſtate: they were ſoon after diſcharged, and loud complaints were made againſt ſuch arbitrary and unjuſt proceedings. The officer was accuſed before the Theban ſenate for having intermeddled in their affairs, and endeavoured to interrupt the good correſpondence between the two ſtates. It was even inſiſted on by ſome of the Tegeans, that he ſhould be indicted and proceeded againſt by his principals; whilſt the more moderate ſort, who foreſaw the conſequences that were likely to attend ſuch appeals, and that it would infallibly bring the Thebans upon them, loudly proteſted againſt their marching into their territories, and did all they could to prevent it. The Thebans, however, were become too powerful and ambitious to miſs ſo fair an opportunity of getting once more footing in Peloponneſus, as they had long ago premeditated;

36 Epaminondas diſpleaſes the ſtates of Greece.

and Epaminondas was ſo far from making a ſecret of their deſign, that he told the Arcadian deputies in juſtification of it, that as it was on their account that the Thebans engaged in the war, they had acted treacherouſly with them in making peace with Athens without their conſent: however, that when he was got with his army on his march into Peloponneſus to aſſiſt his friends, he would ſoon ſee what proofs the Arcadians would give of their fidelity. This ſpeech did not fail to alarm them greatly; eſpecially as it was ſpoken in ſuch a magiſterial ſtyle and threatening tone. Even thoſe who were beſt affected to the Thebans could not forbear expreſſing their diſlike of it; and all that had the welfare of Peloponneſus at heart readily agreed with the Mantineans, that there was no time to be loſt to uſe all proper means to prevent the impending ſtorm.

37
A combination againſt Thebes.

Athens and Sparta were accordingly applied to, and were eaſily prevailed upon to aſſiſt the Mantineans, and to come into a ſtrict confederacy againſt the Thebans; and to prevent all diſputes about the command of the army, it was agreed that each ſtate ſhould have it in its own territories; which plainly ſhows how terrified they all were at the apprehenſion of a freſh invaſion of the Thebans; for this was a point which neither the Spartans nor Athenians would have ſo readily given up to the Arcadians, though theſe had formerly as ſtrenuouſly inſiſted upon it, even when they were almoſt reduced to the laſt extremity, and had never been able to obtain it till now. But Epaminondas was then in full march at the head of his Bœotian troops, with ſome Eubæan auxiliaries, and a body of ſtout Theſſalian horſe; and was moreover to be joined by the Meſſenians, Argives, and ſeveral other nations, as ſoon as he had entered Peloponneſus. The confederate army againſt him had ordered their rendezvous at Mantinea, the place which they naturally concluded would be firſt attacked, as being the chief ſeat of thoſe who had revolted from the Thebans.

38
Epaminondas makes an unſucceſsful attempt on Sparta,

But whilſt they were ſecuring themſelves on that ſide, Epaminondas, who wiſely conſidered how far this confederacy and expedition muſt have drained the city of Sparta of its main ſtrength, broke up privately from Nemæa, where he had lain for ſome time encamped, and marched all that night with a deſign to have ſurpriſed that important capital: but his project being timely diſcovered, the vigilant king took care to diſconcert it; ſo that, though the Theban general made ſeveral vigorous aſſaults on that city, he was ſo ſtoutly repulſed, and the Spartans behaved with ſuch intrepid valour, that he was forced to retire and turn his thoughts againſt Mantinea, which he judged by this time to have been quite defenceleſs. He judged rightly indeed; for the place was not only drained of its troops, but likewiſe of its inhabitants, who took that opportunity, whilſt the ſcene of war was in Lacedæmon, to gather in their harveſt, and were ſcattered all over the country; ſo that he would not have met with any difficulty in gaining the town, had not the Athenian auxiliaries come unexpectedly to its relief, and given him a freſh repulſe.

39
And on Mantinea.

Theſe two laſt defeats greatly exaſperated the Theban general, who had never till now been uſed to them, and could not but foreſee that they would not only leſſen his reputation with his allies, but, if not timely retrieved, would ſully the glory of all his former exploits. What added to his preſent difficulties was, that the time allotted him for his expedition was almoſt expired; ſo that he had but a ſhort ſpace left to undertake ſome brave atchievement, which might recover his and his country's honour, and keep up the ſpirits of his auxiliaries and thoſe under his protection. He was moreover got very far into the enemy's country, and ſaw plainly enough how narrowly they watched all his motions, and how well prepared they were to oppoſe him whatever attempt he reſolved upon, whether to attack them or to retreat. Under all theſe difficulties, he rightly conſidered, that he muſt immediately reſolve upon a deciſive battle; in which, if his priſtine fortune followed him, he might at once retrieve his affairs, and make himſelf maſter of Peloponneſus; or, if that failed him, as it lately had done, fall honourably in the attempt.

40
Battle of Mantinea.

In this engagement Epaminondas made the wiſeſt diſpoſition of his troops, attacked and fought with the moſt intrepid courage and conduct, and had opened himſelf a way through the Spartan phalanxes, thrown them into the utmoſt confuſion, and made a terrible ſlaughter of them, inſomuch that the field of battle was covered with their wounded and ſlain, when, in the heat of the fight, having ventured himſelf too far in order to give them a total overthrow, the enemy rallied again, pouring with their whole fury three volleys of darts at him, ſome of which he drew out and returned to them, till at length, being covered with wounds, and weakened with the loſs of ſo much blood, he received a mortal wound from a javelin, and was with great difficulty reſcued from the enemy by his brave Thebans, and brought alive, though ſpeechleſs, into his tent.

41
Epaminondas killed.

As ſoon as he had recovered himſelf, he aſked his friends that were about him what was become of his ſhield; and being told that it was ſafe, he beckoned to have it brought to him, and kiſſed it. He next inquired which ſide had gained the victory; and being anſwered, The Thebans; he replied, Then all is well: and upon obſerving ſome of his friends bewail his untimely death, and leaving no children behind him, he is ſaid to have anſwered, Yes; I have left two fair daughters, the victory of Leuctra, and this of Mantinea, to perpetuate my memory. Soon after this, upon drawing the point of the javelin out of his body, he expired.

The conſequence of this great general's fall, and of this bloody fight, in which neither ſide could boaſt any great advantage over the other, but a great loſs of men on both ſides, inſomuch that Xenophon makes it a drawn battle, was, that both parties agreed on a ceſſation of arms, and parted, as it were by conſent, to take care of their wounded and ſlain. The Thebans indeed thus far gained the greater ſhare of glory, that they renewed the fight, and after a moſt deſperate conteſt, gained the victory over thoſe Spartans that oppoſed them, and reſcued the body of their dying general out of their hands.

42
Peace concluded.

However, an effectual end was put to this bloody war, and a general peace agreed on by all but Sparta; who refuſed it only becauſe the Meſſenians were included in it. But as to the Thebans, they had no great reaſon to boaſt of this dear-bought victory, ſince their power and glory began to decline from that very time; ſo that it may be truly ſaid, that it roſe and ſet with their great general.

43
State of Thebes to the preſent time.

On the death of Epaminondas, the Thebans relapſed into their former ſtate of inactivity and idolence; and at laſt having ventured to oppoſe Alexander the Great, their city was taken, and the inhabitants ſlaughtered for ſeveral hours, after which the buildings were deſtroyed. It was rebuilt by Caſſander, but never afterwards made any conſiderable figure among the ſtates of Greece. About the year 146 B.C. it fell under the power of the Romans, under which it continued till the extinction of their empire by the Turks. It is now called *Thive*, and is nothing to what it was formerly; yet it is four miles in circumference, but ſo full of ruins, that there are not above 4000 Turks and Chriſtians in it. It is now famous for a fine ſort of white clay, of which they make bowls for pipes after the Turkiſh faſhion. They are never burnt, but dry naturally, and become as hard as a ſtone. There are two moſques in Thebes, and a great many Greek churches. It is ſeated between two ſmall rivers, in E. Long. 23. 40. N. Lat. 38. 17.

Thebes, in Egypt, one of the moſt renowned cities of the ancient world. It was alſo called *Dioſpolis*, or the city of Jupiter, and was built, according to ſome, by Oſiris, according to others by Buſiris. Its length, in Strabo's time, was 80 furlongs, or ten miles; but this was nothing in compariſon of its ancient extent, before it was ruined by Cambyſes, which, we are told, was no leſs than 420 ſtadia, or 52 miles and an half. The wealth of this city was ſo great, that, after it had been plundered by the Perſians, what was found, on burning the remains of the pillage, amounted to above 300 talents of gold and 2300 of ſilver.

Ancient Univerſal Hiſtory, vol. i.

Mr Bruce viſited the ruins of this celebrated city; but informs us that nothing now remains except four temples, and theſe neither ſo entire nor magnificent as ſome others at

Thebes, Theft.

a place called *Dendera*. Thebes has been celebrated by Homer for its hundred gates; but Mr Bruce informs us, that no veſtiges of theſe are now remaining, neither can we diſcover the foundation of any wall it ever had; "and as for the horſemen and chariots it is ſaid to have ſent out, all the Thebaid ſown with wheat would not have maintained one half of them. Thebes, at leaſt the ruins of the temples called *Medinet Tabu*, are built in a long ſtretch of about a mile broad, moſt parſimoniouſly choſen at the ſandy foot of the mountains. The *Horti Penſiles*, or hanging gardens, were ſurely formed upon the ſides of theſe hills, then ſupplied with water with mechanical devices. The utmoſt is done to ſpare the plain, and with great reaſon; for all the ſpace of ground this ancient city has had to maintain its myriads of horſes and men, is a plain of three quarters of a mile broad between the town and the river, upon which plain the water riſes to the height of four and five feet. All this pretended populouſneſs of ancient Thebes I therefore believe to be fabulous."

Bruce's Travels.

Mr Bruce, after examining the ground on which Thebes is ſuppoſed to have ſtood, thinks that it had no walls, and that conſequently Homer's ſtory of its having an hundred gates is miſunderſtood. The mountains of the Thebaid ſtand cloſe behind the town, not in a ridge, but ſtanding ſingle, ſo that you can go round each of them. A hundred of theſe are ſaid to be hollowed out for ſepulchres and other purpoſes. Theſe, he thinks, were the hundred gates of Homer; in proof of this they are ſtill called by the natives *Beeban el Meluke*, "the ports or gates of the kings."

All that is ſaid of Thebes by poets or hiſtorians after the days of Homer is meant of Dioſpolis, which was built by the Greeks long after Thebes was deſtroyed, as its name teſtifies; though Diodorus ſays it was built by Buſiris. It was on the eaſt ſide of the Nile, whereas ancient Thebes was on the weſt, though both are conſidered as one city; and Strabo ſays, that the river runs through the middle of Thebes, by which he means between Old Thebes and Dioſpolis.

THEFT, or SIMPLE LARCENY, is "the felonious taking and carrying away of the perſonal goods of another." This offence certainly commenced then, whenever it was that the bounds of property, or laws of *meum* and *tuum*, were eſtabliſhed. How far ſuch an offence can exiſt in a ſtate of nature, where all things are held to be common, is a queſtion that may be ſolved with very little difficulty. The diſturbance of any individual in the occupation of what he has ſeized to his preſent uſe, ſeems to be the only offence of this kind incident to ſuch a ſtate. But, unqueſtionably, in ſocial communities, when property is eſtabliſhed, any violation of that property is ſubject to be puniſhed by the laws of ſociety; though how far that puniſhment ſhould extend is matter of conſiderable doubt.

By the Jewiſh law it was only puniſhed with a pecuniary fine, and ſatisfaction to the party injured; and in the civil law, till ſome very late conſtitutions, we never find the puniſhment capital. The laws of Draco at Athens puniſhed it with death: but his laws were ſaid to be written with blood; and Solon afterwards changed the penalty to a pecuniary mulct. And ſo the Attic laws in general continued; except that once, in a time of dearth, it was made capital to break into a garden and ſteal figs: but this law, and the informers againſt the offence, grew ſo odious, that from them all malicious informers were ſtyled *ſycophants*; a name which we have much perverted from its original meaning. From theſe examples, as well as the reaſon of the thing, many learned and ſcrupulous men have queſtioned the propriety, if not lawfulneſs, of inflicting capital puniſhment for ſimple theft. And certainly the natural puniſhment for injuries to property ſeems to be the loſs of the offender's own property; which ought to be univerſally the caſe, were all mens fortunes equal. But as thoſe who have no property themſelves are generally the moſt ready to attack the property of others, it has been found neceſſary, inſtead of a pecuniary, to ſubſtitute a corporal puniſhment; yet how far this corporal puniſhment ought to extend, is what has occaſioned the doubt. Sir Thomas More and the Marquis Beccaria, at the diſtance of more than two centuries, have very ſenſibly propoſed that kind of corporal puniſhment which approaches the neareſt to a pecuniary ſatiſfaction, viz. a temporary impriſonment, with an obligation to labour, firſt for the party robbed, and afterwards for the public, in works of the moſt ſlaviſh kind; in order to oblige the offender to repair, by his induſtry and diligence, the depredations he has committed upon private property and public order. But, notwithſtanding all the remonſtrances of ſpeculative politicians and moraliſts, the puniſhment of theft ſtill continues throughout the greateſt part of Europe to be capital: and Puffendorf, together with Sir Matthew Hale, are of opinion that this muſt always be referred to the prudence of the legiſlature; who are to judge, ſay they, when crimes are become ſo enormous as to require ſuch ſanguinary reſtrictions. Yet both theſe writers agree, that ſuch puniſhment ſhould be cautiouſly inflicted, and never without the utmoſt neceſſity.

Theft.

The Anglo Saxon laws nominally puniſhed theft with death, if above the value of twelvepence: but the criminal was permitted to redeem his life by a pecuniary ranſom; as, among their anceſtors the Germans, by a ſtated number of cattle. But in the 9th year of Henry I. this power of redemption was taken away, and all perſons guilty of larceny above the value of twelvepence were directed to be hanged; which law continues in force to this day. For though the inferior ſpecies of theft, or petit larceny, is only puniſhed by whipping at common law, or (by ſtat. 4 Geo. I. c. 11.) may be extended to tranſportation for ſeven years, as is alſo expreſsly directed in the caſe of the Plate-glaſs Company; yet the puniſhment of grand larceny, or the ſtealing above the value of twelvepence (which ſum was the ſtandard in the time of king Athelſtan, 800 years ago), is at common law regularly death; which, conſidering the great intermediate alteration in the price or denomination of money, is undoubtedly a very rigorous conſtitution; and made Sir Henry Spelman (above a century ſince, when money was at twice its preſent rate) complain, that while every thing elſe was riſen in its nominal value, and become dearer, the life of man had continually grown cheaper. It is true, that the mercy of juries will often make them ſtrain a point, and bring in larceny to be under the value of twelvepence, when it is really of much greater value: but this, though evidently juſtifiable and proper when it only reduces the preſent nominal value of money to the ancient ſtandard, is otherwiſe a kind of pious perjury, and does not at all excuſe our common law in this reſpect from the imputation of ſeverity, but rather ſtrongly confeſſes the charge. It is likewiſe true, that by the merciful extenſions of the benefit of clergy by our modern ſtatute law, a perſon who commits a ſimple larceny to the value of thirteen pence or thirteen hundred pounds, though guilty of a capital offence, ſhall be excuſed the pains of death; but this is only for the firſt offence. And in many caſes of ſimple larceny the benefit of clergy is taken away by ſtatute: as from horſe-ſtealing in the principals and acceſſaries both *before* and *after* the fact; theft by great and notorious thieves in Northumberland and Cumberland; taking woollen cloth from off the tenters, or linens, fuſtians, calicoes, or cotton goods, from the place of manufacture (which extends, in the laſt caſe, to aiders, aſſiſters,

ſiſters, procurers, buyers, and receivers); feloniouſly driving away, or otherwiſe ſtealing one or more ſheep or other cattle ſpecified in the acts, or killing them with intent to ſteal the whole or any part of the carcaſe, or aiding or aſſiſting therein; thefts on navigable rivers above the value of forty ſhillings, or being preſent, aiding and aſſiſting thereat; plundering veſſels in diſtreſs, or that have ſuffered ſhipwreck; ſtealing letters ſent by the poſt; and alſo ſtealing deer, hares, and conies, under the peculiar circumſtances mentioned in the Waltham black act. Which additional ſeverity is owing to the great malice and miſchief of the theft in ſome of theſe inſtances; and, in others, to the difficulties men would otherwiſe lie under to preſerve thoſe goods, which are ſo eaſily carried off. Upon which laſt principle the Roman law puniſhed more ſeverely than other thieves the *Abigei* or ſtealers of cattle, and the *Balnearii* or ſuch as ſtole the clothes of perſons who were waſhing in the public baths; both which conſtitutions ſeem to be borrowed from the laws of Athens. And, ſo too, the ancient Goths puniſhed with unrelenting ſeverity thefts of cattle, or of corn that was reaped and left in the field: ſuch kind of property (which no human induſtry can ſufficiently guard) being eſteemed under the peculiar cuſtody of heaven.

Theft-Bote (from the Saxon *theoſ*, i. e. *fur*, and *bote*, *compenſatis)*, is the receiving of a man's goods again from a thief, after ſtolen, or other amends not to proſecute the felon, and to the intent the thief may eſcape; which is an offence puniſhable with fine and impriſonment, &c.

THELIGONUM, in botany: A genus of plants belonging to the claſs of *monœcia*, and order of *polyandria*; and in the natural ſyſtem ranging under the 53d order, *Scabridæ*. The male calyx is bifid; there is no corolla; the ſtamina are generally 12. The female calyx is alſo bifid; there is no corolla; only one piſtil; the capſule is coriaceous, unilocular, and monoſpermous. There is only one ſpecies, the *Cynocrambe*, which is indigenous in the ſouth of Europe.

THEME, denotes the ſubject of an excerciſe for young ſtudents to write or compoſe on.

THEMISON, a phyſician of Laodicea, a diſciple of Aſclepiades. He founded the methodic ſect, with a view to the more eaſily teaching and practiſing the art of medicine. (See MEDICINE, n° 37). Themiſon gave the firſt account of diacodium, which was prepared of the juice and decoction of poppy-heads and honey. He invented a purging medicine called *heira*.

THEMISTIUS, an ancient Greek orator and philoſopher, a native of Paphlagonia, who flouriſhed in the 4th century. He had great intereſt and favour with the emperors in his time, and though a heathen, was of a very tolerating ſpirit. He taught for many years at Conſtantinople, of which city he was made præfect by Julian and Theodoſius; and lived to be exceeding old. More than 30 of his orations are ſtill extant, beſides commentaries on ſeveral parts of Ariſtotle's works.

THEMISTOCLES, the renowned Athenian admiral, general, and patriot, who gained the battle of Salamis againſt the Perſians. Being baniſhed his country by his ungrateful fellow-citizens, he fled to Artaxerxes king of Perſia: but, in order to avoid taking up arms againſt his country, he ſlew himſelf, 464 B. C. See ATTICA, n° 76, *et ſeq.*

THEOBALD (Lewis), the ſon of an attorney at Sittingbourn in Kent, was a well-known writer and critic in the early part of the preſent century. He engaged in a paper called the *Cenſor*, publiſhed in Miſt's Journal, wherein, by delivering his opinions with too little reſerve concerning ſome eminent wits, he expoſed himſelf to their reſentment. Upon the publication of Pope's Homer, he praiſed it in terms of extravagant admiration, yet afterwards thought proper to abuſe it as earneſtly; for which Pope at firſt made him the hero of his Dunciad, though he afterward laid him aſide for another. Mr Theobald not only expoſed himſelf to the laſhes of Pope, but waged war with Mr Dennis, who treated him more roughly, though with leſs ſatire. He nevertheleſs publiſhed an edition of Shakeſpeare, in which he corrected, with great pains and ingenuity, many faults that had crept into that poet's writings. This edition is ſtill in great eſteem; being in general preferred to thoſe publiſhed by Pope, Warburton, and Hanmer. He alſo wrote ſome plays, and tranſlated others from the ancients.

THEOBROMA, in botany: A genus of plants belonging to the claſs of *polyadelphia*, and order of *pentandria*; and in the natural ſyſtem ranging under the 37th order, *Columniferæ*. The calyx is triphyllous; the petals, which are five in number, are vaulted and two-horned; the nectarium is pentaphyllous and regular; the ſtamina grow from the nectarium, each having five antheræ. There are three ſpecies; the *cacao*, *guazuma*, and *anguſta*.

London Medical Journal, vol. viii.

The *cacao*, or chocolate tree, we ſhall deſcribe in the words of Dr Wright: "In all the French and Spaniſh iſlands and ſettlements in the warmer parts of America, the chocolate tree is carefully cultivated. This was formerly the caſe alſo in Jamaica; but at preſent we have only a few ſtraggling trees left as monuments of our indolence and bad policy.

"This tree delights in ſhady places and deep vallies. It is ſeldom above 20 feet high. The leaves are oblong, large, and pointed. The flowers ſpring from the trunk and large branches; they are ſmall, and pale red. The pods are oval and pointed. The ſeeds or nuts are numerous, and curiouſly ſtowed in a white pithy ſubſtance.

"The cocoa nuts being gently parched in an iron pot over the fire, the external covering ſeparates eaſily. The kernel is levigated on a ſmooth ſtone; a little arnotto is added, and with a few drops of water is reduced to a maſs, and formed into rolls of one pound each. This ſimple preparation is the moſt natural, and the beſt. It is in daily uſe in moſt families in Jamaica, and ſeems well adapted for rearing of children." See CHOCOLATE.

THEOCRACY, in matters of government, a ſtate governed by the immediate direction of God alone: ſuch was the ancient government of the Jews before the time of Saul.

THEOCRITUS, the father of paſtoral poetry, was born at Syracuſe in Sicily. Two of his poems aſcertain his age; one addreſſed to Hiero king of Syracuſe, who began his reign about 275 years before Chriſt; and the other to Ptolemy Philadelphus king of Egypt. Hiero, though a prince diſtinguiſhed in arms and political wiſdom, does not ſeem to have been a patron of learning. This is ſuppoſed to have given birth to the 16th Idyllium. From Syracuſe Theocritus went to Alexandria, where he ſeems to have found a munificent patron in Ptolemy Philadelphus, if we may judge from the panegyric which he compoſed on that prince (the 17th Idyllium). It has been ſaid that Theocritus was ſtrangled by Hiero, but we have not found evidence of this.

The compoſitions of this poet are diſtinguiſhed, among the ancients, by the name of *Idylliums*, in order to expreſs the ſmallneſs and variety of their natures: they would now be called *Miſcellanies*, or *Poems on ſeveral Occaſions*. The firſt nine and the eleventh are confeſſed to be true paſtorals, and hence Theocritus has uſually paſſed for nothing more than a paſtoral poet; yet he is manifeſtly robbed of a great part of his fame, if his other poems have not their proper laurels. For though the greater part of his Idylliums cannot be called the ſongs of ſhepherds, yet they have certainly their reſpective merits. His paſtorals ought to be conſidered as the foundation of his credit; upon this claim he will be admitted for the finiſher as well as the inventor of his art, and will be acknowledged to have excelled all his imitators as much as originals uſually do their copies.

The works of this poet were firſt publiſhed in folio by Aldus Manutius at Venice in 1495. A more elegant and correct edition was printed by Henry Stephens at Paris in 1566. An edition was publiſhed at Leipſic in 1765, with valuable notes by the learned Reiſke. But what will moſt highly gratify the admirers of paſtoral poetry, is an edition publiſhed in 1770, 2 vols 4to, by Mr Thomas Wharton. It is accompanied by the ſcholia of the beſt editors, and the different readings of 15 MSS.

THEODOLITE, a mathematical inſtrument for meaſuring heights and diſtances. See GEOMETRY, p. 679.

THEODORE, king of Corſica, baron Nieuhoff in the county of La Marc in Weſtphalia. He had his education in the French ſervice, and afterwards went to Spain, where he received ſome marks of regard from the duke of Riperda and cardinal Alberoni; but being of an unſettled diſpoſition, he quitted Spain, and travelled into Italy, England, and Holland, in ſearch of ſome new adventure. He at laſt fixed his attention on Corſica, and formed the ſcheme of rendering himſelf ſovereign of that iſland. He was a man of abilities and addreſs; and having fully informed himſelf of every thing relating to Corſica, went to Tunis, where he fell upon means to procure ſome money and arms; and then went to Leghorn, from whence he wrote a letter to the Corſican chiefs Giafferi and Paoli, offering conſiderable aſſiſtance to the nation if they would elect him as their ſovereign. This letter was conſigned to Count Domenico Rivarola, who acted as Corſican plenipotentiary in Tuſcany; and he gave for anſwer, that if Theodore brought the aſſiſtance he promiſed to the Corſicans, they would very willingly make him king.

Upon this he, without loſs of time, ſet ſail, and landed at Tavagna in the ſpring of the year 1736. He was a man of a very ſtately appearance, and the Turkiſh dreſs he wore added to the dignity of his mien. He had a few attendants with him; and his manners were ſo engaging, and his offers ſo plauſible, that he was proclaimed king of Corſica before Count Rivarola's diſpatches arrived to inform the chiefs of the terms upon which he had agreed. He brought with him about 1000 zequins of Tunis, beſide ſome arms and ammunition, and made magnificent promiſes of foreign aſſiſtance; whence the Corſicans, who were glad of any ſupport, willingly gave into his ſchemes. Theodore inſtantly aſſumed every mark of royal dignity. He had his guards and his officers of ſtate; he conferred titles of honour, and ſtruck money both of ſilver and copper. The ſilver pieces were few in number, and can now hardly be met with; the copper coins have on one ſide T. R. that is, "Theodorus Rex," with a double branch croſſed, and round it this inſcription, PRO BONO PUBLICO RE. CO. that is, "For the public good of the kingdom of Corſica:" on the other ſide is the value of the piece; *Cinque ſolidi*, or five ſous.

The Genoeſe were not a little confounded with this unexpected adventurer. They publiſhed a violent manifeſto againſt Theodore, treating him with great contempt; but at the ſame time ſhowing they were alarmed at his appearance. Theodore replied, in a manifeſto, with all the calmneſs and dignity of a monarch; but after being about eight months in Corſica, perceiving that the people began to cool in their affections towards him, he aſſembled his chiefs, and declared he would keep them no longer in a ſtate of uncertainty, being determined to ſeek in perſon the ſupport he ſo long expected. He ſettled an adminiſtration during his abſence, recommended unity in the ſtrongeſt terms, and left the iſland with reciprocal aſſurances of fidelity and affection. He went to Holland, where he was ſo ſucceſsful as to obtain credit from ſeveral rich merchants, particularly Jews, who truſted him with cannon and other warlike ſtores to a great value, under the charge of a ſupercargo. With theſe he returned to Corſica in 1739; but by this time the French, as auxiliaries to the Genoeſe, had become ſo powerful in the iſland, that though Theodore threw in his ſupply of warlike ſtores, he did not incline to venture his perſon, the Genoeſe having ſet a high price on his head. He therefore again departed; and after many unavailing attempts to recover his crown, at length choſe for retirement a country where he might enjoy the participation of that liberty which he had ſo vainly endeavoured to give his Corſicans; but his ſituation in England by degrees grew wretched, and he was reduced ſo low as to be ſeveral years before his death a priſoner for debt in the King's Bench. At length, to the honour of ſome gentlemen of rank, a charitable contribution was ſet on foot for him in the year 1753. Mr Boſwell obſerves, that Mr Horace Walpole generouſly exerted himſelf for the unhappy Theodore, and wrote a paper in *The World* with great elegance and humour, ſoliciting a contribution for the unhappy monarch in diſtreſs, to be paid to Mr Robert Dodſley bookſeller, as lord high treaſurer. This brought him a very handſome ſum, and he was ſet at liberty. That gentleman adds, that Mr Walpole has the original deed, by which Theodore made over the kingdom of Corſica in ſecurity to his creditors, and that he has alſo the great ſeal of the kingdom. Theodore died in 1756, and was buried in St Anne's churchyard, Weſtminſter; where, in 1757, a ſimple unadorned monument of marble was erected to his memory by a gentleman, with an inſcription; which, after mentioning ſome of the above particulars, concludes with the following lines:

> The grave, great teacher, to a level brings
> Heroes and beggars, galley-ſlaves and kings;
> But Theodore this moral learn'd ere dead,
> Fate pour'd its leſſon on his living head,
> Beſtow'd a kingdom and deny'd him bread.

Theodore left a ſon, who was an accompliſhed gentleman.

THEODORET, biſhop of St Cyricus in Syria, in the 4th century, and one of the moſt learned fathers of the church, was born in the year 386, and was the diſciple of Theodorus Mopſueſtia and St John Chryſoſtom. Having received holy orders, he was with difficulty perſuaded to accept of the biſhopric of St Cyricus, about the year 420. He diſcovered great frugality in the expences of his table, dreſs, and furniture, but ſpent conſiderable ſums in improving and adorning the city of Cyricus. He erected two large bridges, public baths, fountains, and aqueducts, and laboured with great zeal and ſucceſs in his dioceſe. Yet his zeal was not confined to his own church: he went to preach at Antioch and the neighbouring towns; where he became admired for his eloquence and learning, and had the happineſs to convert multitudes of people. He wrote in favour of John of Antioch and the Neſtorians, againſt Cyril's Twelve Anathemas: he afterwards attacked the opinions of Neſtorius, and was depoſed in the ſynod held by the Eutychians at Epheſus; but was again reſtored by the general council of Chalcedon, in which he was preſent, in 451. It is thought that he died ſoon after; though others ſay that he lived till the year 457. There are ſtill extant Theodoret's excellent Commentary on St Paul's Epiſtles, and on ſeveral other books of the Holy Scriptures. 2. His Eccleſiaſtical Hiſtory from the time of Arius to Theodoſius the Younger. 3. The hiſtory of the famous Anchorites of his time. 4. Epiſtles. 5. Diſcourſes on Providence. And, 6. An excellent treatiſe againſt the Pagans, intitled, *De Curandis Græcorum Affectibus ;* and other works. The beſt edition of all which is that of Father Sirmond in Greek and Latin, in 4 vols. folio.

THEODOSIUS I. called the *Great*, was a native of Spain. The valour he had ſhown, and the great ſervices he had done to the empire, made Gratian, attacked by the Goths and Germans, to admit him as a partner in the government. He received the purple in 379, aged 43. See CONSTANTINOPLE, n° 77—88.

THEOGONY, formed from Θεος *God*, and γονη *genitura*, "ſeed, offſpring," that branch of the heathen theology which taught the genealogy of their gods.

Heſiod gives us the ancient theogony, in a poem under that title. Among the moſt ancient writers, Dr Burnet obſerves, that theogony and coſmogony ſignified the ſame thing. In effect, the generation of the gods of the ancient Perſians, fire, water, and earth, is apparently no other than that of the primary elements.

THEOGNIS, an ancient Greek poet of Megara in Achaia, flouriſhed about the 59th Olympiad, 144 B. C. We have a moral work of his extant, containing a ſummary of precepts and reflections, uſually to be found in the collections of the Greek minor poets.

THEOLOGY

1 Definition.

IS a Greek word (θεολογια), and ſignifies that ſcience which treats of the being and attributes of God, his relations to us, the diſpenſations of his providence, his will with reſpect to our actions, and his purpoſes with reſpect to our end. The word was firſt uſed to denote the ſyſtems, or rather the heterogeneous fables, of thoſe poets and philoſophers who wrote of the genealogy and exploits of the gods of Greece. Hence Orpheus, Muſeus, Heſiod, Pherecydes, and Pythagoras, were called *theologians ;* and the ſame epithet was given to Plato, on account of his ſublime ſpeculations on the ſame ſubject. It was afterwards adopted by the earlieſt writers of the Chriſtian church, who ſtyled the author of the apocalypſe, by way of eminence, ὁ θεολογος, the *Divine*.

Although every pagan nation of antiquity had ſome tutelary deities peculiar to itſelf, they may yet be conſidered as having all had the ſame theology, ſince an intercommunity of gods was univerſally admitted, and the heavenly bodies were adored as the *dii majorum gentium* over the whole earth. This being the caſe, we are happily relieved from treating, in the ſame article, of the truths of Chriſtianity and the fictions of paganiſm, as we have elſewhere traced idolatry from its ſource, and ſhewn by what means "the fooliſh hearts of men became ſo darkened that they changed the glory of the incorruptible God into an image made like to corruptible man, and to birds, and four-footed beaſts, and creeping things." See POLYTHEISM.

2 Chriſtian theology,

The abſurdities and inconſiſtency of the pretended revelation of the Arabian impoſtor have been ſufficiently expoſed under the words ALCORAN and MAHOMETANISM ; ſo that the only theology of which we have to treat at preſent is *Chriſtian* theology, which comprehends that which is commonly called *natural*, and that which is *revealed* in the ſcriptures of the Old and New Teſtaments. Theſe taken together, and they ought never to be ſeparated, compoſe a body of ſcience ſo important, that in compariſon with it all other ſciences ſink into inſignificance ; for without a competent knowledge of the attributes of God, of the ſeveral relations in which he ſtands to us, and of the ends for which we were created, it is obvious that we muſt wander through life like men groping in the dark, ſtrangers to the road on which we are travelling, as well as to the fate awaiting us at the end of our journey.

3 To be ſtudied carefully by thoſe intended for the ſervice of the church.

But if this knowledge be neceſſary to all Chriſtians, it is doubly ſo to thoſe who are appointed to feed the flock of Chriſt, and to teach the ignorant what they are to believe, and what to do, in order to work out their own ſalvation. The wiſdom and piety of our anceſtors have accordingly founded profeſſorſhips of theology in all our univerſities, where the principles of our religion are taught in a ſyſtematic and ſcientific manner ; and the church has ordained, that no man ſhall be admitted to the office of a preacher of the goſpel who has not attended a regular courſe of ſuch theological lectures.

4 Previous knowledge requiſite for the proſecution of this ſtudy.

It muſt not, however, be ſuppoſed, that, by merely liſtening to a courſe of lectures however able, any man will become an accompliſhed divine. The principles of this ſcience are to be found only in the word and works of God ; and he who would extract them pure and unſophiſticated, muſt dig for them himſelf in that exhauſtleſs mine. To fit a man for this important inveſtigation, much previous knowledge is requiſite. He muſt ſtudy the works of God ſcientifically before he can perceive the full force of that teſtimony which they bear to the power, the wiſdom, and the goodneſs of their author. Hence the neceſſity of a general acquaintance with the phyſical and mathematical ſciences before a man enter upon the proper ſtudy of theology, for he will not otherwiſe obtain juſt and enlarged conceptions of the God of the univerſe. See PHYSICS, n° 115.

But an acquaintance with the phyſical and mathematical ſciences is not alone a ſufficient preparation for the ſtudy of theology. Indeed it is poſſible for a man to devote himſelf ſo wholly to any of theſe ſciences, as to make it counteract the only purpoſes for which it can be valuable to the divine ; for he who is conſtantly immerſed in matter, is apt to ſuſpect that there is no other ſubſtance ; and he who is habituated to the routine of geometrical demonſtration, becomes in time incapable of reaſoning at large, and eſtimating the force of the various degrees of moral evidence. To avert theſe untoward conſequences, every man, before he enters upon the ſtudy of that ſcience which is the ſubject of the preſent article, ſhould make himſelf acquainted with the principles of logic, the ſeveral powers of the human mind, and the different ſources of evidence ; in doing which he will find the greateſt aſſiſtance from Bacon's *Novum Organum*, Locke's *Eſſay on the Human Underſtanding*, Reid's *Eſſays on the Intellectual and Active Powers of Man*, and Tatham's *Chart and Scale of Truth*. Theſe works, of which the young ſtudent ought to make himſelf maſter, will teach him to think juſtly, and guard him againſt a thouſand errors, which thoſe who have not laid ſuch a foundation are apt to embrace as the truths of God.

The man who propoſes to ſtudy theology ought to have it in view, as the ultimate end of his labours, to impart to others that knowledge which he may procure for himſelf. "Amongſt the many marks which diſtinguiſh the *Chriſtian* philoſopher from the *Pagan*, this (ſays a learned writer*) is one of the moſt ſtriking—the *Pagan* ſought knowledge in a ſelfiſh way, to ſecrete it for his own uſe ; the *Chriſtian* ſeeks it with the generous purpoſe (firſt in view, though laſt in execution) to impart it to others. The Pagan philoſopher, therefore, having cultivated the *art of thinking*, proceeds to that of *ſpeaking*, in order to diſplay his vanity in the dexterous uſe of deceit. On the other hand, the *Chriſtian philoſopher* cultivates the *art of ſpeaking*, for the ſole purpoſe of diſſeminating the truth in his office of preacher of the goſpel."

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* Warburton.

As every man, before he enters upon the proper ſtudy of theology, receives, at leaſt in this country, the rudiments of a liberal education, it may perhaps be ſuperfluous to mention here any books as peculiarly proper to teach him the art of ſpeaking: we cannot however forbear to recommend to our ſtudent the attentive peruſal of Quintilian's *Inſtitutions*, and Dr Blair's *Lectures on Rhetoric and the Belles Lettres*. A familiar acquaintance with theſe works will enable him, if he be endowed by nature with talents fit for the office in which he propoſes to engage, to expreſs his thoughts with correctneſs and elegance; "without which, it has been well obſerved, that ſcience, eſpecially in a clergyman, is but learned lumber, a burden to the owner, and a nuiſance to every body elſe."

No man can proceed thus far in the purſuits of general ſcience without having been at leaſt initiated in the learned languages; but he who intends to make theology his profeſſion ſhould devote himſelf more particularly to the ſtudy of Greek and Hebrew, becauſe in theſe tongues the original ſcriptures are written. By this we do not mean to inſinuate that it is neceſſary for the man whoſe views aſpire no farther than to the office of paſtor of a Chriſtian congregation, to make himſelf a profound critic in either of theſe ancient languages. The time requiſite for this purpoſe is ſo long, that it would leave very little for other ſtudies of infinitely more importance to him, whoſe proper buſineſs it is to inſtruct the ignorant in thoſe plain and ſimple truths which are ſufficient to guide all men in the way to ſalvation. Still, however, it is obvious, that he who is incapable of conſulting the original ſcriptures, muſt reſt his faith, not upon the ſure foundation of the word of God, but upon the credit of fallible tranſlators; and if he be at any time called upon to vindicate revelation againſt the ſcoffs of infidelity, he will have to ſtruggle with many difficulties which are eaſily ſolved by him who is maſter of the original tongues.

5 Cautions to be obſerved in attending the lectures of a profeſſor.

The ſtudent having laid in this ſtock of preparatory knowledge, is now qualified to attend with advantage the theological lectures of a learned profeſſor; but in doing this, he ſhould be very careful neither to admit nor reject any thing upon the bare authority of his maſter. Right principles in theology are of the utmoſt importance, and can reſt upon no authority inferior to that of the word of God. On this account we have long been of opinion, that a profeſſor cannot render his pupils ſo much ſervice by a ſyſtematical courſe of lectures, as by directing their ſtudies, and pointing out the road in which they may themſelves arrive in the ſhorteſt time at the genuine ſenſe of the ſacred ſcriptures. In this opinion we have the honour to agree with the ableſt lecturer § in theology that we have ever heard. The authors of all ſyſtems are more or leſs prejudiced in behalf of ſome particular and artificial mode of faith. He, therefore, who begins with the ſtudy of them, and afterwards proceeds to the ſacred volume, ſees with a jaundiced eye every text ſupporting the particular tenets of his firſt maſter, and acts as abſurd a part as he who tries not the gold by the copel, but the copel by the gold. Before our young divine, therefore, ſit down to the ſerious peruſal of any one of thoſe *inſtitutes* or *bodies of theology* which abound in all languages, and even before he read that which the nature of our work compels us to lay before him, we beg leave, with the utmoſt deference to the ſuperior judgment of our more learned readers, to recommend to his conſideration the following

Preliminary Directions.

§ The late Dr Campbell of Aberdeen.

Preliminary Directions for the Study of Theology.

Chriſtian theology divided into two great parts.

Christian theology is divided into two great parts, *natural* and *revealed;* the former comprehending that which may be known of God from the creation of the world, even his eternal power and Godhead; the latter, that which is diſcovered to man nowhere but in the ſacred volume of the Old and New Teſtaments.

7 Firſt principles of theology communicated

Concerning the extent of natural theology many opinions have been formed, whilſt ſome have contended that there is no ſuch thing. Into theſe diſputes we mean not at preſent to enter. We believe that one of them could have had no exiſtence among ſober and enlightened men, had the contending parties been at due pains to define with accuracy the terms which they uſed. Whatever be the origin of religion, which we have endeavoured to aſcertain elſewhere (ſee Religion, n° 6—17.), it is obvious, that no man can receive a written book as the word of God till he be convinced by ſome other means that God exiſts, and that he is a Being of power, wiſdom, and goodneſs, who watches over the conduct of his creature man. If the progenitor of the human race was inſtructed in the principles of religion by the Author of his being (a fact of which it is difficult to conceive how a conſiſtent theiſt can entertain a doubt), he might communicate to his children, by natural means, much of that knowledge which he himſelf could not have diſcovered had he not been ſupernaturally enlightened. Between illuſtrating or proving a truth which is already talked of, and making a diſcovery of what is wholly unknown, every one perceives that there is an immenſe difference (A).

8 To the earlieſt mortals by repeated revelations.

To beings whoſe natural knowledge originates wholly from ſenſation, and whoſe minds cannot, but by much diſcipline, advance from ſenſe to ſcience, a long ſeries of revelations might be neceſſary to give them at firſt juſt notions of God and his attributes, and to enable them to perceive the

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(A) The diſcriminating powers of Ariſtotle will not be queſtioned; and in the following extract made by Cicero from ſome of his works which are now loſt, he expreſſes our ſentiments on this important ſubject with his uſual preciſion: ——"Præclare ergo Ariſtoteles, SI ESSENT, inquit, qui ſub terra ſemper habitaviſſent, bonis, et illuſtribus domiciliis, quæ eſſent ornata ſignis atque picturis, inſtructaque rebus iis omnibus, quibus abundant ii, qui beati putantur, nec tamen exiſſent unquam ſupra terram: ACCEPISSENT AUTEM FAMA ET AUDITIONE, ESSE QUODDAM NUMEN, ET VIM DEORUM; deinde aliquo tempore, patefactis terræ faucibus, ex illis abditis ſedibus evadere in hæc loca, quæ nos incolimus, atque exire potuiſſent: cum repente terram, et maria, cœlumque vidiſſent: nubium magnitudinem, ventorumque vim cognoviſſent, adſpexiſſentque ſolem, ejuſque tum magnitudinem, pulchritudinemque, tum etiam efficientiam cognoviſſent, quod is diem efficeret, toto cœlo luce diffuſa: cum autem terras nox opacaſſet, tum cœlum totum cernerent aſtris diſtinctum et ornatum, lunæque luminum varietatem tum creſcentis, tum ſeneſcentis, eorumque omnium ortus et occaſus, atque in omni æternitate ratos, immutabileſque curſus: hæc cum viderent, PROFECTO ET ESSE DEOS, et HÆC TANTA OPERA DEORUM ESSE arbitrarentur." *De Nat. Deorum*, lib. ii. § 37.

From

the relation between the effect and its cauſe, ſo as to infer by the powers of their own reaſon the exiſtence of the Creator from the preſence of his creatures. Such revelations, however, could be ſatisfactory only to thoſe who immediately received them. Whenever the Deity has been pleaſed by ſupernatural means to communicate any information to man, we may be ſure that he has taken effectual care to ſatisfy the perſon ſo highly favoured that his underſtanding was not under the influence of any illuſion; but ſuch a perſon could not communicate to another the knowledge which he had thus received by any other means than an addreſs to his rational faculties. No man can be required to believe, no man indeed can believe, without proof, that another, who has no more faculties either of ſenſation or intellect than himſelf, has obtained information from a ſource to which he has no poſſible acceſs. An appeal to miracles would in this caſe ſerve no purpoſe; for we muſt believe in the exiſtence, power, wiſdom, and juſtice, of God, before a miracle can be admitted as evidence of any thing but the power of him by whom it is performed. See MIRACLE.

9
And yet may be properly termed natural principles.

It is therefore undeniable that there are ſome principles of theology which may be called *natural*; for though it is in the higheſt degree probable that the parents of mankind received all their theological knowledge by *ſupernatural* means, it is yet obvious that ſome parts of that knowledge muſt have been capable of a proof purely rational, otherwiſe not a ſingle religious truth could have been conveyed through the ſucceeding generations of the human race but by the immediate inſpiration of each individual. We indeed admit many propoſitions as certainly true, upon the ſole authority of the Jewiſh and Chriſtian ſcriptures, and we receive theſe ſcriptures with gratitude as the lively oracles of God; but it is ſelf-evident that we could not do either the one or the other, were we not convinced by natural means that God exiſts, that he is a Being of goodneſs, juſtice, and power, and that he inſpired with divine wiſdom the penmen of theſe ſacred volumes. Now, though it is very poſſible that no man or body of men, left to themſelves from infancy in a deſert world, would ever have made a theological diſcovery; yet whatever propoſitions relating to the being and attributes of the firſt cauſe and the duty of man, can be demonſtrated by human reaſon, independent of written revelation, may be called *natural theology*, and are of the utmoſt importance, as being to us the firſt principles of all religion. Natural theology, in this ſenſe of the word, is the foundation of the Chriſtian revelation; for without a previous knowledge of it, we could have no evidence that the ſcriptures of the Old and New Teſtaments are indeed the word of God.

10
Natural theology to be ſtudied before the doctrines of revelation.

Our young divine, therefore, in the regular order of his ſtudies, ought to make himſelf maſter of *natural theology* before he enter upon the important taſk of ſearching the ſcriptures. On this ſubject many books have been publiſhed in our own and other languages; but perhaps there is none more worthy of attention than the Religion of Nature delineated by Mr. Wollaſton (B). It is a work of great merit, and bears ample teſtimony to its author's learning and acuteneſs: yet we think it ought to be read with caution. Mr. Wollaſton's theory of moral obligation is fanciful and groundleſs; and whilſt we readily acknowledge that he demonſtrates many truths with elegance and perſpicuity, we cannot deny that he attempts a proof of others, for which we believe no other evidence can be brought than the declarations of Chriſt and his apoſtles in the holy ſcriptures. To ſupply the defects of his theory of morals, we would recommend to the ſtudent an attentive peruſal of Cumberland on the Law of Nature, and Paley's Elements of Moral Philoſophy. A learned author * affirms of Cumberland, that "he excels all men in fixing the true grounds of moral obligation, out of which natural law and natural religion both ariſe;" and we have ourſelves never read a work in which the various duties which a man owes to his Maker, himſelf, and his fellow-creatures, are more accurately ſtated or placed on a ſurer baſis than in the moral treatiſe of the archdeacon of Carliſle.

11
Books recommended.

* Warburton.

As Wollaſton demonſtrates with great perſpicuity, and to the abſolute conviction of every man capable of feeling the force of argument, the being and many of the attributes of God, it may perhaps appear ſuperfluous to recommend any other book on that ſubject. The preſent age, however, having among other wonderful phenomena, witneſſed a revival of the monſter *Atheiſm*, we would adviſe our ſtudent to read with much attention Cudworth's Intellectual Syſtem, and to read it rather in Moſheim's Latin tranſlation than in the author's original Engliſh. In the original, though many authors are quoted that are now but little known, there are very few references to the book, or chapter, or ſection, from which the quotations are taken. Theſe omiſſions are ſupplied by the tranſlator, who has likewiſe enriched his edition with many valuable and learned notes. It is well known that Cudworth wrote his incomparable work in confutation of Hobbes's philoſophy; but inſtead of confining himſelf to the whimſies of his antagoniſt, which were in a little time to ſink into oblivion, he took a much wider range, and traced atheiſm through all the mazes of antiquity, expoſing the weakneſs of every argument by which ſuch an abſurdity had ever been maintained. In exhauſting the metaphyſical queſtions agitated among the Greeks concerning the being and perfections of God, he has not only given us a complete hiſtory of ancient learning, as far as it relates to theſe inquiries, but has in fact anticipated moſt of the ſophiſms of our modern atheiſts, who are by

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From this paſſage it is evident, that the Stagyrite, though he conſidered the motions of the heavenly bodies, the ebbing and flowing of the ſea, and the other phenomena of nature, as affording a complete *proof* of the being and providence of God, did not however ſuppoſe that from theſe phenomena an untaught barbarian would *diſcover* this fundamental principle of religion. On the contrary, he expreſsly affirms, that before a man can feel the force of the evidence which they give of this important truth, he muſt have HEARD of the exiſtence and power of God.

(B) It may not be improper to inform the reader, that Mr Wollaſton, the author of the Religion of Nature, was a different man from Mr Woolſton, who blaſphemed the miracles of our Saviour. The former was a clergyman of great piety, and of ſuch moderate ambition as to refuſe one of the higheſt preferments in the church of England when it was offered to him; the latter was a layman remarkable for nothing but gloomy infidelity, and a perverſe deſire to deprive the wretched of every ſource of comfort. In the mind of the former, philoſophy and devotion were happily united; in the mind of the latter, there was neither devotion nor ſcience. Yet theſe writers have been frequently confounded; ſometimes through inadvertence from the ſimilarity of their names; and ſometimes, we are afraid, deſignedly, from a weak and bigotted abhorrence of every ſyſtem of religion that pretends to have its foundation in reaſon and in the nature of things.

no means ſuch diſcoverers as they are ſuppoſed to be by their illiterate admirers.

12 How the ſcriptures are to be ſtudied.

The ſtudent having made himſelf maſter of natural theology, and carefully endeavoured to aſcertain its limits, is now prepared to enter upon the important taſk of ſearching the ſcriptures. In doing this, he ought to diveſt himſelf as much as poſſible of the prejudices of education in behalf of a particular ſyſtem of faith, and ſit down to the ſtudy of the ſacred volume as of a work to which he is an entire ſtranger. He ought firſt to read it as a moral hiſtory of facts and doctrines, beginning with the books of Moſes, and proceeding through the reſt, not in the order in which they are commonly publiſhed, but in that in which there is reaſon to believe they were written (ſee SCRIPTURES). If he be maſter of the Hebrew and Greek languages, he will doubtleſs prefer the original text to any verſion; and in this peruſal we would adviſe him to conſult no commentator, becauſe his object at preſent is not to ſtudy the doctrines contained in the bible, but merely to diſcover what are the ſubjects of which it treats. Many hiſtories of the bible have been written; and were we acquainted with a good one, we ſhould recommend it as a clue to direct the young divine's progreſs through the various books which compoſe the ſacred volume. Stackhouſe's hiſtory has been much applauded by ſome, and as much cenſured by others. It is not a work of which we can expreſs any high degree of approbation; but if read with attention, it may no doubt be uſeful as a guide to the ſeries of facts recorded in the ſcriptures. Between the Old and New Teſtaments there is a great chaſm in the hiſtory of the Jewiſh nation; but it is ſupplied in a very able and ſatisfactory manner by Dr Prideaux, whoſe *Old and New Teſtament* connected is one of the moſt valuable hiſtorical works in our own or any other language. Shuckford's *Sacred and Profane Hiſtory of the World connected* is likewiſe a work of merit, and may be read with advantage as throwing light upon many paſſages of the Old Teſtament: but this author is not entitled to the ſame confidence with Prideaux, as his learning was not ſo great, and his partialities ſeem to have been greater.

In thus making himſelf maſter of the hiſtory of the Old and New Teſtaments, the ſtudent will unavoidably acquire ſome general notion of the various doctrines which they contain. Theſe it will now be his buſineſs to ſtudy more particularly, to aſcertain the preciſe meaning of each, and to diſtinguiſh ſuch as relate to the whole human race, from thoſe in which Abraham and his poſterity were alone intereſted. He muſt therefore travel over the ſacred volume a ſecond time; and ſtill we would adviſe him to travel without a guide. From Walton's *Polyglote bible*, and the large collection called *Critici ſacri*, he may indeed derive much aſſiſtance in his endeavours to aſcertain the ſenſe of a difficult text; but we think he will do well to make little uſe of commentators and expoſitors, and ſtill leſs of ſyſtem-builders, till he has formed ſome opinions of his own reſpecting the leading doctrines of the Jewiſh and Chriſtian religions.

"Impreſſed (ſays an able writer) with an awful ſenſe of the importance of the ſacred volume, the philoſophical divine will ſhake off the bias of prejudices however formed, of opinions however ſanctioned, and of paſſions however conſtitutional, and bring to the ſtudy of it the advantage of a pure and impartial mind. Inſtead of waſting all his labour upon a number of minute and leſs ſignificant particulars, and of refining away plain and obvious ſenſe by the ſubtleties of a narrow and corroſive mind, his firſt object will be to inſtitute a theological inquiry into the general deſign of the written word; and from principles fully contained and fairly underſtood, to illuſtrate the true *nature* and *genius of the religious diſpenſation* in all its parts. He will mark the difference between the firſt and ſecond covenants, and obſerve the connection that ſubſiſts between them. He will trace the temporary economy of the *Old Teſtament*, and weigh the nature and intent of the *partial covenant* with the Jews; obſerving with aſtoniſhment how it was made introductory of better things to come: and he will follow it through the *law* and the *prophets* in its wonderful evolutions, till he ſee this vaſt and preparatory machine of providence crowned and completed in the eternal goſpel. This *New Teſtament*, the laſt and beſt part of the religious diſpenſation, he will purſue through the ſacred pages of that goſpel with redoubled attention; contemplating the divine foundation on which it claims to be built, the ſupernatural *means* by which it was executed, and the immortal end which it has in view.*"

In the courſe of this inquiry into the import of the ſacred volume, the ſtudent will pay particular attention to the circumſtances of the age and country in which its various writers reſpectively lived, and to the nature of the different *ſtyles*, *analogical* and *parabolical*, in which it is written. He will likewiſe keep in mind that God, whom it claims for its author, is the parent of truth, and that all his actions and diſpenſations muſt be conſiſtent with one another. He will therefore compare the different paſſages of the Old and New Teſtaments which relate to the ſame doctrine, or to the ſame event, reaſonably concluding that the bible muſt be the beſt interpreter of itſelf; and though the opinions which he thus forms may often be erroneous, they will ſeldom be dangerous errors, and may eaſily be corrected by mature reflection, or by conſulting approved authors who have treated before him of the various points which have been the ſubject of his ſtudies. Of this mode of proceeding one good conſequence will be, that, having from the ſacred ſcriptures formed a ſyſtem of theology for himſelf, he will afterwards ſtudy the ſyſtems of other men without any violent prejudices for or againſt them; he will be ſo much attached to his own opinions as not to relinquiſh them in obedience to mere human authority, at the ſame time that he will be ready to give them up when convinced that they are not well founded; and if he have read the ſcriptures to any good purpoſe, he will have acquired ſuch a love of truth as to embrace her wherever ſhe may be found, whether among Papiſts or Proteſtants, in the ſchool of Arminius or in that of Calvin.

13 Approved ſyſtems of divinity.

As we have ſuppoſed that every man, after having formed a theological ſyſtem of his own, will conſult the ſyſtems of others, it may perhaps be expected that we ſhould here recommend thoſe which, in our opinion, are moſt worthy of his attention. To do this, however, would, we apprehend, be a very ungracious interference with the rights of private judgment. It would be to arrogate to ourſelves a kind of authority to which, when aſſumed by others, we have cautioned our readers not to ſubmit. But leſt we ſhould be ſuſpected of wiſhing to bias the mind of the young ſtudent toward the ſhort ſyſtem which we are obliged to give, we ſhall juſt obſerve, that by the divines of what is called the *Arminian ſchool*, Epiſcopius's *Theologiæ Inſtitutiones* (c), Limborch's *Theologia Chriſtiana*, and Locke's *Reaſonableneſs*

* Tatham's Chart and Scale of Truth.

(c) There is, however, one chapter of this work which the majority of Arminians loudly condemn. Epiſcopius acknowledges ſonableneſs of Chriſtianity*, have long been held in the higheſt eſteem; whilſt the followers of Calvin have preferred the *Inſtitutiones* of their maſter, Turretine's *Inſtitutio Theologiæ Elencticæ*, and Gill's *Body of Divinity*. This laſt work, which was publiſhed in two vols 4to in 1769, has many merits and many defects. Its ſtyle is coarſe, impure, and tedious; and the author, who was a zealous antipædo baptiſt, and ſeems to have poſſeſſed very little ſcience, embraces every opportunity of introducing the diſcriminating tenets of his ſect: but his book is fraught with profound learning, breathes the ſpirit of piety, and may be read with advantage by every divine who has previouſly formed the outlines of a ſyſtem for himſelf.

14 Books recommended on the Moſaic diſpenſation.

As the Jewiſh and Chriſtian diſpenſations are cloſely linked together, being in truth but parts of one great whole, it is impoſſible to have an adequate notion of the latter without underſtanding the deſign of the former. Now, though the Moſaic religion is nowhere to be learned but in the Old Teſtament, it may be convenient for our ſtudent, after he has formed his own opinions of it from that ſacred ſource, to know what has been written on the ſubject by others. For illuſtrating the ritual law, a learned prelate warmly recommends the *Ductor Dubitantium* of Maimonides, and Spencer's book entitled *De Legibus Hebræorum Ritualibus*. Both works have undoubtedly great merit; but our young divine will do well to read along with them *Hermanni Witſii Ægyptiaca*, and Dr Woodward's Diſcourſe on the Worſhip of the Ancient Egyptians, communicated to the London Society of Antiquaries in 1775, where ſome of Spencer's notions are ſhortly and ably refuted. On the other parts of this diſpenſation, ſuch as the nature of its civil government; the rewards and puniſhments peculiar to it (D); its extraordinary adminiſtration by appointed agents, endowed with ſupernatural powers, and with the gifts of miracles and prophecy; the *double ſenſe* in which the latter is ſometimes involved; and the language conſequent to its nature and uſe—the reader will find much erudition and ingenuity diſplayed in the ſecond part of Warburton's *Divine Legation of Moſes demonſtrated*. His Lordſhip indeed is ſuppoſed by many, and perhaps juſtly, to have advanced, together with a great deal of good ſenſe, many paradoxes in his favourite work; but ſtill that work is entitled to a ſerious peruſal, for it diſplays great learning and genius, and, we believe, the heavieſt cenſures have fallen upon it from thoſe by whom it was never read.

15 Inquiry to be made into the reality of revelation.

Having proceeded thus far in the courſe, the ſtudent's next buſineſs ſhould be to inquire ſeriouſly what evidence there is that the doctrines which he has ſo carefully ſtudied were indeed revealed in times paſt by God. He muſt already have perceived, in the nature and tendency of the doctrines themſelves, ſtrong marks of their origin being more than human; but he muſt likewiſe have met with many difficulties, and he muſt prepare himſelf to repel the attacks of unbelievers. Here he will find opportunities of exerting the utmoſt powers of his reaſoning faculties, and of employing in the ſervice of religion all the ſtores he may have amaſſed of human learning. The ſcriptures pretend to have been written by ſeveral men who lived in different ages of the world; but the lateſt of them in an age very remote from the preſent. His firſt buſineſs therefore muſt be to prove the authenticity of theſe books, by tracing them up by hiſtorical evidence to the ſeveral writers whoſe names they bear. But it is not enough to prove them authentic. They profeſs to have been written by men divinely aſſiſted and inſpired, and of courſe infallible in what they wrote. He muſt therefore inquire into the truth of this inſpiration. "The Bible contains a number of truths doctrinal and moral, which are called *myſteries*, and aſſerted to be the immediate dictates of God himſelf. To evince this great point to man, a number of ſupernatural *teſts* and *evidences* are inſeparably connected with thoſe myſteries; ſo that if the former be true, the latter muſt likewiſe be ſo. He muſt therefore examine theſe teſts and evidences, to eſtabliſh the divinity of the Holy Scriptures;" and in this part of his courſe he will find much aſſiſtance from many writers whoſe defences of the truth and divinity of the Chriſtian religion do honour to human nature.

16 Books recommended on that ſubject.

The firſt ſtep towards the embracing of any truth is, to get fairly rid of the objections which are made to it; and the general objections made by deiſtical writers to the Chriſtian revelation are by no writer more completely removed than by Biſhop Butler, in his celebrated work entitled *The Analogy of Religion natural and revealed to the Conſtitution and Courſe of Nature*. This book therefore the ſtudent ſhould read with attention, and meditate upon with patience; but as it does not furniſh a *poſitive proof* of the divinity of our religion, he ſhould paſs from it to *Grotius de Veritate Religionis Chriſtianæ*, and Stillingfleet's *Origines Sacræ*. Both theſe works are excellent; and the latter, which may be conſidered as an improvement of the former, is perhaps the fulleſt and ableſt defence of revelation in general that is to be found in any language. In this part of the united kingdom it is now indeed hardly mentioned, or mentioned with indifference; but half a century ago the Engliſh divines thought it a ſubject of triumph, and ſtyled its author their *incomparable Stillingfleet*. Other works, however, may be read with great advantage, and none with greater than Paley's *Evidences of the Chriſtian Religion*, and Leſlie's *Short Method with the Deiſts*; which laſt work, in the compaſs of a very few pages, contains proofs of the divinity of the Jewiſh and Chriſtian revelations, to which the celebrated Dr Mid-

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ledges (lib. iv. ſect. 2. cap. 33.) that it may be proved from ſcripture, that the perſon who was afterwards Jeſus Chriſt was from eternity the only begotten of his Father, by whom all things were made, and that therefore he is really and truly God. He mentions five ſenſes in which our Saviour is called the ſon of God; and ſhews that in this fifth and laſt ſenſe the filiation is peculiar to him alone. Yet in cap. 34. he ſtates the following queſtion: "An quintus iſte modus filiationis Jeſu Chriſti ad ſalutem ſcitu ac creditu neceſſarius ſit, uſque, qui illum negant, anathema dicendum ſit?" and gravely anſwers it in the negative. It is not to be wondered at that moſt Arminians differ from this celebrated remonſtrant in their anſwers to this queſtion; for nothing can be more abſurd than to hold religious communion with thoſe who deny the *divinity* of that perſon, whoſe divinity, it is *acknowledged*, may be clearly proved. Againſt this extravagant poſition many Arminian pens were drawn; but none to better purpoſe than that of biſhop Bull, whoſe *Judicium Eccleſiæ Catholicæ trium primorum ſeculorum*, &c. *aſſertum contra M. Simonem Epiſcopium alioſque*, obtained for its author the thanks of the whole clergy of France aſſembled (1710) at *St. Germaine en Laye* in a national ſynod.

(D) On this ſubject the reader will find many excellent obſervations in Biſhop Bull's *Harmonia Apoſtolica*, with its ſeveral defences, and in a ſmall book of Dr Wells's, entitled An Help for the right underſtanding of the ſeveral Divine Laws and Covenants, whereby man has been obliged through the ſeveral ages of the world to guide himſelf in order to ſalvation.

Preliminary Directions.

Middleton confeſſed (E), that for 20 years he had laboured in vain to fabricate a ſpecious anſwer (F).

17 Jewiſh controverſy to be ſtudied,

Having ſatisfied himſelf of the truth of revelation in general, it may be worth the young divine's while to provide a defence of the Chriſtian religion againſt the objections of modern Judaiſm. In this part of his ſtudies he will need no other inſtruction than what he may reap from Limborch's work entitled, *De Veritate Religionis Chriſtianæ amica collatio cum erudito Judæo.* "In that diſputation which was held with Orobio, he will find all that the ſtretch of human parts on the one hand, or ſcience on the other, can produce to varniſh error or unravel ſophiſtry. All the papers of Orobio in defence of Judaiſm, as oppoſed to Chriſtianity, are printed at large, with Limborch's anſwers, ſection by ſection; and the ſubtileſt ſophiſms of a very ſuperior genius are ably and ſatisfactorily detected and expoſed by the ſtrong, profound, and clear reaſoning, of this renowned remonſtrant.†" See OROBIO and LIMBORCH.

† Warburton's Directions for the Study of Theology.

18 And the various controverſies among Chriſtians themſelves.

The various controverſies ſubſiſting between the ſeveral denominations of Chriſtians, about points which ſeparate them into different churches, ought next to be ſtudied in the order of the courſe; for nothing is unimportant which divides the followers of that Maſter whoſe favourite precept was *love*. It has indeed been long faſhionable to decry polemical divinity as an uſeleſs, if not a pernicious, ſtudy; but it is not impoſſible that this faſhion, like many others, has had its origin in ignorance, and that it tends to perpetuate thoſe ſchiſms which it profeſſes to lament. We are, however, far, very far, from recommending to the young divine a peruſal of the works of the ſeveral combatants on each ſide of a diſputed queſtion, till he has fitted himſelf for judging between them by a long courſe of preparatory ſtudy; and the only preparation which can fit him for this purpoſe is an impartial and comprehenſive ſtudy of eccleſiaſtical hiſtory. He who has with accuracy traced the progreſs of our holy religion from the days of the apoſtles to the preſent time, and marked the introduction of new doctrines, and the riſe of the various ſects into which the Chriſtian world is unhappily divided, is furniſhed with a criterion within himſelf by which to judge of the importance and truth of the many conteſted doctrines; whilſt he who, without this preparation, ſhall read a multitude of books on any one religious controverſy, will be in danger of becoming a convert to his laſt author, if that author poſſeſs any tolerable ſhare of art and ingenuity. This we know was the caſe with Pope, who declares, that in ſtudying the controverſy between the churches of England and Rome, he found himſelf a Papiſt and Proteſtant by turns, according to the laſt book he read.

19 Importance of eccleſiaſtical hiſtory, and books recommended.

There are many hiſtories of the Chriſtian church which poſſeſs great merit, but we are acquainted with none which appears to us wholly impartial. Moſheim's is perhaps the moſt perfect compend (G); and one of its greateſt excellencies is, that on every ſubject the beſt writers are referred to for fuller information. Theſe indeed ſhould often be conſulted, not only to ſupply the defects neceſſarily reſulting from the narrowneſs of the limits which the author, with great propriety, preſcribed to himſelf; but alſo to correct his partial obliquities; for with all his merits, and they were many and great, he is certainly not free from the influence of prejudice. Indeed there is no coming at the true hiſtory of the primitive church, but by ſtudying the works of the primitive writers; and the principal works of the four firſt centuries will amply reward the labour of peruſing them (H). The riſe and progreſs of the reformation in general, the moſt important period of church-hiſtory, may be beſt learned from Sleidan's book *De ſtatu Religionis et Reipublicæ Carolo V. Cæſare Commentarii*; the Hiſtory of the Reformation of the Church of Scotland from Knox and Spotiſwood: and that of the Church of England from the much applauded work of Biſhop Burnet.

Preliminary Directions.

After this courſe of eccleſiaſtical hiſtory, the young divine may read with advantage the moſt important controverſies which have agitated the Chriſtian world; for he will now read them without danger of giving up his faith to the mere authority of great names. To enumerate theſe controverſies, and to point out the ableſt authors who have written on each, would be a very tedious, and perhaps not a very profitable, taſk. On one controverſy, however, we are induced to recommend a very maſterly work, becauſe it is ſufficient of itſelf to fix the principles of Proteſtants with reſpect to the church of Rome, and to put to ſhame the faſhionable cenſurers of *polemical divinity*. The work to which we allude is Chillingworth's book againſt Knott, entitled *The Religion of Proteſtants a ſafe way to Salvation*; in which the ſchool jargon of that ſubtile Jeſuit is incomparably expoſed, and the long diſpute between the Popiſh and Reformed churches placed on its proper ground, the Holy Scriptures.

20 Toleration

One of the ſtrongeſt and moſt plauſible objections to the ſtudy of polemical divinity, is its tendency to give a rigid turn to the ſentiments of thoſe long engaged in it; whilſt we know, from higher authority than that of the ableſt diſputant, "that the end of the commandment is charity." But for preſerving charity in the minds of Chriſtians, there are better means than abſolute ignorance or indifference to truth. Charity is violated only when a church unreaſonably reſtrains the inquiries of its own members, or exerciſes intolerance towards thoſe who have renounced its juriſdiction. The injuſtice of the firſt ſpecies of eccleſiaſtical tyranny is expoſed in a very maſterly manner by Jeremy Taylor in his *Liberty of Prophecying*, and by Stillingfleet in his *Irenicum*; the injuſtice of the ſecond by Locke in his celebrated Letters on Toleration. The man who ſhall peruſe

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(E) This piece of information we had from the late Dr Berkely, prebendary of Canterbury, who had it from Archbiſhop Secker, to whom the confeſſion was made.

(F) To theſe defences of revelation we might have added the collection of ſermons preached at Boyle's lecture from 1691 to 1732, publiſhed in three volumes folio, 1739; the works of Leland; Biſhop Newton's Diſſertations on Prophecy; and above all, Lardner's Credibility of the Goſpel Hiſtory, with the Supplement to it. But there would be no end of recommending eminent writers on this ſubject. We have mentioned ſuch as we moſt approve among thoſe with whom we are beſt acquainted; but we muſt, once for all, caution the reader againſt ſuppoſing that we approve of *every* thing to be found in any work except the ſacred ſcriptures.

(G) The Biſhop of Landaff, in the catalogue of books publiſhed at the end of his Theological Tracts, recommends ſeveral other eccleſiaſtical hiſtories as works of great merit; ſuch as, Dupin's, Echard's, Gregory's, and Formey's, together with *Pauli Erneſti Jablonſki Inſtitutiones Hiſtoriæ Chriſtianæ*, publiſhed at Frankfort in three volumes, 1754-67.

(H) For a proof of this poſition, and for a juſt eſtimate of the value of the *Fathers*, as they are called, ſee the introduction to Warburton's Julian, and Kett's Sermons at Bampton's Lectures.

uſe theſe three works, and impartially weigh the force of their arguments, will be in no danger, unleſs his pride be very great, or his temper uncommonly irritable, of thinking uncharitably of thoſe from whoſe principles the love of truth may compel him to diſſent.

In theſe directions for the ſtudy of theology, we might have enumerated many more books on each branch of the ſubject well deſerving of the moſt attentive peruſal; but he who ſhall have gone through the courſe here recommended, will have laid a foundation on which, if he continue his diligence, he may raiſe ſuch a ſuperſtructure as will entitle him to the character of an accompliſhed divine. His diligence muſt indeed be continued through life; for when a man ceaſes to make acquiſitions in any department of learning, he ſoon begins to loſe thoſe which he has already made; and a more contemptible character is nowhere to be found than that of a clergyman unacquainted with the learning of his profeſſion. This learning, however, is not to be acquired, and indeed is hardly to be preſerved, by ſtudying *bodies or inſtitutes of theology*; and though we have mentioned a few generally approved by two rival ſects of Chriſtians, and muſt in conformity with the plan of our work, give another ourſelves, we do not heſitate to declare, that the man who has carefully gone through the courſe of ſtudy which we have recommended, though it be little more than the outlines on which he is to work, may, with no great loſs to himſelf, neglect ours and all other ſyſtems. For as an excellent writer,[*] whom we have often quoted, well obſerves, "to judge of the *fact* whether ſuch a revelation containing ſuch a principle, with its myſteries and credentials, was actually ſent from God and received by man, by examining the *evidences* and *circumſtances* which accompanied it —the *time* when, the *place* where, the *manner* how, it was delivered—the *form* in which it deſcends to us—and in what it is *contained*—together with the particular *ſubſtance* and *burden* of it—and how every part is to be rightly *underſtood*: theſe are the various and extenſive ſubjects which conſtitute the ſublime office of THEOLOGIC REASONING and the PROPER STUDY OF DIVINITY." On this account we ſhall paſs over ſlightly, and ſometimes perhaps without any notice, many things which every clergyman ought thoroughly to underſtand, and confine ourſelves, in the ſhort compend which we are to give, to the prime articles of Chriſtian theology. In doing this, we ſhall endeavour as much as poſſible to diveſt ourſelves of party prejudices; but as we are far from thinking that this endeavour will be completely ſucceſsful (for we believe there is no man totally free from prejudice), we cannot conclude this part of the article more properly than with the following ſolemn CHARGE with which a very learned divine[‡] always prefaced his Theological Lectures:

21
A charge to ſtudents of theology,

I. "I do ſolemnly charge you, in the name of the God of Truth, and of our Lord Jeſus Chriſt, who is the Way, the Truth, and the Life, and before whoſe judgment ſeat you muſt in no long time appear, that in all your ſtudies and inquiries of a religious nature, preſent or future, you do conſtantly, carefully, impartially, and conſcientiouſly, attend to evidence, as it lies in the Holy Scriptures, or in the nature of things, and the dictates of reaſon; cautiouſly guarding againſt the ſallies of imagination, and the fallacy of ill-grounded conjecture.

II. "That you admit, embrace, or aſſent, to no principle or ſentiment by me taught or advanced, but only ſo far as it ſhall appear to you to be ſupported and juſtified by proper evidence from revelation or the reaſon of things.

III. "That if, at any time hereafter, any principle or ſentiment by me taught or advanced, or by you admitted or embraced, ſhall, upon impartial and faithful examination, appear to you to be dubious or falſe, you either ſuſpect or totally reject ſuch principle or ſentiment.

IV. "That you keep your mind always open to evidence: That you labour to baniſh from your breaſt all prejudice, prepoſſeſſions, and party zeal: That you ſtudy to live in peace and love with all your fellow Chriſtians; and that you ſteadily aſſert for yourſelf, and freely allow to others, the unalienable rights of judgment and conſcience."

PART I. OF NATURAL THEOLOGY.

SECT. I. *Of the Being and Attributes of* GOD.

HE who cometh to God, ſays an ancient divine[*], deeply read in the philoſophy of his age, muſt believe that he is, and that he is a rewarder of them who diligently ſeek him. This is a truth as undeniable as that a man cannot

22
The being of a God proved from

concern himſelf about a nonentity. The exiſtence of God is indeed the foundation of all religion, and the firſt principle of the ſcience which is the ſubject of this article. It is likewiſe a principle which muſt command the aſſent of every man who has any notion of the relation between effects and their cauſes, and whoſe curioſity has ever been excited by the phenomena of nature. This great and important truth we have elſewhere endeavoured to demonſtrate (ſee METAPHYSICS, Part III. Chap. vi.): but it may be proved by arguments leſs abſtracted from common apprehenſion than the nature of that article required us to uſe. Of theſe we ſhall give one or two, which we hope will be level to every ordinary capacity; whilſt, at the ſame time, we earneſtly recommend to the young divine a diligent ſtudy of thoſe books on the ſubject which we have mentioned in the preceding directions.

23
Propagation of animals

We ſee that the human race, and every other ſpecies of animals, is at preſent propagated by the co-operation of two parents; but has this proceſs continued from eternity? A moment's reflection will convince us that it has not. Let us take any one man alive, and, to avoid perplexity, let us ſuppoſe his father and mother dead, and himſelf the only perſon at preſent exiſting: how came he into the world? It will be ſaid he was produced mechanically or chemically by the conjunction of his parents, and that his parents were produced in the ſame manner by theirs. Let this then be ſuppoſed; it muſt ſurely be granted, that when this man was born, an addition was made to the ſeries of the human race. But a ſeries that can be enlarged may likewiſe be diminiſhed; and by tracing it backwards, we muſt at ſome period, however remote, reach its beginning. There muſt therefore have been a firſt pair of the human race, who were not propagated by the conjunction of parents. How did theſe come into the world?

Anaximander tells us[*], that the firſt men and all animals were bred in a warm moiſture, incloſed in cruſtaceous ſkins like crab-fiſh and lobſters; and that when they arrived at a proper age, their ſhelly priſons growing dry, broke, and made way for their liberty. Empedocles informs us, that mother earth at firſt brought forth vaſt numbers of legs, and arms, and heads, &c. which approaching each other, arranging themſelves properly, and being cemented together, ſtarted up at once full grown men. Another of theſe philoſophers relates, that there firſt grew up a ſort of wombs, which having their roots in the earth, attracted thence a kind of milk for the nouriſhment of the fœtus, which in proceſs of time broke through the membranes and ſhifted for itſelf; whilſt the Egyptian fathers § of this hopeful ſchool content themſelves with ſimply affirming, that animals like vegetables ſprung at firſt from the boſom of the earth.

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[*] Tatham.

[‡] Dr Taylor of Norwich.

[*] St. Paul.

[*] See Bentley's Boyle's Lectures.

24 And vegetables,

Surely thoſe ſages, or their followers, ſhould have been able to tell us why the earth has not in any climate this power of putting forth vegetable men or the parts of men at preſent. If this univerſal parent be eternal and ſelf-exiſtent, it muſt be incapable of decay or the ſmalleſt change in any of its qualities; if it be not eternal, we ſhall be obliged to find a cauſe for its exiſtence, or at leaſt for its form and all its powers. But ſuch a cauſe may have produced the firſt human pair, and undoubtedly did produce them, without making them ſpring as plants from the ſoil. Indeed the growth of plants themſelves clearly evinces a cauſe ſuperior to any vegetative power which can be ſuppoſed inherent in the earth. No plant, from the ſturdy oak to the creeping ivy, can be propagated but from ſeed or ſlips from the parent ſtock; but when one contemplates the regular proceſs of vegetation, the exiſtence of every plant implies the prior exiſtence of a parent ſeed, and the exiſtence of every ſeed the prior exiſtence of a parent plant. Which then of theſe, the oak or the acorn, was the firſt, and whence was its exiſtence derived? Not from the earth; for we have the evidence of univerſal experience that the earth never produces a tree but from ſeed, nor ſeed but from a tree. There muſt therefore be ſome ſuperior power which formed the firſt ſeed or the firſt tree, planted it in the earth, and gave to it thoſe powers of vegetation by which the ſpecies has been propagated to this day.

25 And from the laws of attraction and repulſion, &c.

Thus clearly do the proceſſes of generation and vegetation indicate a power ſuperior to thoſe which are uſually called *the powers of nature*. The ſame thing appears no leſs evident from the laws of attraction and repulſion, which plainly prevail through the whole ſyſtem of matter, and hold together the ſtupendous ſtructure. Experiment ſhows that very few particles of the moſt ſolid body are in actual contact with each other (ſee Optics, nº 63—68, Physics, nº 23,); and that there are conſiderable interſtices between the particles of every elaſtic fluid, is obvious to the ſmalleſt reflection. Yet the particles of ſolid bodies ſtrongly cohere, whilſt thoſe of elaſtic fluids repel each other. How are theſe phenomena accounted for? To ſay that the former is the effect of attraction and the latter of repulſion, is only to ſay that two individual phenomena are ſubject to thoſe laws which prevail through the whole of the claſſes under which they are reſpectively arranged; whilſt the queſtion at iſſue is concerning the ORIGIN OF THE LAWS THEMSELVES, the *power* which makes the particles of gold cohere, and thoſe of air repel each other. Power without ſubſtance is inconceivable; and by a law of human thought, no man can believe a being to operate but where it is in ſome manner or other actually preſent; but the particles of gold adhere, and the particles of air keep at a diſtance from each other, by powers exerted where no matter is preſent. There muſt therefore be ſome ſubſtance endowed with power which is not material.

Of this ſubſtance or being the power is evidently immenſe. The earth and other planets are carried round the ſun with a velocity which human imagination can hardly conceive. That this motion is not produced by the agency of theſe vaſt bodies on one another, or by the interpoſition of any material fluid, has been ſhown elſewhere (ſee Metaphysics, nº 196–200. and Optics, nº 67.); and ſince it is a law of our beſt philoſophy, *that we are not to multiply ſubſtances without neceſſity*, we muſt infer that the ſame Being which formed the firſt animals and vegetables, endowing them with powers to propagate their reſpective kinds, is likewiſe the cauſe of all the phenomena of nature, ſuch as *coheſion*, *repulſion*, *elaſticity*, and *motion*, even the motions of the heavenly bodies themſelves.

26 Abſurdity of an infinite ſeries of effects.

If this powerful Being, who is the parent of vegetable and animal life, and the ſource of all corporeal motions, be ſelf-exiſtent, intelligent, and independent in his actions and volitions, he is an original or firſt cauſe, and that Being whom we denominate God. If he be not ſelf-exiſtent and independent, there muſt be a cauſe in the order of nature prior and ſuperior to Him, which is either itſelf the firſt cauſe, or a link in that ſeries of cauſes and effects, which, however vaſt we ſuppoſe it, muſt be traced ultimately to ſome one Being, who is ſelf-exiſtent, and has in himſelf the power of beginning motion, independent of every thing but his own intelligence and volition. In vain have the atheiſts alleged, that the ſeries may aſcend infinitely, and for that reaſon have no firſt mover or cauſe. An infinite ſeries of ſucceſſive beings involves an abſurdity and contradiction (ſee Metaphysics, nº 288.): but not to inſiſt upon this at preſent, we ſhall only beg leave to conſider ſuch a ſeries as a whole, and ſee what conſequences will flow from the ſuppoſition. That we may with logical propriety conſider it in this light, is incontrovertible; for the birth of every individual of the human race ſhows that it is made up of parts; but parts imply a whole as neceſſarily as an attribute implies its ſubſtance. As in this ſuppoſed ſeries there is no cauſe which is not likewiſe an effect, nor any body moving another which was not itſelf moved by a third, the whole is undeniably equivalent to an infinite effect, or an infinite body moved: but if a finite effect muſt neceſſarily have proceeded from a cauſe, and a finite body in motion muſt have been put into that ſtate by a mover, is there a human mind which can conceive an infinite effect to have proceeded from *no* cauſe, or an infinite body in motion to have been moved by *nothing*? No, ſurely! An infinite effect, were ſuch a thing poſſible, would compel us to admit an infinite cauſe, and an infinite body in motion a mover of infinite power.

27 There is only one original cauſe.

This great cauſe is God, whoſe wiſdom, power, and goodneſs, all nature loudly proclaims. That the phenomena which we daily ſee evince the exiſtence of *one* ſuch Being, has juſt been ſhown; and that we have no reaſon to infer the exiſtence of *more* than one, a very few reflections will make abundantly evident. For, not to lay more ſtreſs than it will bear upon that rule of Newton's which forbids us to multiply ſubſtances without neceſſity, ſuch a harmony prevails through the whole viſible univerſe, as plainly ſhows it to be under the government of one intelligence. That on this globe the ſeveral elements ſerve for nouriſhment to plants, plants to the inferior animals, and animals to man; that the other planets of our ſyſtem are probably inhabited, and their inhabitants nouriſhed in the ſame or a ſimilar manner; that the ſun is ſo placed as to give light and heat to all, and by the law of gravitation to bind the whole planets into one ſyſtem with itſelf—are truths ſo obvious and ſo univerſally acknowledged, as to ſuperſede the neceſſity of eſtabliſhing them by proof. The fair inference therefore is, that the ſolar ſyſtem and all its parts are under the government of *one intelligence*, which directs all its motions and all the changes which take place among its parts for ſome wiſe purpoſes. To ſuppoſe it under the government of two or more intelligences would be highly unreaſonable; for if theſe intelligences had equal power, equal wiſdom, and the ſame deſigns, one of them would evidently be ſuperfluous; and if they had equal power and contrary deſigns, they could not be the parents of that harmony which we clearly perceive to prevail in the ſyſtem.

§ Diodorus Siculus apud Euſeb. Prep. Evangel.

But the Being capable of regulating the movements of ſo vaſt a machine, may well be ſuppoſed to poſſeſs infinite power, and to be capable of ſuperintending the motions of the univerſe. That the widely extended ſyſtem of nature is but one ſyſtem, of which the ſeveral parts are united by many bonds of mutual connection, has been ſhown elſewhere (ſee PHYSICS), and appears daily more and more evident from our progreſs in phyſical diſcoveries; and therefore it is in the higheſt degree unreaſonable to ſuppoſe that it has more than one author, or one ſupreme governor.

28
Of infinite power, wiſdom, and

As the unity of deſign apparent in the works of creation plainly prove the unity of their Author, ſo do the immenſity of the whole, and the admirable adjuſtment of the ſeveral parts to one another, demonſtrate His power and His wiſdom. On this ſubject the following beautiful reflections by Mr Wollaſton are deſerving of the moſt ſerious attention.

“ In order (ſays that able writer ‖) to prove to any one the grandneſs of this fabric of the world, one needs only to bid him conſider the *ſun*, with that inſupportable glory and luſtre that ſurrounds it; to demonſtrate its vaſt diſtance, magnitude, and heat; to repreſent to him the chorus of planets moving periodically, by uniform laws, in their ſeveral orbits about it; guarded ſome of them by ſecondary planets, and as it were emulating the ſtate of the ſun, and probably all poſſeſſed by proper inhabitants; to remind him of thoſe ſurpriſing viſits which the *comets* make to us, and the large trains of uncommon ſplendour which attend them, the far country from which they come, and the curioſity and horror which they excite not only among us, but in the inhabitants of other planets, who may alſo be up to ſee the entry and progreſs of theſe miniſters of fate: to direct his eye and contemplation through thoſe azure fields and vaſt regions above him up to the *fixed ſtars*, that radiant numberleſs hoſt of heaven; and to make him underſtand how unlikely a thing it is that they ſhould be placed there only to adorn and beſpangle a canopy over our heads; to convince him that they are rather ſo many *other ſuns*, with their ſeveral ſyſtems of planets about them; to ſhow him by the help of glaſſes ſtill more and more of theſe fixed lights, and to beget in him an apprehenſion of their inconceivable numbers, and thoſe immenſe ſpaces that lie beyond our reach and even our imagination: One needs but to do this (continues our author), and explain to him ſuch things as are now known almoſt to every body; and by it to ſhow, that if the world be not infinite, it is *infinito ſimilis*, and undoubtedly the work of an INFINITE ARCHITECT.

“ But if we would take a view of all the *particulars* contained within that aſtoniſhing compaſs which we have thus haſtily run over, how would wonders multiply upon us? Every corner, every part of the world, is as it were, made up of *other* worlds. If we look upon this our earth, what ſcope does it furniſh for admiration! The great variety of mountains, hills, valleys, plains, rivers, ſeas, trees, and plants! The many tribes of different animals with which it is ſtocked; the multifarious inventions and works of one of theſe, *i. e.* of us men; with the wonderful inſtincts of others, guiding them uniformly to what is beſt for themſelves, in ſituations where neither ſenſe nor reaſon could direct them. And yet when all theſe (heaven and earth) are ſurveyed as nicely as they can be by the help of our unaſſiſted ſenſes and of teleſcopes, we may diſcover by the aſſiſtance of good microſcopes, in very ſmall parts of matter, as many *new* wonders as thoſe already diſcovered, new kingdoms of animals, with new and curious architecture. So that as our ſenſes and even conception fainted before in the vaſt journeys we took in conſidering the expanſe of the univerſe, they here again fail us in our reſearches into the principles and minute parts of which it is compoſed. Both the *beginnings* and the *ends* of things, the *leaſt* and the *greateſt*, all conſpire to baffle us: and which way ſoever we proſecute our inquiries, we ſtill meet with freſh ſubjects of amazement, and freſh reaſons to believe that there are indefinitely more and more behind, that will forever eſcape our eagereſt purſuits and deepeſt penetration.

“ In this vaſt aſſemblage, and amidſt all the multifarious motions by which the ſeveral proceſſes of generation and corruption, and the other phenomena of nature, are carried on, we cannot but obſerve that there are ſtated methods, as ſo many forms of proceeding, to which things punctually and religiouſly adhere. The ſame *cauſes* circumſtanced in the ſame manner produce always the ſame *effects*; all the *ſpecies* of animals among us are made according to one general *idea*; and ſo are thoſe of *plants* alſo, and even of *minerals*. No new ſpecies are brought forth or have ariſen anywhere; and the old are preſerved and continued by the *old ways*.

“ It appears, laſtly, beyond diſpute, that in the parts and model of the world there is a contrivance for accompliſhing certain ends. The ſun is placed near the centre of our ſyſtem, for the more convenient diſpenſing of his benign influences to the planets moving about him; the place of the earth's *equator* interſects that of her *orbit*, and makes a proper angle with it, in order to diverſify the *year*, and create an uſeful variety of *ſeaſons*; and many other things of this kind will be always obſerved, and though a thouſand times repeated, be meditated upon with pleaſure by good men and true philoſophers. Who can obſerve the vapours to aſcend, eſpecially from the ſea, meet above in clouds, and fall again, after condenſation, without being convinced that this is a kind of *diſtillation*, in order to clear the water of its groſſer ſalts, and then by rains and dews to ſupply the fountains and rivers with freſh and wholeſome liquor; to nouriſh the vegetables below by ſhowers, which deſcend in drops as from a *watering-pot* upon a garden? Who can view the *ſtructure* of a plant or animal, the indefinite number of its fibres and fine veſſels, the formation of larger veſſels, and the ſeveral members out of them, with the apt diſpoſition of all theſe; the means contrived for the reception and diſtribution of *nutriment*; the *effect* this nutriment has in extending the veſſels, bringing the vegetable or animal to its full growth and expanſion, continuing the *motion* of the ſeveral fluids, repairing the decays of the body and preſerving *life*? Who can take notice of the ſeveral *faculties* of animals, their arts of ſaving and providing for themſelves, or the ways in which they are provided for; the uſes of plants to animals, and of ſome animals to others, particularly to mankind; the care taken that the ſeveral ſpecies ſhould be propagated, without confuſion, from their proper ſeeds; the ſtrong inclination planted in animals for that purpoſe, their love of their young and the like.—Who (ſays our author) can obſerve all this, and not ſee a *deſign* in ſuch *regular* pieces, ſo nicely wrought and ſo admirably preſerved? If there were but one animal in exiſtence, and it could not be doubted but that his eyes were formed that he might ſee with them, his ears that he might hear with them, and his feet to be inſtruments by which he might remove himſelf from place to place; if *deſign* and *contrivance* can be much leſs doubted, when the ſame things are repeated in the individuals of all the tribes of animals; if the like obſervations may be made with reſpect to vegetables and other things; and if all theſe *claſſes* of things, and much more the *individuals* comprehended under them, be inconceivably numerous, as moſt unqueſtionably they are—one cannot but be convinced, from what ſo plainly runs through the nobler parts of the viſible world, that not only *they*, but other things, even thoſe that ſeem to be *leſs noble*, have their ends likewiſe, though not always perceived by capacities limited like ours. And ſince we cannot, with the Epicureans of old, ſuppoſe the parts of matter to have *contrived* among themſelves this wonderful form of a world, to have taken by agreement each its reſpective *poſt*, and then to have purſued in conjunction conſtant *ends* by certain methods and meaſures *concerted*, there muſt be ſome other Being, whoſe wiſdom and power are equal to ſuch a mighty work as is the *ſtructure* and *preſervation* of the world. There muſt be ſome Almighty MIND who modelled and preſerves it; lays the cauſes of things ſo deep; preſcribes them ſuch uniform and ſteady laws; deſtines and adapts them to certain purpoſes; and makes one thing to fit and anſwer another ſo as to produce one harmonious whole. Yes,

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‖ Religion of Nature, ſec. v. prop. 14.

These are thy glorious works, Parent of good!
Almighty, thine this univerſal frame,
Thus wondrous fair; THYSELF how wondrous then!

How wondrous in wiſdom and in power!"

29
Goodneſs.

But the GOODNESS of God is not leſs conſpicuous in his works than His power or His wiſdom. Contrivance proves deſign, and the predominant tendency of the contrivances indicates the diſpoſition of the deſigner. "The world (ſays an elegant and judicious writer†) abounds with contrivances, and all the contrivances in it with which we are acquainted are directed to beneficial purpoſes. Evil no doubt exiſts; but it is never that we can perceive the object of contrivance. Teeth are contrived to eat, not to ache; their aching now and then is incidental to the contrivance, perhaps inſeparable from it; but it is not its object. This is a diſtinction which well deſerves to be attended to. In deſcribing implements of huſbandry, one would hardly ſay of a ſickle that it is made to cut the reaper's fingers, though from the conſtruction of the inſtrument, and the manner of uſing it, this miſchief often happens. But if he had occaſion to deſcribe inſtruments of torture or execution, this, he would ſay, is to extend the ſinews; this to diſlocate the joints; this to break the bones; this to ſcorch the ſoles of the feet. Here pain and miſery are the very objects of the contrivance. Now nothing of this ſort is to be found in the works of nature. We never diſcover a train of contrivance to bring about an evil purpoſe. No anatomiſt ever diſcovered a ſyſtem of organization calculated to produce pain and diſeaſe; or, in explaining the parts of the human body, ever ſaid, this is to irritate, this to inflame, this duct is to convey the gravel to the kidneys, this gland to ſecrete the humour which forms the gout. If by chance he come to a part of which he knows not the uſe, the moſt that he can ſay is, that to him it appears to be uſeleſs: no one ever ſuſpects that it is put there to incommode, to annoy, or to torment. If God had wiſhed our miſery, he might have made ſure of his purpoſe, by forming our ſenſes to be as many ſores and pains to us as they now are inſtruments of gratification and enjoyment; or, by placing us among objects ſo ill ſuited to our perceptions, as to have continually offended us, inſtead of miniſtering to our refreſhment and delight. He might have made, for inſtance, every thing we taſted bitter, every thing we ſaw loathſome, every thing we touched a ſting, every ſmell a ſtench, and every ſound a diſcord."

Inſtead of this, all our ſenſations, except ſuch as are excited by what is dangerous to our health, are pleaſures to us: The view of a landſcape is pleaſant; the taſte of nouriſhing food is pleaſant; ſounds not too loud are agreeable, while muſical ſounds are exquiſite; and hardly any ſmells, except ſuch are excited by effluvia obviouſly pernicious to the brain, are diſagreeable; whilſt ſome of them, if not too long indulged, are delightful. Our lives are preſerved and the ſpecies is continued by obeying the impulſe of appetites; of which the gratification is exquiſite when not repeated too frequently to anſwer the purpoſes of the Author of our being. Since, then, God has called forth his conſummate wiſdom to contrive and provide for our happineſs, and has made thoſe things which are neceſſary to our exiſtence and the continuance of the race ſources of our greateſt ſenſual pleaſures, who can doubt but that benevolence is one of his attributes; and that, if it were not impious to draw a compariſon between them, it is the attribute in which he himſelf moſt delighteth?

But it is not from ſenſation only that we may infer the benevolence of the Deity: He has formed us with minds capable of intellectual improvement, and he has implanted in the breaſt of every man a very ſtrong deſire of adding to his knowledge. This addition to be ſure cannot be made without labour; and at firſt the requiſite labour is to moſt people irkſome: but a very ſhort progreſs in any ſtudy converts what was irkſome into a pleaſure of the moſt exalted kind; and he who by ſtudy, however intenſe, enlarges his ideas, and is conſcious that he is daily riſing in the ſcale of intelligence, experiences a complacency, which, though not ſo poignant perhaps as the pleaſures of the ſenſualiſt, is ſuch as endears him to himſelf, and is what he would not exchange for any thing elſe which this world has to beſtow, except the ſtill ſweeter complacency ariſing from the conſciouſneſs of having diſcharged his duty.

That the practice of virtue is attended with a peculiar pleaſure of the pureſt kind, is a fact which no man has ever queſtioned, though the immediate ſource of that pleaſure has been the ſubject of many diſputes. He who attributes it to a moral ſenſe, which inſtinctively points out to every man his duty, and upon the performance of it rewards him with a ſentiment of ſelf-approbation, muſt of neceſſity acknowledge benevolence to be one of the attributes of that Being who has ſo conſtituted the human mind. That to protect the innocent, relieve the diſtreſſed, and do to others as we would in like circumſtances wiſh to be done by, fills the breaſt, previous to all reflection, with a holy joy, as the commiſſion of any crime tears it with remorſe, cannot indeed be controverted. Many, however, contend, that this joy and this remorſe ſpring not from any moral inſtinct implanted in the mind, but are the conſequence of early and deep-rooted aſſociations of the practice of virtue with the hope of future happineſs, and of vice with the dread of future miſery. On the reſpective merits of theſe two theories we ſhall not now decide. We have ſaid enough on the ſubject in other articles (ſee INSTINCT, MORAL PHILOSOPHY, and PASSION); and ſhall here only obſerve, that they both lead with equal certainty to the benevolence of the Deity, who made us capable of forming aſſociations, and ſubjected thoſe aſſociations to fixed laws. This being the caſe, the moral ſenſe, with all its inſtantaneous effects, affords not a clearer or more convincing proof of his goodneſs, than that principle in our nature by which remote circumſtances become ſo linked together, that, after the connecting ideas have eſcaped from the mind, the one circumſtance never occurs without bringing the other alſo into view. It is thus that the pleaſing complacency, which was perhaps firſt excited by the hopes of future happineſs, comes in time to be ſo aſſociated with the conſciouſneſs of virtuous conduct, the only thing entitled to reward, that a man never performs a meritorious action without experiencing the moſt exquiſite joy diffuſed over his mind, though his attention at that inſtant may not be directed either to heaven or futurity. Were we obliged, before we could experience this joy, to eſtimate by reaſon the merit of every individual action, and trace its connection to heaven and future happineſs through a long train of intermediate argumentation,

† Dr Paley.

mentation, we ſhould be in a great meaſure deprived of the preſent reward of virtue; and therefore this aſſociating principle contributes much to our happineſs. But the benevolence of a Being, who ſeems as it were thus anxious to furniſh us with both ſenſual and intellectual enjoyments, and who has made our duty our greateſt pleaſure, cannot be queſtioned; and therefore we muſt infer, that the Author of Nature wiſhes the happineſs of the whole ſenſible and intelligent creation.

30 Objections, To ſuch reaſoning as this in ſupport of the Divine Benevolence many objections have been made. Some of them appear at firſt ſight plauſible, and are apt to ſtagger the faith of him who has beſtowed no time on the ſtudy of that branch of general ſcience which is called *phyſics* (ſee PHYSICS). To omit theſe altogether in ſuch an article as this might be conſtrued into neglect; whilſt it is certain that there is in them nothing worthy of the attention of that man who is qualified either to eſtimate their force, or to underſtand the arguments by which they have often been repelled.

It has been aſked, Why, if the Author of Nature be a benevolent Being, are we neceſſarily ſubject to pain, diſeaſes, and death? The ſcientific phyſiologiſt replies, Becauſe from theſe evils Omnipotence itſelf could not in our preſent ſtate exempt us, but by a conſtant ſeries of miracles. 31 Anſwered. He who admits miracles, knows likewiſe that mankind were originally in a ſtate in which they were not ſubject to death; and that they fell under its dominion through the fault of their common progenitors. But the fall and reſtoration of man is the great ſubject of revealed religion; and at preſent we are diſcuſſing the queſtion like philoſophers who have no other data on which to proceed than the phenomena of nature. Now we know, that as all matter is diviſible, every ſyſtem compoſed of it muſt neceſſarily be liable to decay and diſſolution; and our material ſyſtem would decay and be diſſolved long before it could ſerve the purpoſes of nature, were there not methods contrived with admirable wiſdom for repairing the waſte occaſioned by perpetual friction. The body is furniſhed with different fluids, which continually circulate through it in proper channels, and leave in their way what is neceſſary to repair the ſolids. Theſe again are ſupplied by food *ab extra*; and to the whole proceſſes of digeſtion, circulation, and nutrition, the air we breathe is abſolutely neceſſary. (See PHYSIOLOGY, Sect. 1, 2, 3, 4, 5). But as the air is a very heterogeneous fluid, and ſubject to violent and ſudden changes, it is obvious that theſe changes muſt affect the blood, and by conſequence the whole frame of the human body. We ſee the air indeed in proceſs of time conſume even marble itſelf; and therefore cannot wonder, that as it is in one ſtate the parent of health, it ſhould in another be the ſource of diſeaſe to ſuch creatures as man and other terreſtrial animals. Nor could theſe conſequences be avoided without introducing others much more deplorable. The world is governed by general laws, without which there could be among men neither arts nor ſciences; and tho' laws different from thoſe by which the ſyſtem is at preſent governed might perhaps have been eſtabliſhed, there is not the ſmalleſt reaſon to imagine that they could on the whole have been better, or attended with fewer inconveniencies. As long as we have material and ſolid bodies capable of motion, liable to reſiſtance from other ſolid bodies, ſupported by food, ſubject to the agency of the air, and diviſible, they muſt neceſſarily be liable to pain, diſeaſe, corruption, and death, and that too by the very influence of thoſe laws which preſerve the order and harmony of the univerſe. Thus gravitation is a general law ſo good and ſo neceſſary, that were it for a moment ſuſpended, the world would inſtantly fall to pieces; and yet by means of this law the man muſt inevitably be cruſhed to death upon whom a tower ſhall chance to tumble. Again, the attraction of coheſion is a general law, without which it does not appear that any corporeal ſyſtem could poſſibly exiſt: it is by this law too, or a modification of it, that the glands and lacteals of the human body extract from the blood ſuch particles as are neceſſary to nouriſh the ſolids; and yet it is by means of the very ſame modification of the very ſame law that a man is liable to be poiſoned. How are theſe effects to be prevented?

> Shall burning Ætna, if a ſage requires,
> Forget to thunder, and recal her fires?
> On air or ſea new motions be impreſt,
> Oh blameleſs Bethel! to relieve thy breaſt:
> When the looſe mountain trembles from on high,
> Shall gravitation ceaſe if you go by?
> Or ſome old temple nodding to its fall,
> For Charters' head reſerve the hanging wall;

Such a perpetual miracle, ſuch a frequent ſuſpending of the laws of nature in particular inſtances, we cannot doubt to be within the compaſs of Almighty power: but were this ſuſpenſion really to take place, mankind would be involved in ignorance greater than that of childhood; for not one of them could know, or have any means of diſcovering this moment, what was to happen the next; and the conſequence would be, that, uncertain but the ſingle motion of a ſingle joint might bring on them ſudden deſtruction, they would all periſh in a ſtate of abſolute inactivity.

32 Sickneſs, pain, and the dread of death ſerve good purpoſes. But though the human body could not have been preſerved from dangers and diſſolution but by introducing evils greater on the whole than thoſe to which it is now liable, why, it has ſometimes been aſked, is every diſorder to which it is ſubject attended with ſickneſs or with pain? and why is ſuch a horror of death implanted in our breaſts, ſeeing, that by the laws of nature death is inevitable? We anſwer That ſickneſs, pain, and the dread of death, ſerve the very beſt purpoſes. Could a man be put to death, or have his limbs broken without feeling pain, the human race had long ago been extinct. Felt we no uneaſineſs in a fever, we ſhould be inſenſible of the diſeaſe, and die before we ſuſpected our health to be impaired. The horror which generally accompanies our reflections on death tends to make us more careful of life, and prevents us from quitting this world raſhly when our affairs proſper not according to our fond wiſhes. It is likewiſe an indication that our exiſtence does not terminate in this world; for our dread is ſeldom excited by the proſpect of the pain which we may ſuffer when dying, but by our anxiety concerning what we may be doomed to ſuffer or enjoy in the next ſtage of our exiſtence; and this anxiety tends more perhaps than any thing elſe to make us live while we are here in ſuch a manner as to enſure our happineſs hereafter.

Thus from every view that we can take of the works and laws of God, and even from conſidering the objections which have ſometimes been made to them, we are compelled to acknowledge the benevolence of their Author. We muſt not, however, ſuppoſe the Divine benevolence to be a fond and weak affection like that which is called benevolence among men. All human affections and paſſions originate in our dependence and wants; and it has been doubted whether any of them be at firſt diſintereſted (ſee PASSION): but he to whom exiſtence is eſſential cannot be dependent; he who is the Author of every thing can feel no want. The divine benevolence therefore muſt be wholly diſintereſted, and of courſe free from thoſe partialities originating in ſelf-love, which are alloys in the moſt ſublime of human virtues. The moſt benevolent man on earth, though he wiſhes the happineſs of every fellow-creature, has ſtill, from the ties of blood, the endearments of friendſhip, or, perhaps from a regard to his own intereſt, ſome particular favourites whom, on a competition with others, he would certainly prefer.

33 The divine benevolence coincident with juſtice.

But the equal Lord of all can have no particular favourites. His benevolence is therefore coincident with juſtice; or, to ſpeak more properly, that which is called *divine juſtice*, is only benevolence exerting itſelf in a particular manner for the propagation of general felicity. When God preſcribes laws for regulating the conduct of his intelligent creatures, it is not becauſe he can reap any benefit from their obedience to thoſe laws, but becauſe ſuch obedience is neceſſary to their own happineſs; and when he puniſhes the tranſgreſſor, it is not becauſe in his nature there is any diſpoſition to which the proſpect of ſuch puniſhment can afford gratification, but becauſe in the government of free agents puniſhment is neceſſary to reform the criminal, and to intimidate others from committing the like crimes. But on this ſubject we need not dwell. It has been ſhewn elſewhere (METAPHYSICS, n° 312.), that all the moral attributes of God, his HOLINESS, JUSTICE, MERCY, and TRUTH, ſhould be conceived as the ſame divine BENEVOLENCE, acting in different ways according to different exigencies, but always for the ſame ſublime end—the propagation of the utmoſt poſſible happineſs.

34 God incomprehenſible,

The ſubſtance or eſſence of this ſelf-exiſtent, all-powerful, infinitely wiſe, and perfectly good being, is to us wholly incomprehenſible. That it is not matter, is ſhewn by the proceſs of argumentation by which we have proved it to exiſt; but what it is we know not, and it would be impious preſumption to inquire. It is ſufficient for all the purpoſes of religion to know that God is ſome how or other preſent to every part of his works; that exiſtence and every poſſible perfection is eſſential to him; and that he wiſhes the happineſs of all his creatures. From theſe truths we might proceed to prove and illuſtrate the perpetual ſuperintendance of his providence, both general and particular, over every the minuteſt part of the univerſe: but that ſubject has been diſcuſſed in a ſeparate article; to which, therefore, we refer the reader. (See PROVIDENCE). We ſhall only obſerve at preſent, that the manner in which animals are propagated affords as complete a proof of the conſtant ſuperintendance of divine power and wiſdom, as it does of the immediate exertion of theſe faculties in the formation of the parent pair of each ſpecies. For were this buſineſs of propagation carried on by *neceſſary* and mechanical laws, it is obvious, that in every age there would be generated, in each ſpecies of animals, the very ſame proportion of males to females that there was in the age preceding.

35 But conſtantly preſent to his works.

On the other hand, did generation depend upon *fortuitous* mechaniſm, it is not conceivable but that, ſince the beginning of the world, or, according to this hypotheſis, during the courſe of eternity, ſeveral ſpecies of animals ſhould in *ſome* age have generated nothing but *males*, and others nothing but *females*; and that of courſe many ſpecies would have been long ſince extinct. As neither of theſe caſes has ever happened, the preſervation of the various ſpecies of animals, by keeping up conſtantly in the world a due, though not always the ſame, proportion between the ſexes of male and female, is a complete proof of the ſuperintendance of divine providence, and of that ſaying of the apoſtle, that it is "in God we live, move, and have our being."

SECT. II. *Of the Duties and Sanctions of Natural Religion.*

FROM the ſhort and very inadequate view that we have taken of the divine perfections, it is evidently our duty to reverence in our minds the ſelf-exiſtent Being to whom they belong. This is indeed not only a duty, but a duty of which no man who contemplates theſe perfections, and believes them to be real, can poſſibly avoid the performance.

36 Reverence and gratitude due to God.

He who thinks irreverently of the Author of nature, can never have conſidered ſeriouſly the power, the wiſdom, and the goodneſs, diſplayed in his works; for whoever has a tolerable notion of theſe muſt be convinced, that he who performed them has no imperfection; that his power can accompliſh every thing, which involves not a contradiction; that his knowledge is intuitive, and free from the poſſibility of error; and that his goodneſs extends to all without partiality and without any alloy of ſelfiſh deſign. This conviction muſt make every man on whoſe mind it is impreſſed ready to proſtrate himſelf in the duſt before the Author of his being; who, though infinitely exalted above him, is the ſource of all his enjoyments, conſtantly watches over him with paternal care, and protects him from numberleſs dangers. The ſenſe of ſo many benefits muſt excite in his mind a ſentiment of the livelieſt gratitude to him from whom they are received, and an ardent wiſh for their continuance.

37 Of whom no poſitive idea ſhould be formed.

Whilſt ſilent gratitude and devotion thus glow in the breaſt of the contemplative man, he will be careful not to form even a mental image of that all-perfect Being to whom they are directed. He knows that God is not material; that he exiſts in a manner altogether incomprehenſible; that to frame an image of him would be to aſſign limits to what is infinite; and that to attempt to form a poſitive conception of him would be impiouſly to compare himſelf with his Maker.

38 How he ought to be ſpoken of; and

The man who has any tolerable notion of the perfections of the Supreme Being will never ſpeak lightly of him, or make uſe of his name at all but on great and ſolemn occaſions. He knows that the terms of all languages are inadequate and improper, when applied directly to him who has no equal, and to whom nothing can be compared; and therefore he will employ theſe terms with caution. When he ſpeaks of his mercy and compaſſion, he will not conſider them as feelings wringing the heart like the mercy and compaſſion experienced by man, but as rays of pure and diſintereſted benevolence. When he thinks of the ſtupendous ſyſtem of nature, and hears it, perhaps, ſaid that God formed it for his own glory, he will reflect that God is ſo infinitely exalted above all his creatures, and ſo perfect in himſelf, that he can neither take pleaſure in their applauſe, as great men do in the applauſes of their fellow-creatures, nor receive any acceſſion of any kind from the exiſtence of ten thouſand worlds. The immenſe fabric of nature therefore only diſplays the glory or perfections of its Author to *us* and to other *creatures* who have not faculties to comprehend him in himſelf.

When the contemplative man talks of *ſerving* God, he does not dream that his ſervices can increaſe the divine felicity; but means only that it is his duty to obey the divine laws. Even the pronoun *He*, when it refers to God, cannot be of the ſame import as when it refers to man; and by the philoſophical divine it will ſeldom be uſed but with a mental alluſion to this obvious diſtinction.

39 What is meant by ſerving him.

As the man who duly venerates the Author of his being will not ſpeak of him on trivial occaſions, ſo will he be ſtill further from calling upon him to witneſs impertinences and falſehood, (ſee OATH). He will never mention his name but with a *pauſe*, that he may have time to reflect in ſilence on his numberleſs perfections, and on the immenſe diſtance between himſelf and the Being of whom he is ſpeaking. The ſlighteſt reflection will convince him that the world with all that it contains depends every moment upon

40 Divine worſhip a natural duty.

upon that God who formed it; and this conviction will compel him to wiſh for the divine protection of himſelf and his friends from all dangers and misfortunes. Such a wiſh is in effect a prayer, and will always be accompanied with adoration, confeſſion, and thankſgiving (ſee Prayer). But adoration, confeſſion, ſupplication, and thankſgiving, conſtitute what is called *worſhip*, and therefore the worſhip of God is a natural duty. It is the addreſſing of ourſelves as his dependants to him as the ſupreme cauſe and governor of the world, with acknowledgments of what we enjoy, and petitions for what we really want, or he knows to be convenient for us. As if, *ex. gr.* I ſhould in ſome humble and compoſed manner (ſays Mr Wollaſton) pray to that "Almighty Being, upon whom depends the exiſtence of the world, and by whoſe providence I have been preſerved to this moment, and enjoyed many undeſerved advantages, that he would graciouſly accept my grateful ſenſe and acknowledgments of all his beneficence towards me; that he would deliver me from the evil conſequences of all my tranſgreſſions and follies; that he would endue me with ſuch diſpoſitions and powers as may carry me innocently and ſafely through all future trials, and may enable me on all occaſions to behave myſelf conformably to the laws of reaſon piouſly and wiſely; that He would ſuffer no being to injure me, no misfortunes to befal me, nor me to hurt myſelf by any error or miſconduct of my own; that he would vouchſafe me clear and diſtinct perceptions of things; with ſo much health and proſperity as may be good for me; that I may at leaſt paſs my time in peace, with contentment and tranquillity of mind; and that having faithfully diſcharged my duty to my family and friends, and endeavoured to improve myſelf in virtuous habits and uſeful knowledge, I may at laſt make a decent and happy exit, and find myſelf in ſome better ſtate."

That an untaught ſavage would be prompted by *inſtinct* to addreſs the Supreme Being in ſuch terms as this, we are ſo far from thinking, that to us it appears not probable that ſuch a ſavage, in a ſtate of ſolitude, would be led by inſtinct to ſuppoſe the exiſtence of that Being. But as ſoon as the being and attributes of God were, by whatever means, made known unto man, every ſentiment expreſſed in this prayer muſt neceſſarily have been generated in his mind; for not to be ſenſible that we derive our exiſtence and all our enjoyments from God, is in effect to deny his being or his providence; and not to feel a wiſh that he would give us what we want, is to deny either his goodneſs or his power.

41 Whether or not is public worſhip a duty of natural religion?

The worſhip of God therefore is a natural duty reſulting from the contemplation of his attributes and a ſenſe of our own dependence. But the reaſoning which has led us to this concluſion reſpects only *private* devotion; for it is a queſtion of much greater difficulty, and far enough from being yet determined, whether *public* worſhip be a duty of that religion which can with any propriety be termed *natural*. Mr Wollaſton indeed poſitively affirms that it is, and endeavours to prove his poſition by the following arguments.

42 Arguments for it,

"A man (ſays he) may be conſidered as a member of ſome ſociety: and as *ſuch* he ought to worſhip God if he has the opportunity of doing it, if there be proper prayers uſed publicly which he may reſort to, and if his health, &c. permit. Or the ſociety may be conſidered as *one body*, that has common intereſts and concerns, and *as ſuch* is obliged to worſhip the Deity, and offer one prayer. Beſides, there are many who know not of themſelves how to pray; perhaps cannot ſo much as read. Theſe muſt be taken *as they are*; and conſequently ſome time and place *appointed* where they may have ſuitable prayers read to them, and be guided in their devotions. And further, towards the keeping mankind in order, it is *neceſſary* there ſhould be ſome religion profeſſed, and even eſtabliſhed, which cannot be without public worſhip. And were it not for that ſenſe of virtue which is *principally* preſerved (ſo far as it is preſerved) by national *forms* and *habits* of religion, men would ſoon loſe it *all*, run wild, prey upon one another, and do what elſe the worſt of ſavages do."

43 Borrowed from revelation.

Theſe are in themſelves juſt obſervations, and would come with great force and propriety from the tongue or pen of a Chriſtian preacher, who is taught by revelation that the Maſter whom he ſerves has commanded his followers "not to forſake the aſſembling of themſelves together," and has promiſed, "that if two of them ſhall agree on earth as touching any thing that they ſhall aſk, it ſhall be done for them of his Father who is in heaven." As urged by ſuch a man and on ſuch grounds, they would ſerve to ſhow the fitneſs of the divine command, and to point out the benefits which a religious obedience to it might give us reaſon to expect. But the author is here profeſſing to treat of *natural* religion, and to ſtate the duties which reſult from the mere relation which ſubſiſts between man as a creature and God as his creator and conſtant preſerver. Now, though we readily admit the benefits of public worſhip as experienced under the Chriſtian diſpenſation, we do not perceive any thing in this reaſoning which could lead a pious theiſt to expect the ſame benefit previous to all experience. When the author thought of *national forms* and *eſtabliſhments of religion*, he certainly loſt ſight of his proper ſubject, and, as ſuch writers are too apt to do, comprehended under the religion of nature what belongs only to that which is revealed. Natural religion, in the proper ſenſe of the words, admits of no particular *forms*, and of no *legal eſtabliſhment*. Private devotion is obviouſly one of its duties, becauſe ſentiments of adoration, confeſſion, ſupplication, and thankſgiving, neceſſarily ſpring up in the breaſt of every man who has juſt notions of God and of himſelf: but it is not ſo obvious that ſuch notions would induce any body of men to meet at *ſtated times* for the purpoſe of expreſſing their devotional ſentiments in public. Mankind are indeed ſocial beings, and naturally communicate their ſentiments to each other; but we cannot conceive what ſhould at firſt have led them to think that public worſhip at ſtated times would be acceptable to the ſelf-exiſtent Author of the univerſe. In caſe of a famine, or any other calamity in which the whole tribe was equally involved, they might ſpeak of it to each other, inquire into its cauſe, and in the extremity of their diſtreſs join perhaps in one fervent petition, that God would remove it. In the ſame manner they might be prompted to pour forth occaſional ejaculations of public gratitude for public mercies; but it does not follow from theſe incidental occurrences that they would be led to inſtitute times and places and forms of national worſhip, as if they believed the omniſcient Deity more ready to hear them in public than in private. That the appointment of ſuch times and forms and places is beneficial to ſociety, experience teaches us; and therefore it is the duty, and has been the practice, of the ſupreme magiſtrate in every age and in every civilized country to provide for the maintenance of the national worſhip. But this practice has taken its riſe, not from the deductions of reaſon, but either from direct revelation, as among the Jews and Chriſtians; or from tradition, which had its origin in ſome early revelation, as among the more enlightened Pagans of ancient and modern times.

We hope that none of our readers will be ſo unjuſt as to ſuppoſe that by this diſquiſition we mean, in any degree, to

44 Its great uſefulneſs

call in queſtion the fitneſs or the duty of public worſhip. This is ſo far from our intention, that we firmly believe with Mr. Wollaſton, that what piety remains among us is to be attributed in a great meaſure to the practice of frequenting the church on Sundays; and that it is the neglect of this particular duty which has rendered the preſent generation of men leſs pious, leſs humble, and more prone to faction than their fathers were, who made it a point every Lord's day to unite with ſome congregation of Chriſtians in the public worſhip of their Creator and Redeemer. But whilſt we are convinced of the importance and neceſſity of this too much neglected duty, and could wiſh to impreſs our conviction upon the minds of all our readers, we do not apprehend that we leſſen its dignity, or detract from the weight of almoſt univerſal practice, by endeavouring to derive that practice from its true ſource, which appears to us to be not human reaſon, but divine revelation.

45 The practice of virtue a duty of natural religion.

But whatever doubts may be entertained with reſpect to the origin of public worſhip, there can be none as to the foundation of moral virtue. Reaſon clearly perceives it to be the will of our Maker, that every individual of the human race ſhould treat every other individual as, in ſimilar circumſtances, he could juſtly expect to be treated himſelf. It is thus only that the greateſt ſum of human happineſs can be produced (ſee MORAL PHILOSOPHY, nº 17. and 135.); for were all men temperate, ſober, juſt in their dealings, faithful to their promiſes, and charitable to the poor, &c. it is obvious that no miſeries would be felt upon earth, but the few which, by the laws of corporeal nature, unavoidably reſult from the union of our minds with ſyſtems of matter. But it has been already ſhown, that the deſign of God in forming ſentient beings was to communicate to them ſome portion, or rather ſome reſemblance, of that felicity which is eſſential to himſelf; and therefore every action which in its natural tendency co-operates with this deſign muſt be agreeable to him, as every action of a contrary tendency muſt be diſagreeable.

46 Cruelty to the inferior animals a ſin.

From this reaſoning it follows undeniably, that we are obliged not only to be juſt and beneficent to one another, but alſo to abſtain from all unneceſſary cruelty to inferior animals. That we have a right to tame cattle, and employ them for the purpoſes of agriculture and other arts where ſtrength is required, is a poſition which we believe has never been controverted. But if it is the intention of God to communicate, in different degrees according to their different ranks, a portion of happineſs to all his creatures endowed with ſenſe, it is obvious that we ſin againſt him when we ſubject even the horſe or the aſs to greater labour than he is able to perform; and this ſin is aggravated when from avarice we give not the animal a ſufficient quantity of food to ſupport him under the exertions which we compel him to make. That it is our duty to defend ourſelves and our property from the ravages of beaſts of prey, and that we may even exterminate ſuch beaſts from the country in which we live, are truths which cannot be queſtioned; but it has been the opinion of men, eminent for wiſdom and learning, that we have no right to kill an ox or a ſheep for *food*, but in conſequence of the divine permiſſion to Noah recorded in the ninth chapter of the book of Geneſis. Whether this opinion be well or ill founded we ſhall not poſitively determine, though the arguments upon which it is made to reſt are of ſuch a nature as the faſhionable reaſoners of the preſent day would perhaps find it no eaſy taſk to anſwer; but it cannot admit of a doubt, that, in killing ſuch animals, we are, in duty to *their* Creator and *ours*, bound to put them to the leaſt poſſible pain. If this be granted, and we do not ſee how it can be denied by any man convinced of the benevolence of the Deity, it is ſtill more evident that we act contrary to the divine will when, for our mere amuſement, we torture and put to death ſuch animals as are confeſſedly not injurious to ourſelves, or to any thing upon which the comforts of life are known to depend. We are indeed far from being convinced with the poet, that inſects and reptiles "in mortal ſufferance feel as when a giant dies," (ſee PLEASURE and PHYSIOLOGY, Sect. viii.); but their feelings on that occaſion are certainly ſuch, as that, when we wantonly inflict them, we thwart, as far as in our power, the benevolent purpoſe of the Creator in giving them life and ſenſe. Let it be obſerved too, that the man who practiſes needleſs cruelty to the brute creation is training up his mind for exerciſing cruelty towards his fellow creatures, to his ſlaves if he have any, and to his ſervants; and by a very quick progreſs to all who may be placed beneath him in the ſcale of ſociety.

Such are the plain duties of natural religion; and if they were univerſally practiſed, it is ſelf-evident that they would be productive of the greateſt happineſs which mankind could enjoy in this world, and that piety and virtue would be their own reward. They are however far from being univerſally practiſed; and the conſequence is, that men are frequently raiſed to affluence and power by vice, and ſometimes ſunk into poverty by a rigid adherence to the rules of virtue.

47 Natural religion defective in its evidence of a future ſtate.

This being the caſe, there can be no queſtion of greater importance, while there are few more difficult to be anſwered, than "What are the ſanctions by which natural religion enforces obedience to her own laws?" It is not to be ſuppoſed that the great body of mankind ſhould, without the proſpect of an ample reward, practiſe virtue in thoſe inſtances in which ſuch practice would be obviouſly attended with injury to themſelves; nor does it appear reaſonable in any man to forego preſent enjoyment, without the well-grounded hope of thereby ſecuring to himſelf a greater or more permanent enjoyment in reverſion. Natural religion therefore, as a ſyſtem of doctrines influencing the conduct, is exceedingly defective, unleſs it affords ſufficient evidence, intelligible to every ordinary capacity, of the immortality of the ſoul, or at leaſt of a future ſtate of rewards and puniſhments. That it *does* afford this evidence, is ſtrenuouſly maintained by ſome deiſts, and by many philoſophers of a different deſcription, who, though they profeſs Chriſtianity, ſeem to have ſome unaccountable dread of being deceived by their bibles in every doctrine which cannot be propped by the additional buttreſs of philoſophical reaſoning.

48 The general expectation of a future ſtate.

One great argument made uſe of to prove that the immortality of the ſoul is among the doctrines of natural religion, is the univerſal belief of all ages and nations that men continue to live in ſome other ſtate after death has ſeparated their ſouls from their bodies. "Quod ſi *omnium conſenſus naturæ vox eſt:* omneſque, qui ubiqui ſunt, conſentiunt eſſe aliquid, quod ad eos pertineat, qui vita ceſſerint: nobis quoque idem exiſtimandum eſt: et ſi, quorum aut ingenio, aut virtute animus excellit, eos arbitramur, quia natura optima ſunt, cernere naturæ vim maxime: veriſimile eſt, *cum optimus quiſque maxime poſteritati ſerviat*, eſſe aliquid, cujus is poſt mortem ſenſum ſit, habiturus. Sed ut deos eſſe natura opinamur, qualeſque ſint, ratione cognoſcimus, ſic permanere animos arbitramur *conſenſu nationum omnium* *."

49 Not the offspring of nature.

That this is a good argument for the truth of the doctrine, through whatever channel men may have received it, we readily acknowledge; but it appears not to us to be any proof of that doctrine's being the deduction of human reaſoning. The popular belief of Paganiſm, both ancient and modern, is ſo fantaſtic and abſurd, that it could never have been

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* Cicer. Tuſc. Queſt. lib. i. § 15, 16.

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been rationally inferred from what nature teaches of God and the ſoul. In the Elyſium of the Greek and Roman poets, departed ſpirits were viſible to mortal eyes; and muſt therefore have been clothed with ſome material vehicle of ſufficient denſity to reflect the rays of light, though not to reſiſt the human touch. In the mythology of the northern nations, as deceaſed heroes are repreſented as eating and drinking, they could not be conſidered as entirely diveſted of matter; and in every popular creed of idolatry, future rewards were ſuppoſed to be conferred, not for private virtue, but for public violence, upon heroes and conquerors and the deſtroyers of nations. Surely no admirer of what is now called natural religion will pretend that theſe are part of its doctrines; they are evidently the remains of ſome primeval tradition obſcured and corrupted in its long progreſs through ages and nations.

50 Opinions of the philoſophers reſpecting a future ſtate.

The philoſophers of Greece and Rome, deſpiſing the popular mythology of their reſpective countries, employed much time and great talents in diſquiſitions concerning the human ſoul and the probability of a future ſtate; and if the genuine concluſions of natural religion on this ſubject are anywhere to be found, one would naturally look for them in the writings of thoſe men whoſe genius and virtues did honour to human nature. Yet it is a fact which cannot be controverted, that the philoſophers held ſuch notions concerning the ſubſtance of the ſoul and its ſtate after death as could afford no rational ſupport to ſuffering virtue, (ſee METAPHYSICS, Part III. chap. 4). Socrates is indeed an exception. Confining himſelf to the ſtudy of ethics, and deſpiſing thoſe metaphyſical ſubtilties with which ſo many others had bewildered themſelves, that excellent perſon inferred by the common moral arguments (ſee MORAL PHILOSOPHY, nº 232—246), that the reality of a future ſtate of rewards and puniſhments is in the higheſt degree probable. He was not, however, at all times abſolutely *convinced* of this important truth; for a little before his death he ſaid to ſome who were about him, "I am now about to leave this world, and ye are ſtill to continue in it; which of us have the better part allotted us, God only knows*." And again, at the end of his moſt admired diſcourſe concerning the immortality of the ſoul, delivered at a time when he muſt have been ſerious, he ſaid to his friends who came to pay their laſt viſit, "I would have you to know that I have great hopes that I am now going into the company of good men; yet I would not be too peremptory and confident concerning it §."

Next to Socrates, Cicero was perhaps the moſt reſpectable of all the philoſophers of antiquity; and he ſeems to have ſtudied this great queſtion with uncommon care: yet what were his concluſions? After retailing the opinions of various ſages of Greece, and ſhowing that ſome held the ſoul to be the *heart*; others, the *blood* in the heart; ſome, the *brain*; others, the *breath*; one, that it was *harmony*; another, that it was *number*; one, that it was *nothing* at all; and another, that it was a certain *quinteſſence* without a name, but which might properly be called εντελεχια—he gravely adds, "Harum ſententiarum quæ vera ſit, Deus aliquis viderit: quæ veriſimillima, magna queſtio eſt §." He then proceeds to give his own opinion; which, as we have ſhown elſewhere, was, that the ſoul is part of God.

To us who know by other evidence that the ſoul is immortal, and that there will be a future ſtate in which all the obliquities of the preſent ſhall be made ſtraight, the argument drawn from the moral attributes of God, and the unequal diſtribution of the good things of this life, appears to have the force of demonſtration. Yet none of us will ſurely pretend to ſay that his powers of reaſoning are greater than were thoſe of Socrates and Cicero: and therefore the probability is, that had we been like them deſtitute of the light of revelation, we ſhould have been diſturbed by the ſame doubts, and have ſaid with the latter, upon reading the arguments of the former as detailed by Plato, "Neſcio quomodo, dum lego, aſſentior: cum poſui librum, et mecum ipſe de immortalitate animorum cœpi cogitare, aſſenſio illa elabitur ‡."

51 Without the light of revelation we ſhould have doubted like them.

No one, we hope, will ſuſpect us of an impious attempt to weaken the evidence of a future ſtate, God forbid! The expectation of that ſtate is the only ſupport of virtue and religion; and we think the arguments which we have ſtated elſewhere, and referred to on the preſent occaſion, make the reality of it ſo highly probable, that, though there were no other evidence, he would act a very fooliſh part who ſhould confine his attention wholly to the preſent life. But we do not apprehend that we can injure the cauſe either of virtue or of religion, by confeſſing, that thoſe arguments which left doubts in the minds of Socrates and Cicero appear not to us to have the force of *complete demonſtration* of that life and immortality which our Saviour brought to light through the goſpel.

52 Natural religion has no means of certainly reconciling the Deity to ſinners.

Were the caſe, however, otherwiſe; were the arguments which the light of nature affords for the immortality of the human ſoul as abſolutely convincing as any geometrical demonſtration—natural religion would ſtill be defective; becauſe it points out no method by which ſuch as have offended God may be certainly reſtored to his favour, and to the hopes of happineſs, which by their ſin they had loſt. That he who knows whereof we are made would ſhow himſelf placable to ſinners, and that he would find ſome way to be reconciled, might perhaps be reaſonably inferred from the conſideration of his benevolence diſplayed in his works. But when we come to inquire more particularly *how* we are to be reconciled, and whether a *propitiation* will be required, *nature* ſtops ſhort, and expects with impatience the aid of ſome particular revelation. That God will receive returning ſinners, and accept of repentance inſtead of perfect obedience, cannot be certainly known by thoſe to whom he has not *declared* that he will. For though repentance be the moſt probable, and indeed the only means of reconciliation which nature ſuggeſts; yet whether he, who is of purer eyes than to behold iniquity, will not require ſomething further before he reſtore ſinners to the privileges which they have forfeited, mere human reaſon has no way of diſcovering. From nature therefore ariſes no ſufficient comfort to ſinners, but anxious and endleſs ſolicitude about the means of appeaſing the Deity. Hence thoſe divers ways of ſacrificing, and thoſe numberleſs ſuperſtitions which overſpread the heathen world, but which were ſo little ſatisfactory to the wiſer part of mankind, that, even in thoſe days of darkneſs, the philoſophers frequently declared that, in their opinion, thoſe rites and oblations could avail nothing towards appeaſing the wrath of an offended God, or making their prayers acceptable to him. Hence Socrates and one of his diſciples are repreſented by Plato† as expecting a perſon divinely commiſſioned to inform them whether ſacrifices be acceptable to the Deity, and as reſolving to offer no more till that perſon's arrival, which they piouſly hoped might be at no great diſtance.

53 Theſe doubts removed by the Scriptures.

This darkneſs of the pagan world, which the beſt of men who lived under it ſo pathetically deplored, is to us who live under the ſunſhine of the goſpel happily removed by the various revelations contained in the ſcriptures of the Old and New Teſtaments. Theſe taken together, and in the order in which they were given, exhibit ſuch a diſplay of providence, ſuch a ſyſtem of doctrines, and ſuch precepts of practical

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[*] Plato in Apolog. Soc.

[§] Plato in Phæd.

[§] Tuſc. Queſt. lib. i § 9, 10, 11.

[‡] Ibid.

[†] In Alcibiades.

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practical wiſdom, as the ingenuity of man could never have diſcovered. The Chriſtian, with the ſcriptures in his hands, can regulate his conduct by an infallible guide, and reſt his hopes on the ſureſt foundation. Theſe ſcriptures it is now our buſineſs to examine.

PART II. OF REVEALED THEOLOGY.

54 Many pretences to revelation,

IN every civilized country the popular ſyſtem of theology has claimed its origin from divine revelation. The Pagans of antiquity had their augurs and oracles; the Chineſe have their inſpired teachers Confucius and Fohi; the Hindoos have their ſacred books derived from Brahama; the followers of Mahomet have their koran dictated by an angel; and the Jews and Chriſtians have the ſcriptures of the Old and New Teſtaments, which they believe to have been written by holy men of old, who ſpake and wrote as they were moved by the Holy Ghoſt.

That the claims of ancient Paganiſm to a theology derived from heaven, as well as the ſimilar claims of the Chineſe, Hindoos, and Mahometans, are ill founded, has been ſhown in various articles of this work, (ſee CHINA, HINDOSTAN, MAHOMETANISM, MYTHOLOGY, and POLYTHEISM); whilſt, under the words RELIGION, REVELATION, and SCRIPTURE, we have ſufficiently proved the divine inſpiration of the Jewiſh and Chriſtian ſcriptures, and of courſe the divine origin of Jewiſh and Chriſtian theology. Theſe indeed are not two ſyſtems of theology, but parts of one ſyſtem which was gradually revealed as men were able to receive it; and therefore both ſcriptures muſt be ſtudied by the Chriſtian divine.

55 Though the Jewiſh and Chriſtian revelations are alone true.

There is nothing in the ſacred volume which it is not of importance that he ſhould underſtand whoſe office it is to be a teacher of religion; for the whole proceeds from the fountain of truth: but ſome of its doctrines are much more important than others, as relating immediately to man's everlaſting happineſs; and theſe it has been cuſtomary to arrange and digeſt into regular ſyſtems, called *bodies* or *inſtitutes* of *Chriſtian theology*. Could theſe artificial ſyſtems be formed with perfect impartiality, they would undoubtedly be uſeful, for the bible contains many hiſtorical details, but remotely related to human ſalvation; and even of its moſt important truths, it requires more time and attention than the majority of Chriſtians have to beſtow, to diſcover the mutual connection and dependence.

56 Common diviſions of revealed theology,

Artificial ſyſtems of theology are commonly divided into two great parts, the *theoretic* and the *practical;* and theſe again are ſubdivided into many inferior branches. Under the theoretic part are ſometimes claſſed,

1. *Dogmatic* theology; which comprehends an entire ſyſtem of all the dogmas or tenets which a Chriſtian is bound to believe and profeſs. The truth of theſe the divine muſt clearly perceive, and be able to enforce upon his audience: and hence the neceſſity of ſtudying what is called,

2. The *exegeſis*, or the art of attaining the true ſenſe of the holy ſcriptures; and,

3. *Hermeneutic* theology, or the art of interpreting and explaining the ſcriptures to others; an art of which no man can be ignorant who knows how to attain the true ſenſe of them himſelf.

4. *Polemical* theology, or controverſy; and,

5. *Moral* theology, which is diſtinguiſhed from moral philoſophy, or the ſimple doctrine of ethics, by teaching a much higher degree of moral perfection than the mere light of reaſon could ever have diſcovered, and adding new motives to the practice of virtue.

The practical ſciences of the divine are,

1. *Homiletic*, or *paſtoral* theology; which teaches him to adapt his diſcourſes from the pulpit to the capacity of his hearers, and to purſue the beſt methods of guiding them by his doctrine and example in the way of ſalvation.

2. *Catechetic* theology, or the art of teaching youth and ignorant perſons the principal points of evangelical doctrine, as well with regard to belief as to practice.

3. *Caſuiſtic* theology, or the ſcience which decides on doubtful caſes of moral theology, and that calms the ſcruples of conſcience which ariſe in the Chriſtian's ſoul during his journey through the preſent world.

We have mentioned theſe diviſions and ſubdiviſions of the ſcience of theology, not becauſe we think them important, but merely that our readers may be at no loſs to underſtand the terms when they meet with them in other works. Of ſuch terms we ſhall ourſelves make no uſe, for the greater part of them indicate diſtinctions where there is no difference, and tend only to perplex the ſtudent. As the truths of Chriſtianity are all contained in the ſcriptures of the Old and New Teſtaments, it is obvious that dogmatic theology muſt comprehend the ſpeculative part of that which is called moral, as well as every doctrine about which controverſy can be of importance. But no man can extract a ſingle dogma from the bible but by the practice of what is here called the *exegeſis;* ſo that all the ſubdiviſions of this arrangement of theoretical theology muſt be ſtudied together as they neceſſarily coaleſce into one. The ſame thing is true of the three branches into which practical theology is here divided. He who has acquired the art of adapting his homilies to the various capacities of a mixed audience, will need no new ſtudy to fit him for inſtructing children, and the moſt ignorant perſons who are capable of inſtruction; and the complete maſter of moral theology will find it no very difficult taſk to reſolve all the caſes of conſcience which he can have reaſon to ſuppoſe will ever be ſubmitted to his judgment. For theſe reaſons we ſhall not, in the ſhort ſummary which our limits permit us to give, trouble either ourſelves or our readers with the various diviſions and ſubdiviſions of theology. Our preliminary directions will ſhow them how we think the ſcience ſhould be ſtudied; and all that we have to do as ſyſtem-*builders*, a title of which we are far from being ambitious, is to lay before them the view which the ſcriptures preſent to us of the being and perfections of God, his various diſpenſations to man, and the duties thence incumbent upon Chriſtians. In doing this, we ſhall follow the order of the divine diſpenſations as we find them recorded in the Old and New Teſtaments, dwelling longeſt upon thoſe which appear to us of moſt general importance. But as we take it for granted that every reader of this article will have previouſly read the whole ſacred volume, we ſhall not ſcruple to illuſtrate dogmas contained in the Old Teſtament by texts taken from the New, or to confirm doctrines peculiar to the Chriſtian religion by the teſtimony of Jewiſh prophets.

57 Uſeleſs,

SECT. I. *Of God and his Attributes.*

58 The firſt revelation ſuppoſes the Being of God to be a known truth.

IN every ſyſtem of theology the firſt truths to be believed are thoſe which relate to the being and attributes of God. The Jewiſh lawgiver, therefore, who records the earlieſt revelations that were made to man, begins his hiſtory with a diſplay of the power and wiſdom of God in the creation of the world. He does not inform his countrymen,

men, and expect them to believe, upon the authority of his divine commiſſion, that God *exiſts*; for he well knew that the being of God muſt be admitted, and tolerably juſt notions entertained of his attributes, before man can be required to pay any regard to miracles which afford the only evidence of a primary revelation. " In the beginning (ſays he) God created the heavens and the earth." Here the being of God is aſſumed as a truth univerſally received; but the ſentence, ſhort as it is, reveals another which, as we ſhall afterwards ſhew, human reaſon could never have diſcovered.

59
Extraordinary denomination of the Supreme Being in the book of Geneſis

It will however be proper, before we conſider the creation of the world, and compare what the ſcriptures ſay of it with the opinions of the moſt enlightened ancients on the ſame ſubject, to attend to the appellation which is here given to God; and inquire what light is thrown upon it by ſubſequent revelations. The paſſage in the original is בראשית ברא אלהים, where it is remarkable that the Creator is denominated by a noun in the plural number, ſignifying literally " perſons under the obligation of an oath to perform certain conditions." This is certainly a very extraordinary denomination for the one ſupreme and ſelf-exiſtent Being; and what adds to the ſtrangeneſs of the phraſeology is, that the verb with which this plural noun is made to agree is put in the ſingular number. What now could be the ſacred hiſtorian's motive for expreſſing himſelf in this manner? His ſtyle is in general remarkable for its plainneſs and grammatical accuracy; and we believe it would be difficult to find in all his five books a ſingle phraſe not relating to the Supreme Being in which there appears ſuch a violation of concord.

In anſwer to this queſtion, it has been ſaid, that Moſes uſes the plural noun to expreſs in a magnificent way the majeſty of God, juſt as it is cuſtomary for kings and earthly potentates, when publiſhing edicts and laws, to call themſelves *we* and *us*. But there is no evidence on record that ſuch a mode of ſpeaking was introduced among kings at a period ſo early as the era of Moſes. Pharaoh was probably as mighty a potentate as any who then reigned upon the earth; but though he is often mentioned by the ſame ſacred hiſtorian as iſſuing edicts with regal authority, he is nowhere repreſented as ſpeaking of himſelf in the plural number. Let it be obſerved, too, that whenever this phraſeology was introduced among men, the plural noun was in every grammatical tongue joined to a plural verb; whereas Moſes not only puts the noun and the verb in different numbers in the verſe under conſideration, but afterwards repreſents the אלהים as ſaying, " let *us* make man in *our* image;" and, " behold the man is become as *one of us*." Such phraſes as theſe laſt were never uſed by a ſingle man, and therefore cannot have been borrowed from human idioms.

Do they then denote a plurality of gods? No; there is nothing which the ſcriptures more frequently or more earneſtly inculcate than the unity of the divine nature. The texts aſſerting this great and fundamental truth are almoſt numberleſs. " Unto thee (ſays Moſes to his countrymen[†]) it was ſhewed, that thou mighteſt know that the Lord is God; there is *none elſe beſides him*. Know therefore that the Lord *he is God* in *heaven above* and upon the *earth beneath: there is none elſe*." And again, " Hear, O Iſrael, the Lord our God is *one Lord*," or, as it is expreſſed in the original, " Jehovah our God is one Jehovah," one Being to whom exiſtence is eſſential, who could not have a beginning and cannot have an end. In the prophecies of Iſaiah, God is introduced as repeatedly declaring[‡], " I am Jehovah, and there is *none elſe*; there is *no God beſides me*; that they may know from the riſing of the ſun and from the weſt, that there is *none beſides me*: I am *Jehovah*, and there is *none elſe*: Is there a God beſides me? Yea there is *no God*; I know not any." In perfect harmony with theſe declarations of Moſes and the prophets, our Saviour, addreſſing himſelf to his Father, ſays[§], " This is life eternal, that they might know *Thee, the only true God*, and Jeſus Chriſt whom Thou haſt ſent;" and St Paul, who derived his doctrine from his divine Maſter, affirms[‖], that an idol is nothing in the world; and that there is *none other God but one*."

The unity of the divine nature, which, from the order and harmony of the world, appears probable to human reaſon, theſe texts of revelation put beyond a doubt. Hence the firſt precept of the Jewiſh law, and, according to their own writers, the foundation of their whole religion, was, " Thou ſhalt have none other gods before Me." Hence, too, the reaſon of that ſtrict command to Jews and Chriſtians to give divine worſhip to none but God: " Thou ſhalt worſhip the Lord thy God, and him only ſhalt thou ſerve;" becauſe he is *God alone*. Him only muſt we fear, becauſe he alone hath infinite power; in him alone muſt we truſt, becauſe " he only is our rock and our ſalvation;" and to him alone muſt we direct our devotions, becauſe " he only knoweth the hearts of the children of men."

60
Denotes a plurality of perſons in the Godhead.

It is paſt diſpute, then, that the word אלהים does not indicate a plurality of gods. In the opinion, however, of many eminent divines, it denotes, by its junction with the ſingular verb, a plurality of perſons in the one Godhead; and ſome few have contended, that by means of this peculiar conſtruction, the Chriſtian doctrine of the Trinity may be proved from the firſt chapter of the book of Geneſis. To this latter opinion we can by no means give our aſſent. That there are three diſtinct perſons in the one divine nature may be inferred with ſufficient evidence from a multitude of paſſages in the Old and New Teſtaments diligently compared together; but it would perhaps be raſh to reſt the proof of ſo ſublime a myſtery upon any ſingle text of holy ſcripture, and would certainly be ſo to reſt it upon the text in queſtion. That Moſes was acquainted with this doctrine, we, to whom it has been explicitly revealed, may reaſonably conclude from his ſo frequently making a plural name of God to agree with a verb in the ſingular number, but had we not poſſeſſed the brighter light of the New Teſtament to guide us, we ſhould never have thought of drawing ſuch an inference. For ſuppoſing the word אלהים to denote clearly a plurality of perſons, and that it cannot poſſibly ſignify any thing elſe, how could we have known that the number is neither more nor leſs than three, had it not been aſcertained to us by ſubſequent revelations?

There are indeed various paſſages in the Old Teſtament of the phraſeology of which no rational account can be given, but that they indicate more than one perſon in the Godhead. Such are thoſe texts already noticed, " and the Lord God ſaid, let US make man in OUR image, after OUR likeneſs;" and " the Lord God ſaid, behold the man is become like ONE of US." To theſe may be added the following, which are to us perfectly unintelligible upon any other ſuppoſition; " and the Lord God, ſaid, let US go down and there confound their language[†]." " If I be a *Maſter* (in the Hebrew *adonim*, MASTERS), where is my fear[‡]?" " The fear of the Lord (JEHOVAH) is the beginning of wiſdom, and the knowledge of the Holy (in the Hebrew HOLY ONES) is underſtanding[‖]." " Remember thy Creator (Hebrew, thy CREATORS) in the days of thy youth[*]." " And now the LORD GOD and his SPIRIT hath ſent me[§]." " Seek ye out of the book of the LORD and read; for MY mouth it hath commanded, and his SPIRIT it hath gathered them[¶]."

That theſe texts imply a plurality of divine perſons, ſeems to us incontrovertible. It has been already obſerved, that when Moſes repreſents God as ſaying, let us make man, the majeſty of the plural number had not been adopted by earthly ſovereigns; and it is obvious that the Supreme being could not, as has been abſurdly ſuppoſed, call upon angels to make man; for in different places of ſcripture* creation is attributed to God alone. Hence it is that Solomon ſpeaks of Creators in the *plural number*, though he means only the one Supreme Being, and exhorts men to remember them in the days of their youth. In the paſſage firſt quoted from Iſaiah, there is a diſtinction made between the *Lord God* and his *Spirit;* and in the other, three divine perſons are introduced, *viz.* the *Speaker*, the *Lord* and the *Spirit* of the Lord. It does not, however, appear evident from theſe paſſages, or from any other that we recollect in the Old Teſtament, that the perſons in Deity are three and no more: but no ſober Chriſtian will harbour a doubt but that the preciſe number was by ſome means or other made known to the ancient Hebrews; for inquiries leading to it would be naturally ſuggeſted by the form in which the high-prieſt was commanded to bleſs the people. "The LORD bleſs thee and keep thee. The LORD make his face to ſhine upon thee, and be gracious unto thee. The Lord lift up his countenance upon thee, and give thee peace†."

[†] Deut. iv. 35. and 39. vi. 4.

[‡] Iſaiah xiv. 5, 6, 18, 21. xliv. 8.

[§] John xvii.

[‖] 1 Cor. viii. 4.

[†] Gen. xi. 6, 7.

[‡] Mal. i. 6.

[‖] Prov. ix. 10.

[*] Eccl. xii. 1.

[§] Iſaiah xlviii. 16.

[¶] Iſaiah xxxiv. 16.

* Job ix 8. Iſa. xlv. paſſim.

† Numb. vi. 24, 25, 26

Of this benediction it has been well obſerved, that if its three articles be attentively conſidered, they will be found to agree reſpectively to the three perſons taken in the uſual order of the FATHER, the SON, and the HOLY GHOST. The Father is the author of *bleſſing* and *preſervation.* *Grace* and *illumination* are from the Son, by whom we have "the light of the knowledge of the glory of God, in the face of Jeſus Chriſt." *Peace* is the gift of the Spirit, whoſe name is the *Comforter*, and whoſe firſt and beſt fruit is the work of *peace* (1).

61
A Trinity in unity the doctrine of ſcripture.

Similar to this benediction, but much more explicit, is the form of Chriſtian baptiſm; which, to us who live under the ſunſhine of the goſpel, eſtabliſhes the truth of the doctrine of the Trinity beyond all reaſonable ground of diſpute. "Go (ſays our bleſſed Saviour) and teach all nations, baptizing them in the name of the Father, and of the Son, and of the Holy Ghoſt." What was it the apoſtles, in obedience to this command, were to teach all nations? Was it not to turn from their vanities to the living God; to renounce their idols and falſe gods, and ſo to be baptized in the name of the Father, and of the Son, and of the Holy Ghoſt? What now muſt occur to the Gentile nations upon this occaſion, but that, inſtead of all their deities, to whom they had before bowed down, they were in future to ſerve, worſhip, and adore, Father, Son, and Holy Ghoſt, as the only true and living God? To ſuppoſe that GOD and TWO CREATURES are here joined together in the ſolemn rite by which men were to be admitted into a new religion, which directly condemns all *creature-worſhip*, would be ſo extravagantly unreaſonable, that we are perſuaded ſuch a ſuppoſition never was made by any converted Polytheiſt of antiquity. The nations were to be baptized in the name of three perſons, in the *ſame manner*, and therefore, doubtleſs, in the *ſame ſenſe.* It is not ſaid in the name of GOD and his two faithful *ſervants;* nor in the name of GOD, and CHRIST, and the HOLY GHOST, which might have ſuggeſted a thought that *one* only of the three is God; but in the name of the FATHER, and of the SON, and of the HOLY GHOST. Whatever honour, reverence, or regard, is paid to the firſt perſon in this ſolemn rite, the ſame we cannot but ſuppoſe paid to all three. Is he acknowledged as the object of worſhip? So are the other two likewiſe. Is he God and Lord over us? So are they. Are we enrolled as ſubjects, ſervants, and ſoldiers, under him? So are we equally under all. Are we hereby regenerated and made the temple of the Father? So are we likewiſe of the Son and Holy Ghoſt. "We will come (ſays our Saviour‡) and make our abode with him."

‡ John xiv. 23.

If thoſe who believe the inſpiration of the ſcriptures could require any further proof that the Godhead comprehends a Trinity of perſons in one nature, we might urge upon them the apoſtolical form of benediction; "The grace of our LORD JESUS CHRIST, and the love of GOD, and the communion of the HOLY GHOST, be with you all*." Would St Paul, or any other man of common ſenſe, have in the ſame ſentence, and in the moſt ſolemn manner, recommended his Corinthian converts to the love of God, and to the grace and communion of two creatures? We ſhould think it very abſurd to recommend a man at once to the favour of a king and a beggar; but how infinitely ſmall is the diſtance between the greateſt earthly potentate and the meaneſt beggar when compared with that which muſt for ever ſubſiſt between the Almighty Creator of heaven and earth and the moſt elevated creature?

* 2 Cor. xiii. 14.

62
Difficulties in this doctrine.

But how, it will be aſked, can three divine perſons be but one and the ſame God? This is a queſtion which has been often put, but which, we believe, no created being can fully anſwer. The divine nature and its manner of exiſtence is, to us, wholly incomprehenſible; and we might with greater reaſon attempt to weigh the mountains in a pair of ſcales, than by our limited faculties to fathom the depths of infinity. The Supreme Being is preſent in power to every portion of ſpace, and yet it is demonſtrable, that in his eſſence he is not extended (ſee METAPHYSICS, n° 309, 310). Both theſe truths, his inextenſion and omnipreſence, are fundamental principles in what is called *natural religion*; and when taken together they form, in the opinion of moſt people, a myſtery as incomprehenſible as that of the Trinity in unity. Indeed there is nothing of which it is more difficult for us to form a diſtinct notion than *unity* ſimple, and abſolutely indiviſible; and we are perſuaded that ſuch of our readers as have been accuſtomed to turn their thoughts inwards, and reflect upon the operations of their own minds, will acknowledge the difficulty is not much leſs to them. Though the Trinity in unity, therefore, were no Chriſtian doctrine, myſteries muſt ſtill be believed; for they are as inſeparable from the religion of nature as from that of revelation; and atheiſm involves the moſt incomprehenſible of all myſteries, even the beginning of exiſtence without a cauſe. We muſt indeed form the beſt notions that we can of this and of all other myſteries; for if we have no notions whatever of a Trinity in unity, we can neither believe nor diſbelieve that doctrine. It is however to be remembered, that all our notions of God are more or leſs analogical; that they muſt be expreſſed in words which, literally interpreted, are applicable only to man; and that propoſitions underſtood in this literal ſenſe may involve an apparent contradiction, from which the truth meant to be expreſſed by them would be ſeen to be free, had we direct and adequate conceptions of the divine nature. On this account it is to be wiſhed that men treating of the myſtery of the holy Trinity, had always expreſſed themſelves in ſcripture language, and never aimed at being wiſe beyond what is written; but ſince they have acted otherwiſe, we muſt, in juſtice to our readers, animadvert upon one or two ſtatements of this doctrine, which we have reaſon to believe are earneſtly contended for by ſome who conſider themſelves as the only orthodox.

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(1) Petrus Alphonſi, an eminent Jew, converted in the beginning of the 12th century, and preſented to the font by Alphonſus a king of Spain, wrote a learned treatiſe againſt the Jews, wherein he preſſes them with this ſcripture, as a plain argument that there are three perſons to whom the great and incommunicable name of *Jehovah* is applied. And even the unconverted Jews, according to Bechai, one of their Rabbies, have a tradition, that when the high-prieſt pronounced this bleſſing over the people—*elevatione manuum ſic digitos compoſuit, ut* Triada *exprimerent*, "he lifted up his hands, and diſpoſed his fingers into ſuch a form as to expreſs a *Trinity*." All the foundation there is for this in the ſcripture, is Lev. ix. 22. As for the reſt, be it a matter of fact or not, yet if we conſider whence it comes, there is ſomething very remarkable in it. See *Obſerv. Joſ. de voiſ.* in *Pug. Fid.* p. 400, 556, 557.

In the ſcriptures, the three perſons are denominated by the terms Father, Son, and Holy Ghost, or by God, the word, who is alſo declared to be God, and the Spirit of God. If each be truly God, it is obvious that they muſt all have the ſame divine nature, juſt as every man has the ſame human nature with every other man; and if there be but one God, it is equally obvious that they muſt be of the ſame individual ſubſtance or eſſence, which no three men can poſſibly be. In this there is a difficulty; but, as will be ſeen by and by, there is no contradiction. The very terms Father and Son imply ſuch a relation between the two perſons ſo denominated, as that though they are of the ſame ſubſtance, poſſeſſed of the ſame attributes, and equally God, juſt as a human father and his ſon are equally men, yet the ſecond muſt be perſonally ſubordinate to the firſt. In like manner, the Holy Ghost, who is called the Spirit of God, and is ſaid to *proceed from* the *Father*, and to be *ſent* by the *Son*, muſt be conceived as ſubordinate to both, much in the ſame way as a ſon is ſubordinate to his parents, tho' poſſeſſed of equal or even of ſuperior powers. That this is the true doctrine, appears to us undeniable from the words of our Saviour himſelf, who, in a prayer addreſſed to his Father, ſtyles‖ him by way of pre-eminence, "the only true God," as being the fountain or origin of the Godhead from which the Son and the Holy Ghoſt derive their true divinity. In like manner, St Paul, when oppoſing the polytheiſm of the Greeks, ſays expreſsly ‡, that "to us there is but one God, the Father, of whom are all things, and we in, or for, him; and one Lord Jesus Christ, by whom are all things, and we by him."

63
Subordination of the ſecond and third perſons.

That the primitive fathers of the Chriſtian church maintained this ſubordination of the ſecond and third perſons of the bleſſed Trinity to the firſt, has been evinced with ſuch complete evidence by biſhop Bull, that we do not perceive how any man can read his works and entertain a doubt on the ſubject. We ſhall tranſcribe two quotations from him, and refer the reader for fuller ſatisfaction to *ſect.* 4. of his *Defenſio fidei Nicenæ*. The firſt ſhall be a paſſage cited from *Novatian*, or whoever is the author of the book on the Trinity publiſhed among the works of Tertullian, in which the learned prelate aſſures us the ſenſe of all the ancients is expreſſed. "Quia quid eſt Filius, non ex ſe eſt, quia nec innatus eſt; ſed ex patre eſt, quia genitus eſt: ſive dum verbum eſt, ſive dum virtue eſt, ſive dum ſapientia eſt, ſive dum lux eſt, ſive dum Filius eſt, et quicquid horum eſt, non aliunde eſt quam ex Patre, Patri ſuo originem ſuam debens." The next is from Athanaſius, who has never been accuſed of holding low opinions reſpecting the ſecond perſon of the holy Trinity. This father, in his fifth diſcourſe againſt the Arians, ſays, κατα γαρ τον Ιωαννην εν ταυτη τη αρχῃ ην ὁ λογος και ὁ λογος ην προς τον θεον. Θεος γαρ εστιν ἡ αρχη, και επειδαν εξ αυτης εστι, δια τουτο και θεος ην ὁ λογος; *according to John, the word was in this firſt principle, and the word was God. For God is the principle; and becauſe the word is from the principle, therefore the word is God.* Agreeably to this doctrine, the Nicene fathers, in the creed which they publiſhed for the uſe of the univerſal church, ſtyle the only begotten Son, God of God θεος εκ θεου.

Regardleſs however of antiquity, and as we think, of the plain ſenſe of ſcripture, ſome modern divines of great learning contend, that the three perſons in Deity are all *conſubſtantial*, *co-eternal*, *co-ordinate*, without *derivation*, *ſubordination*, or *dependence*, of *any ſort*, as to nature or eſſence; whilſt others affirm, that the ſecond and third perſons derive from the firſt their perſonality, but not their nature. We ſhall conſider theſe opinions as different, though, from the obſcurity of the language in which we have always ſeen them expreſſed, we cannot be certain but they may be one and the ſame. The maintainers of the former opinion hold, that the three perſons called *Elohim* in the Old Teſtament, naturally independent on each other, entered into an agreement before the creation of the world, that one of them ſhould in the fulneſs of time aſſume human nature, for the purpoſe of redeeming mankind from that miſery into which it was foreſeen that they would fall. This antemundane agreement, they add, conſtitutes the whole of that paternal and filial relation which ſubſiſts between the firſt and ſecond perſons whom we denominate Father and Son; and they hold, that the Son is ſaid to be begotten before all worlds, to indicate that *He* who was before all worlds was *begotten*, or to *be* begotten, into the office of redeemer; or, more deciſively, to ſignify that he undertook that office before the creation, and *aſſumed* to himſelf ſome appearance or figure of the reality in which he was to execute it; and he is called μονογενης or the only begotten, becauſe he *alone* was begotten into the office of redeemer*.

64
Denied by ſome modern divines, but

To many of our readers we doubt not but this will appear a very extraordinary doctrine, and not eaſy to be reconciled with the unity of God. It is however ſufficiently overturned by two ſentences of holy ſcripture, about the meaning of which there can be no diſpute. "In this (ſays St John †) was manifeſted the love of God towards us, becauſe that God ſent his only begotten Son into the world, that we might live through him." Taking the word *ſon* in its uſual acceptation, this was certainly a wonderful degree of love in the Father of mercies to ſend into the world on our account a perſon ſo nearly related to him as an only ſon; but if we ſubſtitute this novel interpretation of the words *only begotten ſon* in their ſtead, the apoſtle's reaſoning will loſe all its force. St John will then be made to ſay, "In this was manifeſted the love of God toward us, becauſe that God ſent a divine perſon equal to himſelf, and no way related to him, but who had before the creation covenanted to come into the world, that we might live through him." Is this a proof of the love of the perſon here called God? Again, the inſpired author of the epiſtle to the Hebrews, treating of our Saviour's prieſthood, ſays, among other things expreſſive of his humiliation, that "though he was a son, yet learned he obedience (or, as others would render the words εμαθεν ὑπακοην, he taught obedience) by the things which he ſuffered ‡." If the word *ſon* be here underſtood in its proper ſenſe, this verſe diſplays in a very ſtriking manner the condeſcenſion of our divine Redeemer, who, though he was no leſs a perſon than the proper Son of God by nature, yet vouchſafed to learn or teach us obedience by the things which he ſuffered; but if we ſubſtitute this metaphorical ſonſhip in place of the natural, the reaſoning of the author (for that he is reaſoning cannot be denied) will be very extraordinary. "Though this divine perſonage agreed before all words to ſuffer death for the redemption of man, yet learned he obedience, or yet taught

65
The expreſs doctrine of ſcripture.

‖ John xvii. 3.

‡ 1 Cor. viii. 6

* See Ridgeley's Body of divinity.

† John iv 9.

‡ Heb. v. 8.

he us obedience, by the things which he ſuffered." What ſenſe is there in this argument? Is it a proof of condeſcenſion to fulfil one's engagement? Surely, if the meaning of the word *ſon*, when applied to the ſecond perſon of the bleſſed Trinity, were what is here ſuppoſed, the inſpired writer's argument would have been more to the purpoſe for which it is brought had it run thus; "Though he was *not* a ſon, *i. e.* though he had made no previous agreement, yet condeſcended he to learn or teach," &c.

The other opinion, which ſuppoſes the Son and the Holy Ghoſt to derive from the Father their perſonality, but not their nature, is to us wholly unintelligible; for perſonality cannot exiſt, or be conceived in a ſtate of ſeparation from all natures, any more than a quality can exiſt in a ſtate of ſeparation from all ſubſtances. The former of theſe opinions we are unable to reconcile with the unity of God; the latter is clothed in words that have no meaning. Both, as far as we can underſtand them, are palpable polytheiſm; more palpable indeed than that of the Grecian philoſophers, who though they worſhipped gods many, and lords many, yet all held one God ſupreme over the reſt. See POLYTHEISM, nº 32.

66 The ſecond and third perſons not poſterior to the firſt.

But if the Son and the Holy Ghoſt derive their nature as well as their perſonality from the Father, will it not follow that they muſt be poſterior to him in time, ſince every effect is poſterior to its cauſe? No; this conſequence ſeems to follow only by reaſoning too cloſely from one nature to another, when there is between the two but a very diſtant analogy. It is indeed true, that among men, every father muſt be prior in time as well as in the order of nature to his ſon; but were it eſſential to a man to be a father, ſo as that he could not exiſt otherwiſe than in that relation, it is obvious that his ſon would be coeval with himſelf, though ſtill as proceeding from him, he would be poſterior in the order of nature. This is the caſe with all neceſſary cauſes and effects. The viſible ſun is the immediate and neceſſary cauſe of light and heat, either as emitting the rays from his own ſubſtance, or as exciting the agency of a fluid diffuſed for that purpoſe through the whole ſyſtem. Light and heat therefore muſt be as old as the ſun; and had he exiſted from all eternity, they would have exiſted from eternity with him, though ſtill, as his effects, they would have been behind him in the order of nature. Hence it is, that as we muſt ſpeak analogically of the Divine nature, and when treating of mind, even the Supreme mind, make uſe of words literally applicable only to the modifications of matter, the Nicene fathers illuſtrate the eternal generation of the ſecond perſon of the bleſſed Trinity by this proceſſion of light from the corporeal ſun, calling him *God of God, light of light*.

Another compariſon has been made uſe of to enable us to form ſome notion, however inadequate, how three Divine perſons can ſubſiſt in the ſame ſubſtance, and thereby conſtitute but one God. Moſes informs us, that man was made after the image of God. That this relates to the ſoul more than to the body of man, has been granted by all but a few groſs anthropomorphites; but it has been well obſerved §, that the ſoul, though in itſelf one indiviſible and unextended ſubſtance, is conceived as conſiſting of three principal faculties, the *underſtanding*, the *memory*, and the *will*. Of theſe, though they are all coeval in time, and equally eſſential to a rational ſoul, the underſtanding is in the order of nature obviouſly the firſt, and the memory the ſecond; for things muſt be perceived before they can be remembered; and they muſt be remembered and compared together before they can excite volitions, from being, ſome agreeable, and others diſagreeable. The memory therefore may be ſaid to ſpring from the underſtanding, and the will from both; and as theſe three faculties are conceived to conſtitute one ſoul, ſo may three Divine perſons partaking of the ſame individual nature or eſſence conſtitute one God.

67 No contradiction in the Catholic doctrine of the Trinity.

Theſe parallels or analogies are by no means brought forward as proofs of the Trinity, of which the evidence is to be gathered wholly from the word of God; but they ſerve perhaps to help our labouring minds to form the juſteſt notions of that adorable myſtery which it is poſſible for us to form in the preſent ſtate of our exiſtence; and they ſeem to reſcue the doctrine ſufficiently from the charge of contradiction, which has been ſo often urged againſt it by Unitarian writers. To the laſt analogy we are aware it has often been objected, that the ſoul may as well be ſaid to conſiſt of ten or twenty faculties as of three, ſince the paſſions are equally eſſential to it with the underſtanding, the memory, and the will, and are as different from one another as theſe three faculties are. This, however, is probably a miſtake; for the beſt philoſophy ſeems to teach us, that the paſſions are not innate; that a man might exiſt through a long life a ſtranger to many of them; and that there are probably no two minds in which are generated *all* the paſſions (ſee PASSION); but underſtanding, memory, and will, are abſolutely and equally neceſſary to every rational being. But whatever be in this, if the human mind can be *conceived* to be one indiviſible ſubſtance, conſiſting of different faculties, whether many or few, why ſhould it be thought an impoſſibility for the infinite, and eternal nature of God to be communicated to three perſons acting different parts in the creation and government of the world, and in the great ſcheme of man's redemption.

68 Objections

To the doctrine of the Trinity many objections have been made, as it implies the divinity of the Son and the Holy Ghoſt; of whom the former aſſumed our nature, and in it died for the redemption of man. Theſe we ſhall notice when we come to examine the revelations more peculiarly Chriſtian; but there is one objection which, as it reſpects the doctrine in general, may be properly noticed here. It is ſaid that the firſt Chriſtians borrowed the notion of a Tri-une God from the later Platoniſts; and that we hear not of a Trinity in the church till converts were made from the ſchool of Alexandria. But if this be the caſe, we may properly aſk, whence had thoſe Platoniſts the doctrine themſelves? It is not ſurely ſo ſimple or ſo obvious as to be likely to have occurred to the reaſoning mind of a Pagan philoſopher; or if it be, why do Unitarians ſuppoſe it to involve a contradiction? Plato indeed taught a doctrine in ſome reſpects ſimilar to that of the Chriſtian Trinity, and ſo did Pythagoras, with many other philoſophers of Greece and the Eaſt (ſee PLATONISM, POLYTHEISM, and PYTHAGORAS); but tho' theſe ſages appear to have been on ſome occaſions extremely credulous, and on others to have indulged themſelves in the moſt myſterious ſpeculations, there is no room to ſuppoſe that they were *naturally weaker men* than ourſelves, or that they were capable of inculcating as truths what they *perceived* to involve a *contradiction*. The Platonic and Pythagorean Trinities never could have occurred to the mind of him who merely from the works of creation endeavoured the diſcover the being and attributes of the Creator; and therefore as thoſe philoſophers travelled into Egypt and the Eaſt in queſt of knowledge, it appears to us in the higheſt degree probable, that they picked up this myſterious and ſublime doctrine in thoſe regions where it had been handed down as a dogma from the remoteſt ages, and where we know that ſcience was not taught ſyſtematically, but detailed in collections of ſententious maxims and traditionary opinions. If this be ſo, we cannot doubt but that the Pagan Trinities had their origin in ſome primæval reve-

69 Anſwered.

§ Leſlie's Socinian Controverſy.

revelation. Nothing elſe indeed can account for the general prevalence of a doctrine ſo remote from human imagination, and of which we find veſtiges in the ſacred books of almoſt every civilized people of antiquity. The corrupt ſtate in which it is viewed in the writings of Plato and others, is the natural conſequence of its deſcent through a long courſe of oral tradition; and then falling into the hands of men who bent every opinion as much as poſſible to a conformity with their own ſpeculations. The Trinity of Platoniſm therefore, inſtead of being an objection, lends, in our opinion, no feeble ſupport to the Chriſtian doctrine, ſince it affords almoſt a complete proof of that doctrine's having made part of the firſt revelations communicated to man.

Having thus diſcovered that the one God, to whom Moſes gives the plural name *Elohim*, comprehends three perſons; let us now inquire what power this Tri-une God exerted, when, as the ſame ſacred writer informs us, he created the heaven and the earth. That by the heaven and the earth is here meant the whole univerſe, viſible and inviſible, is known to every perſon acquainted with the phraſeology of Scripture; and we need inform no man converſant with Engliſh writers, that by *creation*, in its proper ſenſe, is meant bringing into *being*, or making that to *exiſt* which exiſted not *before*. It muſt, however, be acknowledged, that the Hebrew word ברא does not always imply the production of ſubſtance, but very often the forming of particular organized bodies out of pre-exiſting matter. Thus when it is ſaid * that God *created* great whales, and every living creature that moveth, which the waters brought forth abundantly after their kind," and again, that "he *created* man male and female;" though the word ברא is uſed on both occaſions, we are not to conceive that the bodies of the firſt human pair, and of theſe animals, were brought into being from nonentity, but only that they were formed by a proper organization being given to pre-exiſtent matter. But when Moſes ſays, "In the beginning God *created* the heaven and the earth," he cannot be ſuppoſed to mean that "in the beginning God only gave form to matter already exiſting of itſelf;" for in the very next verſe we are aſſured that after this act of creation was over, "the earth was ſtill *without form* and void," or, in other words, in a chaotic ſtate.

70
Creation taught by Moſes.

That the Jews, before the coming of our Saviour, underſtood their lawgiver to teach a proper creation, is plain from that paſſage in the ſecond book of the Maccabees, in which a mother, to perſuade her ſon to ſuffer the cruelleſt tortures rather than forſake the law of his God, uſes the following argument: "I beſeech thee, my ſon, look upon the heaven and the earth, and all that is therein, and conſider that God made them of things that were not." To the ſame purpoſe the inſpired author of the epiſtle to the Hebrews, when magnifying the excellence of faith, ſays, "Through faith we underſtand that the worlds were framed by the word of God, ſo that things which are ſeen were not made of things which do appear?" where, as biſhop Pearſon has ably proved ||, the phraſe μη εκ φαινομενων is equivalent to ουκ εξ οντων, in the quotation from the Maccabees.

The very firſt verſe therefore of the book of Geneſis informs us of a moſt important truth, which all the uninſpired wiſdom of antiquity could not diſcover. It aſſures us, that as nothing exiſts by chance, ſo nothing is neceſſarily exiſting but the three divine perſons in the one Godhead. Every thing elſe, whether material or immaterial, derives its ſubſtance, as well as its form or qualities, from the fiat of that ſelf-exiſtent Being, "who was, and is, and is to come."

71
The whole univerſe not created at once.

It does not, however, follow from this verſe, or from any other paſſage in the ſacred Scriptures, that the whole univerſe was called into exiſtence at the ſame inſtant; neither is it by any means evident that the chaos of our world was brought into being on the firſt of thoſe ſix days during which it was gradually reduced into form. From a paſſage ‡ in the book of Job, in which we are told by God himſelf, that when the "foundation of the earth was laid the morning ſtars ſang together, and all the ſons of God ſhouted for Joy," it appears extremely probable that worlds had been created, formed, and inhabited, long before our earth had any exiſtence. Nor is this opinion at all contrary to what Moſes ſays of the creation of the ſtars; for though they are mentioned in the ſame verſe with the ſun and moon, yet the manner in which, according to the original, they are introduced, by no means indicates that all the ſtars were formed at the ſame time with the luminaries of our ſyſtem. Moſt of them may have been created long before, and ſome of them ſince, our world was brought into being; for that clauſe (verſe 16.) "he made the ſtars alſo," is in the Hebrew no more than "and the ſtars;" the words *he made* being inſerted by the tranſlators. The whole verſe therefore ought to be rendered thus, "and God made two great lights; the greater light to rule the day, and the leſſer light with the ſtars to rule the night;" where nothing is intimated with reſpect to the *time* when the ſtars were formed, any more than in that verſe of the Pſalms ||, which exhorts us to give thanks to God who made the moon and ſtars to rule by night; for his mercy endureth "for ever." The firſt verſe of the book of Geneſis informs us, that all things ſpiritual and corporeal derive their exiſtence from God; but it is nowhere ſaid that all matter was created at the ſame time; and the generations of men afford ſufficient evidence of a ſucceſſive and continual creation of ſpirits.

72
The ſolar ſyſtem created at once.

That the whole corporeal univerſe *may have been* created at once muſt be granted; but if ſo, we have reaſon to believe that this earth, with the ſun and all the planets of the ſyſtem, were ſuffered to remain for ages in a ſtate of chaos, "without form and void;' becauſe it appears from other ſcriptures, that worlds of intelligent creatures exiſted, and even that ſome angels had fallen from a ſtate of happineſs prior to the era of the Moſaic coſmogony. That the ſun and the other planets revolving round him were formed at the ſame time with the earth, cannot indeed be queſtioned; for it is not only extremely probable in itſelf from the known laws of nature, but is expreſsly affirmed by the ſacred hiſtorian, who relates the formation of the ſun and moon in the order in which it took place. Into the particulars of his narrative we have no occaſion to enter, as it is ſufficiently explained and vindicated in other articles of this work (ſee CREATION and EARTH); but there is one difficulty which, though we have given the common ſolutions of it elſewhere, we may again notice in this place, becauſe it has furniſhed infidel ignorance with ſomething like an objection to the divine legation of the Hebrew lawgiver.

73
A difficulty ſolved.

Moſes informs us, that on the *firſt day* after the production of the chaos, the *element of light* was created; and yet within a few ſentences he declares, that the ſun, the fountain of light, was not made till the *fourth day*. How are theſe two paſſages to be reconciled? We anſwer, That they may be reconciled many ways. Moſes wrote for the uſe of a whole people, and not for the amuſement or inſtruction of a few aſtronomers; and in this view his language is ſufficiently proper, even though we ſuppoſe the formation of the ſun and the other planets to have been carried on at the ſame time, and in the ſame progreſſive manner, with the formation of this earth. The voice which called light into exiſtence would ſeparate the fiery and luminous particles of the

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* Gen. i. 21, 27.

|| Expoſition of the creed.

‡ xxxviii. 7.

|| Pſalms cxxxvi. 9

God and his attributes.

the chaos from thoſe which were opake, and, on this hypotheſis, conſolidate them in one globe, diffuſing an obſcure light through the planetary ſyſtem; but if the earth's atmoſphere continued till the fourth day loaded with vapours, as from the narrative of Moſes it appears to have done, the ſun could not till *that day* have been *ſeen* from the earth, and may therefore, in popular language, be ſaid with ſufficient propriety to have been *formed* on the fourth day, as it was then firſt made to *appear*. (See Creation, n° 13. and Earth, n° 108, 174, 175). But though this ſolution of the difficulty ſerves to remove the infidel objection, and to ſecure the credit of the ſacred hiſtorian, candour compels us to confeſs that it appears not to be the true ſolution.

The difficulty itſelf ariſes entirely from ſuppoſing the ſun to be the ſole fountain of light; but the truth of this opinion is not ſelf-evident, nor has it ever been eſtabliſhed by ſatisfactory proof. It is indeed to a mind diveſted of undue deference to great names, and conſidering the matter with impartiality, an opinion extremely improbable. The light of a candle placed upon an eminence may in a dark night be ſeen in every direction at the diſtance of at leaſt three miles. But if this ſmall body be rendered viſible by means of rays emitted from itſelf, the flame of a candle, which cannot be ſuppoſed more than an inch in diameter, muſt, during every inſtant that it continues to burn, throw from its own ſubſtance luminous matter ſufficient to fill a ſpherical ſpace of ſix miles in diameter. This phenomenon, if real, is certainly ſurpriſing; but if we purſue the reflection a little farther, our wonder will be greatly increaſed. The matter which, when converted into flame, is an inch in diameter, is not, when of the conſiſtence of cotton and tallow, of the dimenſions of the 20th part of an inch; and therefore, upon the common hypotheſis, the 20th part of an inch of tallow may be ſo rarefied as to fill a ſpace of 113,0976 cubic miles! a rarefaction which to us appears altogether incredible. We have indeed heard much of the diviſibility of matter *ad infinitum*, and think we underſtand what are uſually called *demonſtrations* of the truth of that propoſition; but theſe demonſtrations prove not the actual diviſibility of real ſolid ſubſtances, but only that upon trial we ſhall find no end of the ideal proceſs of dividing and ſubdividing imaginary extenſion.

Upon the whole, therefore, we are much more inclined to believe that the matter of light is an extremely ſubtile fluid, diffuſed through the corporeal univerſe, and only excited to agency by the ſun and other fiery bodies, than that it conſiſts of ſtreams continually iſſuing from the ſubſtance of theſe bodies. It is indeed an opinion pretty generally received, and certainly not improbable in itſelf, that light and electricity are one and the ſame ſubſtance (ſee *Electricity Index*); but we know that the electrical fluid, though pervading the whole of corporeal nature, and, as experiments ſhow, capable of acting with great violence, yet lies dormant and unperceived till its agency be excited by ſome foreign cauſe. Juſt ſo it may be with the matter of light. That ſubſtance may be "diffuſed from one end of the creation § to the other, it may traverſe the whole univerſe, form a communication between the moſt remote ſpheres, penetrate into the inmoſt receſſes of the earth, and only wait to be put in a proper motion to communicate viſible ſenſations to the eye. Light is to the organ of ſight what the air is to the organ of hearing. Air is the medium which, vibrating on the ear, cauſes the ſenſation of ſound; but it equally exiſts round us at all times, though there be no ſonorous body to put it in motion. In like manner, light may be equally extended at all times, by night as well as by day, from the moſt diſtant fixed ſtars to this earth, tho' it then only ſtrikes our eyes ſo as to excite viſible ſenſations when impelled by the ſun or ſome other maſs of fire." Nor let any one imagine that this hypotheſis interferes with any of the known laws of optics; for if the rays of light be impelled in ſtraight lines, and in the ſame direction in which they are ſuppoſed to be emitted, the phenomena of viſion muſt neceſſarily be the ſame.

74 Moſes a ſound philoſopher.

Moſes therefore was probably a more accurate philoſopher than he is ſometimes ſuppoſed to be. The element of light was doubtleſs created, as he informs us, on the firſt day; but whether it was then put in that ſtate in which it is the medium of viſion, we cannot know, and we need not inquire, ſince there was neither man nor inferior animal with organs fitted to receive its impreſſions. For the firſt three days it may have been uſed only as a powerful inſtrument to reduce into order the jarring chaos. Or if it was from the beginning capable of communicating viſible ſenſations, and dividing the day from the night, its agency muſt have been immediately excited by the Divine power till the fourth day, when the ſun was formed, and endowed with proper qualities for inſtrumentally diſcharging that office. This was indeed miraculous, as being contrary to the preſent laws of nature: but the whole creation was miraculous: and we ſurely need not heſitate to admit a leſs miracle where we are under the neceſſity of admitting a greater. The power which called light and all other things into exiſtence, could give them their proper motions by ten thouſand different means; and to attempt to ſolve the difficulties of creation by philoſophic theories reſpecting the laws of nature, is to trifle with the common ſenſe as well as the piety of mankind: it is to conſider as ſubſervient to a law that very power by whoſe continued exertion the law is eſtabliſhed.

Having thus proved that the univerſe derives its being, as well as the form and adjuſtment of its ſeveral parts, from the one ſupreme and ſelf-exiſtent God, let us here pauſe, and reflect on the ſublime conceptions which ſuch aſtoniſhing works are fitted to give us of the Divine perfections.

75 Infinite power of the Creator,

And, in the firſt place, how ſtrongly do the works of creation impreſs upon our minds a conviction of the infinite power of their Author? He ſpoke, and the univerſe ſtarted into being; he commanded, and it ſtood faſt. How mighty is the arm which "ſtretched out the heavens and laid the foundations of the earth; which removeth the mountains, and they know it not; which overturneth them in his anger; which ſhaketh the earth out of her place, and the pillars thereof tremble! How powerful the word which commandeth the ſun, and it riſeth not; and which ſealeth up the ſtars;" which ſuſtaineth numberleſs worlds of amazing bulk ſuſpended in the regions of empty ſpace, and directs their various and inconceivably rapid motions with the utmoſt regularity! "Lift up your eyes on high, and behold, who hath created all theſe things? By the word of the Lord were the heavens made, and all the hoſt of them by the breath of his mouth. Hell is naked before him, and deſtruction hath no covering. He ſtretcheth out the North over the empty place, and hangeth the earth upon nothing. He has meaſured the waters in the hollow of his hand, and meted out the heavens with a ſpan; and comprehended the duſt of the earth in a meaſure; and weighed the mountains in ſcales, and the hills in a balance. Behold! the nations are as a drop of the bucket, and are counted as the ſmall duſt of the balance; behold, he taketh up the iſles as a very little thing. All nations before him are as nothing, and they are counted to him leſs than nothing, and vanity. To whom then will ye liken God, or what likeneſs will ye compare unto him ||?"

76 His wiſdom.

As the works of creation are the effects of God's power, they likewiſe in the moſt eminent manner diſplay his wiſdom. This was ſo apparent to Cicero, even from the partial

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§ Nature diſplayed.

|| Pſ. xxxiii. 6, 9.; Job ix. 4, &c. xxvi 6. Iſa. xi. 12.

God and his attributes.

§ De Nat. Deorum, lib. II.

partial and very imperfect knowledge in aſtronomy which his time afforded, that he declared § thoſe who could aſſert the contrary void of all underſtanding. But if that great maſter of reaſon had been acquainted with the modern diſcoveries in aſtronomy, which exhibit numberleſs worlds ſcattered through ſpace, and each of immenſe magnitude; had he known that the ſun is placed in the centre of our ſyſtem, and that to diverſify the ſeaſons the planets move round him with exquiſite regularity; could he have conceived that the diſtinction between light and darkneſs is produced by the diurnal rotation of the earth on its own axis, inſtead of that diſproportionate whirling of the whole heavens which the ancient aſtronomers were forced to ſuppoſe; had he known of the wonderful motions of the comets, and conſidered how ſuch excentric bodies have been preſerved from falling upon ſome of the planets in the ſame ſyſtem, and the ſeveral ſyſtems from falling upon each other; had he taken into the account that there are yet greater things than theſe, and "that we have ſeen but a few of God's works;"—that virtuous Pagan would have been ready to exclaim in the words of the Pſalmiſt, "O Lord, how manifold are thy works! In wiſdom haſt thou made them all; the earth is full of thy riches."

77 And goodneſs.

That creation is the offspring of unmixed goodneſs, has been already ſhown with ſufficient evidence (ſee METAPHYSICS, n° 312, and n° 29, of this article); and from the vaſt number of creatures on our earth endowed with life and ſenſe, and a capability of happineſs, and the infinitely greater number which probably inhabit the planets of this and other ſyſtems, we may infer that the goodneſs of God is as boundleſs as his power, and that "as is his majeſty, ſo is his mercy." Out of his own fulneſs hath he brought into being numberleſs worlds repleniſhed with myriads of myriads of creatures, furniſhed with various powers and organs, capacities and inſtincts; and out of his own fulneſs he continually and plentifully ſupplies them all with every thing neceſſary to make their exiſtence comfortable. "The eyes of all wait upon him, and he giveth them their meat in due ſeaſon. He openeth his hand and ſatisfies the deſires of every living thing: he loveth righteouſneſs and judgment; the earth is full of the goodneſs of the Lord. He watereth the ridges thereof abundantly; he ſettleth the furrows thereof; he maketh it ſoft with ſhowers, and bleſſeth the ſpringing thereof. He crowneth the year with his goodneſs; and his paths drop fatneſs. They drop upon the paſtures of the wilderneſs; and the little hills rejoice on every ſide. The paſtures are clothed with flocks; the valleys alſo are covered with corn; they ſhout with joy, they alſo ſing."* Survey the whole of what may be ſeen on and about this terraqueous globe, and ſay if our Maker hath a ſparing and a niggardly hand. Surely the Author of ſo much happineſs muſt be eſſential goodneſs; and we muſt conclude with St John, that "God is love."

* Pſal. cxlv. 15, 16. xxiii. 5. lv. 10, &c.

78 The ſecond perſon in the Trinity the immediate Creator.

Theſe attributes of power, wiſdom, and goodneſs, ſo conſpicuouſly diſplayed in the works of creation, belong in the ſame ſupreme degree to each perſon in the bleſſed Trinity; for Moſes declares that the heaven and the earth were created, not by *one* perſon, but by the *Elohim*. The λογος indeed, or ſecond perſon, appears to have been the *immediate* Creator; for St John aſſures us,|| that "all things were made by him, and that without him was not any thing made that was made." Some Arian writers of great learning (and we believe the late Dr Price was of the number) have aſſerted, that a being who was created himſelf may be endowed by the Omnipotent God with the power of creating other beings; and as they hold the λογος or *word* to be a creature, they contend that he was employed by the Supreme Deity to create, not the whole univerſe, but only this earth, or at the utmoſt the ſolar ſyſtem. "The old argument (ſays one of them), that no being inferior to the great Omnipotent can create a world, is ſo childiſh as to deſerve no anſwer. Why may not God communicate the power of making worlds to any being whom he may chooſe to honour with ſo glorious a prerogative? I have no doubt but ſuch a power may be communicated to many good men during the progreſs of their exiſtence; and to ſay that it may *not*, is not only to limit the power of God, but to contradict acknowledged analogies."

|| Ch. i. 3.

79 Creation peculiar to God.

We are far from being inclined to limit the power of God. He can certainly do whatever involves not a direct contradiction; and therefore, though we know nothing *analogous* to the power of *creating worlds*, yet as we perceive not any contradiction implied in the notion of that power being communicated, we ſhall admit that ſuch a communication may be *poſſible*, though we think it in the higheſt degree *improbable*. But ſurely no man will contend that the *whole univerſe* was brought into exiſtence by *any creature*; becauſe that creature himſelf, however highly exalted, is neceſſarily comprehended in the notion of the univerſe. Now St Paul expreſsly affirms,§ that, by the ſecond perſon in the bleſſed Trinity, "were ALL *things* created that are in heaven, and that are in earth, *viſible* and *inviſible*, whether they be THRONES, OF DOMINIONS, OF PRINCIPALITIES, OF POWERS; all things were created by him and for him; and he is before all things, and by him all things conſiſt." Indeed the Hebrew Scriptures in more places than one† expreſsly declare that this earth and of courſe the whole ſolar ſyſtem, was *formed* as well as *created*, not by any inferior being, but by the *true* God, even *Jehovah* alone; and in the New Teſtament*, the Gentiles are ſaid to be without excuſe for not glorifying him as God, "becauſe his eternal power and Godhead are clearly ſeen from the creation of the world." But if it were natural to ſuppoſe that the power of creating worlds has been, or ever will be, communicated to beings inferior to the great Omnipotent, this reaſoning of the apoſtle's would be founded on falſe principles, and the ſentence which he paſſed on the Heathen would be contrary to juſtice.

§ Coloſ. iv. 17.

† Iſai. xl. 12. xliv. 24. Jerem. x. 10—13.

* Rom. i. 18—22.

But though it be thus evident that the λογος was the immediate Creator of the univerſe, we are not to ſuppoſe that it was without the concurrence of the other two perſons. The Father, who may be ſaid to be the fountain of the Divinity itſelf, was certainly concerned in the creation of the world, and is therefore in the apoſtle's creed denominated the "Father Almighty, Maker of heaven and earth;" and that the Holy Ghoſt or third perſon is likewiſe a Creator, we have the expreſs teſtimony of two inſpired writers: "By the word of the Lord (ſays the Pſalmiſt) were the heavens made, and all the hoſt of them by the breath (Hebrew SPIRIT) of his mouth." And Job declares that the "SPIRIT of God made him, and that the breath of the Almighty gave him life." Indeed theſe three divine perſons are ſo intimately united, that what is done by one muſt be done by all, as they have but one and the ſame will. This is the reaſon aſſigned by Origen* for our paying divine worſhip to each; θρησκευόμεν ουν τον πατερα της αληθειας και τον υιον την αληθειαν, οντα δυο τη υποστασει πραγματα, εν δε τη ομονοια, και τη συμφωνια και τη ταυτοτητι της βουλησεως, "we worſhip the Father of truth, and the Son the truth itſelf, being two things as to Hypoſtaſis, but one in agreement, conſent, and ſameneſs of will." Nor is their union a mere agreement in will only; it is a phyſical or eſſential union: ſo that what is done by one muſt neceſſarily be done by the others alſo, according to that of our Saviour, "I am in the Father and the Father in me: The Father who dwelleth in me, he doth the works."

* Contr. Celſ. p. 386.

Thus

Original ſtate of man.

Thus we ſee, that to the ſeveral perſons in the ever bleſſed Trinity is equal praiſe due for the creation of the world. Their all-powerful word commanded into being every thing that exiſts, and by the ſame Divine power is every thing continued in exiſtence. Well therefore might the Pſalmiſt call upon the heavens and the earth to praiſe the name of the Lord; "for he commanded, and they were created. He hath alſo eſtabliſhed them for ever and ever; he hath made a decree which ſhall not paſs. Let all things praiſe the name of the Lord; for his name יהוה אלהים, Father, Son, and Holy Ghoſt, alone is excellent, and his glory above the earth and heaven."

Sect. II. *Of the Original State of Man, and the firſt Covenant of Eternal Life which God vouchſafed to make with him.*

80 Peculiarity of the expreſſion in which God is ſaid to make man

In the Moſaic account of the creation, every attentive reader muſt be ſtruck with the manner in which the ſupreme Being is repreſented as making man: "and God ſaid, let us make man in our image, after our likeneſs; and let *them* have dominion over the fiſh of the ſea, and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth. So God created man in his own image; in the image of God created he him; male and female created he THEM. And God bleſſed them; and God ſaid unto them, be fruitful, and multiply, and repleniſh the earth, and ſubdue it; and have dominion over the fiſh of the ſea, and over the fowl of the air, and over every living thing that moveth upon the earth. And God ſaid, behold, I have given you every herb bearing ſeed, which is upon the face of all the earth; and every tree in the which is the fruit of a tree yielding ſeed: to you it ſhall be for meat. And God ſaw every thing that he had made, and, behold, it was very good. And the evening and the morning were the ſixth day. Thus the heavens and the earth were finiſhed, and all the hoſt of them. And on the ſeventh day God ended his work which he had made; and he reſted on the ſeventh day from all his works which he had made. And God bleſſed the ſeventh day, and ſanctified it: becauſe that in it he had reſted from all his work which God created and made‡".

This is a very remarkable paſſage, and contains much important information. It indicates a plurality of perſons in the Godhead, deſcribes the nature of man as he came at firſt from the hands of his Creator, and furniſhes data from which we may infer what were the duties required of him in that primeval ſtate, and what were the rewards to which obedience would entitle him.

81 In his own image.

Of the plurality of Divine perſons, and their eſſential union, we have treated in the preceding ſection, and proceed now to inquire into the ſpecific nature of the firſt man. This muſt be implied in the *image of God*, in which he is ſaid to have been created; for it is by that phraſe alone that he is characterized, and his pre-eminence marked over the other animals. Now this image or likeneſs muſt have been found either in his body alone, his ſoul alone, or in both united. That it could not be in his body alone, is obvious; for the infinite and omnipotent God is allowed by all men to be without body, parts, or paſſions, and therefore to be ſuch as nothing corporeal can poſſibly reſemble.

82 Different opinions reſpecting the image of God.

If the likeneſs is to be found in the human ſoul, it comes to be a queſtion in what faculty or power of the ſoul it conſiſts. Some have contended, that man is the only creature on this earth who is animated by a principle eſſentially different from matter; and hence they have inferred, that he is ſaid to have been formed in the Divine image, on account of the immateriality of that vital principle which was infuſed into his body when the "Lord God breathed into his noſtrils the breath of life, and man became a living ſoul§." That this account of the animation of the body of man indicates a ſuperiority of the human ſoul to the vital principle of all other animals, cannot, we think, be queſtioned; but it does not therefore follow, that the human ſoul is the only immaterial principle of life which animates any terreſtrial creature. It has been ſhown elſewhere (ſee METAPHYSICS, n° 235), that the power of ſenſation, attended with individual conſciouſneſs, as it appears to be in all the higher ſpecies of animals, cannot reſult from any organical ſtructure, or be the quality of a compound extended being. The vital principle in ſuch animals therefore muſt be immaterial as well as the human ſoul; but as the word *immaterial* denotes only a negative notion, the ſouls of men and brutes, though both immaterial, may yet be ſubſtances eſſentially different. This being the caſe, it is plain that the Divine image in which man was formed, and by which he is diſtinguiſhed from the brute creation, cannot conſiſt in the mere circumſtance of his mind being a ſubſtance different from matter, but in ſome poſitive quality which diſtinguiſhes him from every other creature on this globe.

83 Calviniſtic opinions.

About this characteriſtic quality very various opinions have been formed. Some have ſuppoſed|| "that the image of God in Adam appeared in that rectitude, righteouſneſs, and holineſs, in which he was made; for God made man upright (Eccleſ. vii. 2.) a holy and righteous creature; which holineſs and righteouſneſs were in their kind perfect; his underſtanding was free from all error and miſtakes; his will biaſſed to that which is good; his affections flowed in a right channel towards their proper objects; there were no ſinful motions and evil thoughts in his heart, nor any propenſity or inclination to that which is evil; and the whole of his conduct and behaviour was according to the will of God. And this righteouſneſs (ſay they) was *natural*, and not perſonal and acquired. It was not obtained by the exerciſe of his free-will, but was created with him, and belonged to his mind, as a natural faculty or inſtinct." They therefore call it *original righteouſneſs*, and ſuppoſe that it was loſt in the fall.

84 Objected to.

To this doctrine many objections have been made. It has been ſaid that righteouſneſs conſiſting in right actions proceeding from proper principles, could not be created with Adam and make a part of his nature; becauſe nothing which is produced in a man without his knowledge and conſent can be in him either virtue or vice. Adam, it is added, was unqueſtionably placed in a ſtate of trial, which proves that he had righteous habits to *acquire*; whereas the doctrine under conſideration, affirming his original righteouſneſs to have been perfect, and therefore incapable of improvement, is inconſiſtent with a ſtate of trial. That his underſtanding was free from all errors and miſtakes, has been thought a blaſphemous poſition, as it attributes to man one of the incommunicable perfections of the Deity. It is likewiſe believed to be contrary to fact; for either his underſtanding was bewildered in error, or his affections flowed towards an improper object, when he ſuffered himſelf at the perſuaſion of his wife to tranſgreſs the expreſs law of his Creator. The objector expreſſes his wonder at its having ever been ſuppoſed that the *whole* of Adam's conduct and behaviour was according to the will of God, when it is ſo notorious that he yielded to the firſt temptation with which, as far as we know, he was aſſailed in paradiſe.

Convinced by theſe and other arguments, that the image of God in which man was created could not conſiſt in original righteouſneſs, for in exemption from all poſſibility of error, many learned men, and Biſhop Bull* among others, have

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‡ Gen. i. 26, &c. ii. 1, 2, 3.

§ Gen. ii. 7.

|| Gill's Body of Divinity, b. iii. ch. 3.

* See his Engliſh Works, vol. iii.

85 Opinion of Biſhop Bull and ſome of the ancient fathers

have ſuppoſed, that by the image of God is to be underſtood certain gifts and powers ſupernaturally infuſed by the Holy Spirit into the minds of our firſt parents, to guide them in the ways of piety and virtue. This opinion they reſt chiefly upon the authority of Tatian, Irenæus, Tertullian, Cyprian, Athanaſius, and other fathers of the primitive church; but they think, at the ſame time, that it is countenanced by ſeveral paſſages in the New Teſtament. Thus when St Paul ſays §, "and ſo it is written, The firſt man Adam was made a living ſoul, the laſt Adam was made a quickening Spirit; they underſtand the whole paſſage as relating to the creation of man, and not as drawing a compariſon between Adam and Chriſt, to ſhow the great ſuperiority of the latter over the former. In ſupport of this interpretation they obſerve, that the apoſtle immediately adds, "howbeit, that was not firſt which is ſpiritual, but that which is natural, and afterwards that which is ſpiritual;" an addition which they think was altogether needleſs, if by the quickening Spirit he had referred to the incarnation of Chriſt, which had happened in the very age in which he was writing. They are therefore of opinion, that the body of Adam, after being formed of the duſt of the ground, was firſt animated by a vital principle endowed with the faculties of reaſon and ſenſation, which entitled the whole man to the appellation of a living ſoul. After this they ſuppoſe certain graces of the Holy Spirit to have been infuſed into him, by which he was made a quickening ſpirit, or formed in the image of God; and that it was in conſequence of this ſucceſſion of powers communicated to the ſame perſon, that the apoſtle ſaid, "Howbeit, that was not firſt which is ſpiritual, but that which is natural."

86 Ill founded.

We need hardly obſerve, that with reſpect to a queſtion of this kind the authority of *Tatian* and the other fathers quoted is nothing. Thoſe men had no better means of diſcovering the true ſenſe of the ſcriptures of the Old Teſtament than we have; and their ignorance of the language in which theſe ſcriptures are written, added to ſome metaphyſical notions reſpecting the ſoul, which too many of them had derived from the ſchool of Plato, rendered them very ill qualified to interpret the writings of Moſes. Were authority to be admitted, we ſhould conſider that of biſhop Bull and his modern followers as of greater weight than the authority of all the ancients to whom they appeal. But authority cannot be admitted; and the reaſoning of this learned and excellent man from the text of St Paul is ſurely very inconcluſive. It makes two perſons of Adam; a firſt, when he was a natural man compoſed of a body and reaſonable ſoul; a ſecond, when he was endowed with the gifts of the Holy Spirit, and by them formed in the image of God! In the verſe following too, the apoſtle expreſsly calls the ſecond man, of whom he had been ſpeaking, "the Lord from heaven;" but this appellation we apprehend to be too high for Adam in the ſtate of greateſt perfection in which he ever exiſted. That our firſt parents were endowed with the gifts of the Holy Ghoſt, we are ſtrongly inclined to believe for reaſons which ſhall be given by and by; but as theſe gifts were adventitious to their nature, they could not be that image in which God *made* man.

87 Other opinions.

Since man was *made* in the image of God, that phraſe, whatever be its preciſe import, muſt denote ſomething *peculiar* and at the ſame time eſſential to human nature; but the only two qualities at once natural and peculiar to man are his ſhape and his reaſon. As none but an anthropomorphite will ſay that it was Adam's ſhape which reflected this image of his Creator, it has been concluded that it was the faculty of reaſon which made the reſemblance. To give ſtrength to this argument it is obſerved ‡, that when God ſays, "let us make man in our image," he immediately adds, "and let them have dominion over the fiſh of the ſea, and over the fowl of the air, and over the cattle, and over all the earth;" but as many of the cattle have much greater bodily ſtrength than man, this dominion could not be maintained but by the faculty of reaſon beſtowed upon him and withheld from them.

If the image of God was impreſſed only on the mind of man, this reaſoning ſeems to be concluſive; but it has been well obſerved ‡ that it was the whole man, and not the *ſoul alone*, or the *body* alone, that is ſaid to have been formed in the divine image; even as the whole man, ſoul and body, is the ſeat of the new and ſpiritual image of God in regeneration and ſanctification. "The very God of peace (ſays the apoſtle) ſanctify you wholly; and may your whole *ſpirit*, *ſoul* and *body*, be preſerved blameleſs to the coming of our Lord Jeſus Chriſt." It is worthy of notice too, that the reaſon aſſigned for the prohibition of murder to Noah and his ſons after the deluge, is, that man was made in the image of God. "Whoſo ſheddeth man's blood, by man ſhall his blood be ſhed; for in the image of God made he man." Theſe texts ſeem to indicate, that whatever be meant by the image of God, it was ſtamped equally on the ſoul and on the body. In vain is it ſaid that man cannot reſemble God in ſhape. This is true, but it is little to the purpoſe; for man does not reſemble God in his reaſoning faculty more than in his form. It would be idolatry to ſuppoſe the ſupreme majeſty of heaven and earth to have a body or a ſhape; and it would be little ſhort of idolatry to imagine that he is obliged to compare ideas and notions together; to advance from particular truths to general propoſitions; and to acquire knowledge, as we do, by the tedious proceſſes of inductive and ſyllogiſtic reaſoning. There can therefore be no direct image of God either in the ſoul or in the body of man; and the phraſe really ſeems to import nothing more than thoſe powers or qualities by which man was fitted to exerciſe dominion over the inferior creation; as if it had been ſaid, "Let us make man in our image, after our likeneſs, that *they may have* dominion, &c." But the erect form of man contributes in ſome degree, as well as his rational powers, to enable him to maintain his authority over the brute creation; for it has been obſerved by travellers, that the fierceſt beaſt of prey, unleſs ready to periſh by hunger, ſhrinks back from a ſteady look of the human face divine.

88 True import of the phraſe.

By ſome *, however, who have admitted the probability of this interpretation, another, and in their opinion a ſtill better reaſon, has been deviſed for its being ſaid that man was formed in the image of God. All the members of Chriſt's body, ſay they, were written and delineated in the book of God's purpoſes and decrees, and had an ideal exiſtence from eternity in the divine mind; and therefore the body of Adam might be ſaid to be formed after the image of God, becauſe it was made according to that idea. But to this reaſoning objections may be urged, which we know not how to anſwer. All things that ever were or ever ſhall be, the bodies of us who live at preſent as well as the bodies of thoſe who lived 5000 years ago, have from all eternity had an ideal exiſtence in the Divine mind; nor in this ſenſe can one be ſaid to be prior to another. It could not therefore be after the idea of the identical body of Chriſt that the body of Adam was formed; for in the Divine mind ideas of both bodies were preſent together from all eternity, and each body was undoubtedly formed after the ideal archetype of itſelf. It may be added likewiſe, that the body of Chriſt was not God, nor the idea of that body the idea of God. Adam therefore could not with propriety, or even with truth, be ſaid to have been formed in the image of God, if by that phraſe nothing more were intended than the reſemblance between his body and the body of Chriſt.

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§ 1 Cor. xv. 45, 46.

‡ Warburton's Divine Leg. book ix.

‡ Gill's Body of Divinity, book iii. chap. 3.

* Gill, &c.

Theſe objections to this interpretation appear to us unanſwerable; but we mean not to dictate to our readers. Every man will adopt that opinion which he thinks ſupported by the beſt arguments; but it is obvious, that whatever more may be meant by the image of God in which man was made, the phraſe undoubtedly comprehends all thoſe powers and qualities by which he is enabled to maintain his authority over the inferior creation. Among theſe the faculty of reaſon is confeſſedly the moſt important; for it is by it that man is capable of being made acquainted with the Author of his being, the relation which ſubſiſts between them, and the duties implied in that relation from the creature to the Creator.

89 Religious inſtruction communicated to Adam.

That the firſt man, however, was not left to diſcover theſe things by the mere efforts of his own unaſſiſted reaſon, we have endeavoured to ſhow in another place; (ſee Religion, n° 5—10.); and the concluſion to which we were there led is confirmed by the portion of revelation before us. The inſpired hiſtorian ſays, "that God bleſſed the ſeventh day and *ſanctified* it, becauſe that in it he had reſted from all his works, which he created and made; but Adam could not have underſtood what was meant by the *ſanctification* of a particular day, or of any thing elſe, unleſs he had previouſly received ſome religious inſtruction. There cannot therefore be a doubt, but that as ſoon as man was made, his Creator communicated to him the truths of what is called natural religion, which we have endeavoured to explain and eſtabliſh in Part I. of this article; and to theſe were added the precept to keep holy the Sabbath day, and ſet it apart for the purpoſes of contemplation and worſhip.

90 Inſtitution of the Sabbath.

This was a very wiſe inſtitution, as all the divine inſtitutions muſt be. "The great end for which we are brought into life, is to attain the knowledge and be confirmed in the love of God. This includes obedience to his will in thought, word, and deed, or that courſe of conduct which can alone make us happy here, and fit us for everlaſting glory hereafter. But of theſe things we cannot retain a proper ſenſe without cloſe and repeated application of thought; and the unavoidable cares and concerns of the preſent life occupying much of our attention, it is, in the nature of things, neceſſary that ſome certain portion of time ſhould be appropriated to the purpoſes of religious inſtruction and the public adoration of our Creator, in whom we all live, and move, and have our being." Hence a very learned divine † has inferred, that though the particular time is a matter of poſitive appointment, the obſervation of a ſabbath in general is a duty of natural religion, as having its foundation in the reaſon of things. See Sabbath.

† Dr Taylor of Norwich.

91 Duties of man in his original ſtate,

Man therefore in his *natural* and original ſtate was a rational and religious being, bound to do "juſtice, to love mercy, to walk humbly with his God, and to keep holy the Sabbath-day." Theſe ſeem to be all the duties which in that ſtate were required of him; for as ſoon as he was introduced into the terreſtrial paradiſe and admitted into covenant with his Maker, he was placed in a *ſupernatural* ſtate, when other duties were of courſe enjoined.

That our firſt parents were both made on the ſixth day, Moſes expreſsly affirms when he ſays ‖, that "God created them male and female, and bleſſed them, and called *their* name *Adam* (K), in the day when they were created:" but that they were introduced into the garden of Eden on that day, is an opinion which, however generally it may be received, ſeems not to be reconcileable with the plain narrative of the ſacred penman. After telling us that on the ſixth day God finiſhed all his works, which he ſaw to be very good, and reſted on the ſeventh day, he briefly recapitulates the hiſtory of the generations of the heavens and of the earth, gives us a more particular account of the formation of the firſt man, informing us that the "Lord God formed him out of the duſt of the ground, and breathed into his noſtrils the breath of life, when man became a living ſoul;" and then proceeds to ſay ‡, that the "Lord God planted a garden eaſtward in Eden, where he put the man whom he HAD *formed*."

‖ Gen. i. 27. v. 2.

‡ Gen. ii. 7, 8, and 15.

92 Before he was placed in the garden of Eden,

From this ſhort hiſtory of the firſt pair it appears beyond diſpute evident, that neither the man nor the woman was formed *in* the garden: and that from their creation ſome time elapſed before the garden was prepared for their reception, is likewiſe evident from a compariſon of Gen. i. 29. with Gen. ii. 16, 17. In the firſt of theſe paſſages God gives to man, immediately after his creation, "every herb bearing ſeed which was upon the face of all the earth, and *every tree*, without exception, in which was the fruit of a tree bearing ſeed: to him he ſaid it ſhould be for meat." In the ſecond, "he commanded the man, ſaying, of every tree of the garden thou mayeſt freely eat; but of the tree of knowledge of good and evil, thou ſhalt not eat of it; for in the day thou eateſt thereof thou ſhalt ſurely die." When the firſt grant of food was given, Adam and his wife muſt have been where no tree of knowledge grew, and they muſt have been intended to live at leaſt ſo long in that ſtate as that they ſhould have occaſion for food, otherwiſe the formal grant of it would have been not only ſuperfluous, but apt to miſlead them with reſpect to the ſubſequent reſtriction.

In this original ſtate man was under the diſcipline of what we have called *natural religion*, entitled to happineſs while he ſhould perform the duties required of him, and liable to puniſhment when he ſhould neglect thoſe duties, or tranſgreſs the law of his nature as a rational and moral agent. This being the caſe, it is a matter of ſome importance, and what will enable us to perceive more clearly the prerogatives of Chriſtianity, to aſcertain, if we can, what the rewards and puniſhments are which natural religion holds out to her votaries.

That under every diſpenſation of religion the pious and virtuous man ſhall, during the whole of his exiſtence, enjoy more happineſs than miſery; and that the incorrigibly wicked, if there be any ſuch, ſhall have a greater portion of miſery than happineſs, are truths which cannot be controverted by any one who admits, that the Almighty governor of the univerſe is a Being of wiſdom, goodneſs, and juſtice. But reſpecting the rewards of virtue and the puniſhment of vice, more than theſe general truths ſeems not to be taught by natural religion.

93 Did not, when performed, entitle him to eternal life.

Many divines, however, of great learning and worth, have thought otherwiſe, and have contended, that from the nature of things the rewards beſtowed by an infinite God upon piety and virtue muſt be eternal like their author. Theſe men indeed appear willing enough to allow that the puniſhments with which natural religion is armed againſt vice muſt be only of a temporary duration, becauſe reaſon, ſay they, is ready to revolt at the thought of *everlaſting* puniſhment.

This opinion, which confounds natural with revealed religion, giving to the former an important truth which belongs excluſively

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(K) The woman was ſome time afterwards diſtinguiſhed by the name of Eve חוה, becauſe ſhe was to be the mother of all living, and particularly of that bleſſed ſeed which was to bruiſe the head of the ſerpent. See *Parkhurſt's Lexicon* on the word.

excluſively to the latter, has been ſo ably confuted by a learned writer, who was never averſe from allowing to human reaſon all the diſcoveries which it can juſtly claim, that we ſhall ſubmit his arguments to our readers in preference to any thing which we can give ourſelves.

“ If reaſon doth, on the one hand, ſeem to revolt at *everlaſting puniſhment*, we muſt confeſs that FANCY, on the other, (even when full plumed by *vanity*), hath ſcarce force enough to riſe to the idea of *infinite rewards*. How the heart of man came to conſider this as no more than an adequate retribution for his right conduct during the ſhort trial of his virtue here, would be hard to tell, did we not know what monſters PRIDE begot of old upon *Pagan philoſophy*; and how much greater ſtill theſe latter ages have diſcloſed, *by the long* incubation of *ſchool-divinity* upon *folly*. What hath been urged from natural reaſon, in ſupport of this extravagant preſumption, is ſo very ſlender, that it recoils as you enforce it. Firſt, you ſay, ‘ that the ſoul, the ſubject of theſe eternal rewards, being *immaterial*, and ſo therefore unaffected by the cauſes which bring material things to an end, is, by its nature, fitted for eternal rewards.—This is an argument *ad ignorantiam*, and holds no farther. Becauſe an *immaterial* being is not ſubject to that mode of diſſolution which affects *material* ſubſtances, you conclude it to be eternal. This is going too faſt. There may be, and probably are, many natural cauſes (unknown indeed to us), whereby immaterial beings come to an end. But if the nature of things cannot yet God certainly can, put a final period to ſuch a being when it hath ſerved the purpoſe of its creation. Doth ANNIHILATION impeach that wiſdom and goodneſs which was diſplayed when God brought it *out of nothing*? Other immaterial beings there are, *viz.* the ſouls of brutes, which have the ſame natural ſecurity with man for their exiſtence, of whoſe *eternity* we never dream. But pride, as the poet obſerves, *calls God unjuſt*.

94
Arguments to prove that they did inconcluſive.

If man alone engroſs not heaven's high care;
Alone made *perfect* here, IMMORTAL there.

However, let us (for argument's ſake) allow the human ſoul to be unperiſhable by nature, and ſecured in its exiſtence by the unchangeable will of God, and ſee what will follow from thence—An *infinite* reward for virtue, during one moment of its exiſtence, becauſe reaſon diſcovers that, by the law of nature, *ſome* reward is due? By no means. When God hath amply repaid us for the performance of our duty, will he be at a loſs how to diſpoſe of us for the long remainder of *eternity?* May he not find new and endleſs employment for reaſonable creatures, to which, when properly diſcharged, new rewards and in endleſs ſucceſſion will be aſſigned? Modeſt reaſon ſeems to dictate this to the followers of the *law of nature*. The flattering expedient of ETERNAL REWARDS for virtue here was invented in the ſimplicity, of early ſpeculation, after it had fairly brought men to conclude that the ſoul is immaterial.

“ Another argument urged for the eternity of the rewards held out by natural religion to the practice of piety and virtue is partly phyſical and partly moral. The merit of ſervice (ſay the admirers of that religion) increaſes in proportion to the excellence of that Being to whom our ſervice is directed and becomes acceptable. An infinite being, therefore, can diſpenſe no rewards but what are infinite. And thus the virtuous man becomes intitled to immortality.

“ The misfortune is, that this reaſoning holds equally on the ſide of the unmerciful doctors, as they are called, who doom the wicked to EVERLASTING PUNISHMENT. Indeed were this the only diſcredit under which it labours, the mercileſs doctors would hold themſelves little concerned. But the truth is, that the argument from *infinity* proves juſt nothing. To make it of any force, both the parties ſhould be *infinite*. This inferior emanation of God's *image*, MAN, ſhould either be ſupremely good or ſupremely bad, a kind of deity or a kind of devil. But theſe reaſoners, in their attention to the *divinity*, overlook the *humanity* which makes the decreaſe keep pace with the accumulation, till the rule of logic, that the *concluſion follows the weaker* part, comes in to end the diſpute ‡.

Theſe arguments ſeem to prove unanſwerably that immortality is not eſſential to any part of the compound being man, and that it cannot be claimed as a reward due to his virtue. It is not indeed eſſential to any created being, for what has not exiſtence of itſelf, cannot of itſelf have perpetuity of exiſtence (ſee METAPHYSICS, nº 272, &c.); and as neither man nor angel can be profitable to God, they cannot claim from him any thing as a debt. Both, indeed, as moral agents have duties preſcribed them; and while they faithfully perform theſe duties, they have all the ſecurity which can ariſe from the perfect benevolence of him who brought them into exiſtence, that they ſhall enjoy a ſufficient portion of happineſs to make that exiſtence preferable to non-exiſtence; but reaſon and philoſophy furniſh no data from which it can be inferred that they ſhall exiſt for ever. Man is compoſed in part of periſhable materials. However perfect Adam may be thought to have been when he came firſt from the hands of his Creator, his body, as formed of the duſt of the ground, muſt have been naturally liable to decay and diſſolution. His ſoul, indeed, was of a more durable ſubſtance; but as it was formed to animate his body, and had no prior conſcious exiſtence, it is not eaſy to conceive what ſhould have led him, under an equal providence, where rewards and puniſhments were exactly diſtributed, to ſuppoſe that one part of him ſhould ſurvive the other. In his natural and original ſtate, before the covenant made with him in paradiſe, he was unqueſtionably a mortal creature. How long he continued in that ſtate, it ſeems not poſſible to form a plauſible conjecture. Biſhop Warburton ſuppoſes him to have lived ſeveral years under no other diſpenſation than that of natural religion; during which he was as liable to death as his fallen poſterity are at preſent.

95
Adam before his introduction into paradiſe liable to death.

“ We muſt needs conclude (ſays this learned writer*), that God having tried Adam in *the ſtate of nature*, and approved of the good uſe he made of his free-will under the direction of that light, advanced him to a ſuperior ſtation in *Paradiſe*. How long, before this remove, man had continued ſubject to *natural religion* alone, we can only gueſs; but of this we may be aſſured, that it was ſome conſiderable time before the garden of Eden could naturally be made fit for his reception. Since Moſes, when he had concluded his hiſtory of the creation, and of God's *reſt* on, and *ſanctification* of, the ſeventh day, proceeds to ſpeak of the condition of this new world in the following terms: “ *And God made every plant of the field before it was in the earth, and every herb of the field before it grew; for the Lord God had not cauſed it to rain upon the earth* ‡.’ Which ſeems plainly to intimate, that when the ſeeds of vegetables had been created on the third day, they were left to nature, in its ordinary operations, to mature by ſun and ſhowers. So that when in courſe of time Paradiſe was become capable of accommodating its inhabitants, they were tranſplanted thither.”

96
How long he continued in that ſtate.

This reaſoning is not without a portion of that ingenuity which was apparent in every thing that fell from the pen of Warburton; but it was completely confuted almoſt as ſoon as it was given to the public, and ſhown to be deduced from premiſes which could be employed againſt the author's ſyſtem. If only the *ſeeds* of vegetables were created on the third day, and then left to nature, in its ordinary operations,

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‡ Warburton's Divine Legation, book ix.

* Divine Legation, b. ix. ch. i.

‡ Gen. ii. 4, 5.

Original ſtate of man.

to mature by ſun and ſhowers, the firſt pair muſt have periſhed before a ſingle vegetable could be fit to furniſh them with food; and we may ſuppoſe that it was to prevent this diſaſter that the garden of Eden was miraculouſly ſtored at once with full grown trees and fruit in perfect maturity, whilſt the reſt of the earth was left under the ordinary laws of vegetation. There is, however, no evidence that they were only the *ſeeds* of vegetables that God created. On the contrary, Moſes ſays expreſsly †, that "God made the earth on the third day bring forth the herb *yielding* ſeed after his kind, and the tree *yielding fruit* whoſe *ſeed* was in itſelf after his kind;" and when he recapitulates the hiſtory of the creation, he ſays, that God made, not every ſeed, but every *plant* of the field *before* it was in the earth, and every *herb* of the field *before* it grew. From the proceſs of vegetation, therefore, nothing can be inferred with reſpect to the time of Adam's introduction into Paradiſe, or to aſcertain the duration of his original ſtate of nature. If angels were created during the ſix days of which the Hebrew lawgiver writes the hiſtory, an hypotheſis very generally received (ſee ANGEL), though in the opinion of the preſent writer not very probable, there can be no doubt but our firſt parents lived a conſiderable time under the law of nature before they were raiſed to a ſuperior ſtation in the garden of Eden; for it ſeems very evident that the period of their continuance *in* that ſtation was not long. Of this, however, nothing can be ſaid with certainty. They may have lived for years or only a few days in their original ſtate; but it is very neceſſary to diſtinguiſh between that ſtate in which they were under no other diſpenſation than what is commonly called *natural religion*, entitled, upon their obedience, to the indefinite rewards of piety and virtue, and their ſtate in Paradiſe when they were put under a new law, and by the free grace of God promiſed, if they ſhould be obedient, a ſupernatural and eternal reward. Into that ſtate we muſt now attend them, and aſcertain, if we can, the preciſe terms of the firſt covenant.

† Gen. i. 12.

97 Impoſſible to be known.

Moſes, who in this inveſtigation is our only guide, tells us, that the Lord God, after he had formed the firſt pair, "planted a garden eaſtward in Eden, and took the man and put him into the garden to dreſs it and to keep it. And the Lord God (continues he) commanded the man, ſaying, of every tree of the garden thou mayeſt freely eat; but of the tree of the knowledge of good and evil thou ſhalt not eat of it; for in the day that thou eateſt thereof, thou ſhalt ſurely die‡." Here is no mention made of the laws of piety and moral virtue reſulting from the relation in which the various individuals of the human race ſtand to each other, and in which all as creatures ſtand to God their Almighty and beneficent Creator. With theſe laws Adam was already well acquainted; and he muſt have been ſenſible, that as they were founded in his nature no ſubſequent law could diſpenſe with their obligation. They have been equally binding upon all men in every ſtate and under every diſpenſation; and they will continue to be ſo as long as the general practice of juſtice, mercy, and piety, ſhall contribute to the ſum of human happineſs. The new law peculiar to his paradiſaical ſtate was the command not to eat of the fruit of the tree of the knowledge of good and evil. This was a poſitive precept, not founded in the nature of man, but very proper to be the teſt of his obedience to the will of his Creator. The laws of piety and virtue are ſanctioned by nature, or by that general ſyſtem of rules according to which God governs the phyſical and moral worlds, and by which he has ſecured, in ſome ſtate or other, happineſs to the pious and virtuous man, and miſery to ſuch as ſhall prove incorrigibly wicked. The law reſpecting the forbidden fruit was ſanctioned by the penalty of *death* denounced againſt diſobedience; and by the ſubjects of that law the nature of this penalty muſt have been perfectly underſtood: but Chriſtian divines, as we ſhall afterwards ſee, have differed widely in opinion reſpecting the full import of the Hebrew words which our tranſlators have rendered by the phraſe *thou ſhalt ſurely die*. All, however, agree that they threatened death, in the common acceptation of the word, or the ſeparation of the ſoul and body as one part of the puniſhment to be incurred by eating the forbidden fruit; and hence we muſt infer, that had the forbidden fruit not been eaten, our firſt parents would never have died, becauſe the penalty of death was denounced againſt no other tranſgreſſion. What therefore is ſaid reſpecting the fruit of the tree of knowledge, implies not only a law but alſo a covenant (L), promiſing to man, upon the obſervance of one poſitive precept, immortality or eternal life; which is not eſſential to the nature of any created being, and cannot be claimed as the merited reward of the greateſt virtue or the moſt fervent piety.

‡ Gen. ii. 8, 15, 16, 17.

Original ſtate of man.

98 The covenant of eternal life made with Adam in paradiſe,

This obvious truth will enable us to diſpoſe of the objections which have been ſometimes brought by free-thinking divines againſt the wiſdom and juſtice of puniſhing ſo ſeverely as by death the breach of a mere poſitive precept; which, conſidered in itſelf, or as connected with the general principles of moral obligation, appears to be a precept of very little importance. We have only to reply, that as an exemption from death is not due either to the nature or to the virtue of man, it was wiſe and juſt to make it depend upon the obſervance of a poſitive precept, to impreſs upon the minds of our firſt parents a conſtant conviction that they were to be preſerved immortal, not in the ordinary courſe of divine providence, but by the ſpecial grace and favour of God. The ſame conſideration will ſhow us the folly of thoſe men who, becauſe the terms of the firſt covenant, as ſtated in ſome ſyſtems of theology, agree not with certain philoſophical maxims which they have adopted, are for turning all that is ſaid of the trees of knowledge and of life into figure and allegory. But the other trees which Adam and Eve were permitted to eat were certainly real trees, or they muſt have periſhed for want of food. And what rules of interpretation will authoriſe us to interpret *eating* and *trees* literally in one part of the ſentence and figuratively in the other? A garden in

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(L) It does not appear that any tranſaction between God and mankind in general was denominated by a word equivalent to the Engliſh word *covenant* till the end of the fourth century, when ſuch phraſeology was introduced into the church by the celebrated Auguſtine, biſhop of Hippo. That the phraſeology is ſtrictly proper, no man can ſuppoſe who reflects on the infinite diſtance between the contracting parties, and the abſolute dominion of the one over the other. To be capable of entering into a *covenant*, in the proper ſenſe of the word, both parties muſt have a right either to agree to the terms propoſed or to reject them; but ſurely Adam had no right to bargain with his Maker, or to refuſe the gift of immortality on the terms on which it was offered to him. The word *diſpenſation* would more accurately denote what is here meant by the word *covenant*; but as this laſt is in general uſe, we have retained it as ſufficient, when thus explained, to diſtinguiſh what man received from God upon certain poſitive conditions, from what he had a claim to by the conſtitution of his nature.

in a delightful climate is the very habitation, and the fruits produced in that garden the very food, which we ſhould naturally ſuppoſe to have been prepared for the progenitors of the human race; and though in the garden actually fitted up for this purpoſe two trees were remarkably diſtinguiſhed from the reſt, perhaps in ſituation and appearance as well as in uſe, the diſtinction was calculated to ſerve the beſt of purpoſes. The one called the *tree of life*, of which, while they continued innocent, they were permitted to eat, ſerved as a ſacramental pledge or aſſurance on the part of God, that as long as they ſhould obſerve the terms of the covenant their life ſhould be preſerved; the other, of which it was death to taſte, was admirably adapted to impreſs upon their minds the neceſſity of implicit obedience to the Divine will, in whatever manner it might be made known to them.

99
Had it not been violated, entitled him to heaven,

A queſtion has been ſtated, and it is of ſome importance, What would have finally become of men if the firſt covenant had not been violated? That they would have been all immortal is certain; but it is by no means certain that they would have lived for ever upon this earth. On the contrary, it has been an article of very general belief in all ages of the church *, that the garden of Eden was an emblem or type of heaven, and therefore called *Paradiſe* (ſee PARADISE;) and that under the firſt covenant, mankind, after a ſufficient probation here, were to be tranſlated into heaven without taſting death. This doctrine is not indeed explicitly taught in ſcripture; but many things conſpire to make it highly probable. The frequent communications between God and man before the fall (M), ſeem to indicate that Adam was training up for ſome higher ſtate than the terreſtrial paradiſe. Had he been intended for nothing but to cultivate the ground and propagate his ſpecies, he might have been left like other animals to the guidance of his own reaſon and inſtincts; which, after the rudiments of knowledge were communicated to him, muſt ſurely have been ſufficient to direct him to every thing neceſſary to the comforts of a life merely ſenſual and rational, otherwiſe he would have been an imperfect animal. It is obvious too, that this earth, however fertile it may have originally been, could not have afforded the means of ſubſiſtence to a race of immortal beings multiplying to infinity. For theſe reaſons, and others which will readily occur to the reader, it ſeems incontrovertible, that, under the firſt covenant, either mankind would have been ſucceſſively tranſlated to ſome ſuperior ſtate, or would have ceaſed to propagate their kind as ſoon as the earth ſhould have been repleniſhed with inhabitants. He who reflects on the promiſe, that, after the general reſurrection, there is to be a new heaven and a new earth, will probably embrace the latter part of the alternative; but that part in its conſequences differs not from the former. In the new earth promiſed in the Chriſtian revelation, nothing is to dwell but righteouſneſs. It will therefore be preciſely the ſame with what we conceive to be expreſſed by the word heaven; and if under the firſt covenant this earth was to be converted into a ſimilar place, where, after a certain period, men ſhould neither marry nor be given in marriage, but enjoy what divines have called the *beatific viſion*, we may confidently affirm, that, had the firſt covenant been faithfully obſerved, Adam and his poſterity, after a ſufficient probation, would all have been tranſlated to ſome ſuperior ſtate or heaven.

* Bull's ſtate of Man before the fall.

100
And the gifts of divine grace.

To fit them for that ſtate, the gifts of divine grace ſeem to have been abſolutely neceſſary. To them it was a ſtate certainly ſupernatural, otherwiſe a God of infinite wiſdom and perfect goodneſs would not, for a moment, have placed them in an inferior ſtate. But to enable any creature, eſpecially ſuch a creature as man, whom an ancient philoſopher has juſtly ſtyled ζωον μιμητικον, to riſe above its *nature*, foreign and divine aid is unqueſtionably requiſite: and therefore, though we cannot perſuade ourſelves that the gifts of the Holy Ghoſt conſtituted that image of God in which man was originally made, we agree with biſhop Bull, that theſe gifts were beſtowed upon our firſt parents to enable them to fulfil the terms of the covenant under which they were placed.

101
It is therefore improperly called the Covenant of Works,

Upon the whole, we think it apparent from the portions of ſcripture which we have examined, that Adam and Eve were endued with ſuch powers of body and mind as fitted them to exerciſe dominion over the other animals; that thoſe powers conſtituted that image of God in which they are ſaid to have been formed; that they received by immediate revelation the firſt principles of all uſeful knowledge, and eſpecially of that ſyſtem which is uſually called *natural religion*; that they lived for ſome time with no other religion, entitled to the natural rewards of piety and virtue, but all the while liable to death; that they were afterwards tranſlated into paradiſe, where they were placed under a new law, with the penalty of death threatened to the breach of it, and the promiſe of endleſs life if they ſhould faithfully obſerve it; and that they were endued with the gifts of the Holy Ghoſt, to enable them, if not wanting to themſelves, to fulfil the terms of that covenant, which has been improperly termed the *covenant of works*, ſince it flowed from the mere grace of God, and conferred privileges on man to which the moſt perfect human virtue could lay no juſt claim.

SECT. III. *Of the Fall of Adam, and its Conſequences.*

102
As it could be violated only by diſobedience to one poſitive command.

FROM the preceding account of the primeval ſtate of man, it is evident that his continuance in the terreſtrial paradiſe, together with all the privileges which he there enjoyed, were made to depend upon his obſervance of one poſitive precept. Every other duty incumbent on him, whether as reſulting from what is called the law of his nature, or from the expreſs command of his God, was as much his duty before as after he was introduced into the garden of Eden; and though the tranſgreſſion of any law would undoubtedly have been puniſhed, or have been forgiven only in conſequence of ſincere repentance and amendment, it does not appear that a breach of the *moral* law, or of the commandment reſpecting the ſanctification of the *Sabbath-day*, would have been puniſhed with death, whatever may be the import of that word in the place where it is firſt threatened. The puniſhment was denounced only againſt eating the fruit of the tree of the knowledge of good and evil: For "the Lord God commanded the man, ſaying, of every tree of the garden thou mayeſt freely eat, but of the tree of the knowledge of good and evil thou ſhalt not eat of it; for in the day that thou eateſt thereof thou ſhalt ſurely die." To the word *death* in this paſſage, divines have affixed many and different meanings. By ſome it is ſuppoſed to import a ſeparation of the ſoul and body, while the former was to continue in a ſtate of conſcious exiſtence; by others, it is taken to imply annihilation or a ſtate without conſciouſneſs; by ſome, it is imagined to ſignify eternal life in torments; and by others a ſpiritual and moral death, or a ſtate neceſſarily ſubject to ſin. In

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(M) That there were ſuch frequent communications, has been ſhown to be in the higheſt degree probable by the late Dr Law biſhop of Carliſle. See his *Diſcourſe on the ſeveral Diſpenſations of revealed Religion.*

In any one of theſe acceptations it denoted ſomething new to Adam, which he could not underſtand without an explanation of the term; and therefore, as it was threatened as the puniſhment of only one tranſgreſſion, it could not be the divine intention to inflict it upon any other.

103 It was violated, The abſtaining from a particular fruit in the midſt of a garden abounding with fruits of all kinds, was a precept which at firſt view appears of eaſy obſervation; and the penalty threatened againſt the breach of it was, in every ſenſe, awful. The precept, however, was broken notwithſtanding that penalty; and though we may thence infer that our firſt parents were not beings of ſuch abſolute perfection as by ſyſtem building divines they have ſometimes been repreſented, we ſhall yet find, upon due conſideration, that the temptation by which they were ſeduced, when taken with all its circumſtances, was ſuch as no wiſe and modeſt man will think himſelf able to have reſiſted. The ſhort hiſtory of this important tranſaction, as we have it in the third chapter of the book of Geneſis, is as follows:

“Now the ſerpent was more ſubtile than any beaſt of the field which the Lord God had made: and he ſaid unto the woman, Yea, hath God ſaid, ye ſhall not eat of every tree of the garden? And the woman ſaid unto the ſerpent, We may eat of the fruit of the trees of the garden; but of the fruit of the tree which is in the midſt of the garden, God hath ſaid ye ſhall not eat of it, neither ſhall ye touch it, leſt ye die. And the ſerpent ſaid unto the woman, ye ſhall not ſurely die: For God doth know, that on the day ye eat thereof, then your eyes ſhall be opened, and ye ſhall be as gods, knowing good and evil. And when the woman *ſaw* that the tree was good for food, and that it was pleaſant to the eyes, and a tree to be deſired to make one wiſe, ſhe took of the fruit thereof, and did eat, and gave alſo unto her huſband with her, and he did eat.”

104 In conſequence of a moſt artful temptation, To the leſs attentive reader this converſation between the ſerpent and the woman muſt appear to begin abruptly; and indeed it is not poſſible to reconcile it with the natural order of a dialogue, or even with the common rules of grammar, but by ſuppoſing the tempter's queſtion. “Yea, hath God ſaid, ye ſhall not eat of every tree in the garden?” to have been ſuggeſted by ſomething immediately preceding either in words or in ſignificant ſigns. Eve had undoubtedly by ſome means or other informed the ſerpent that ſhe was forbidden to eat of the fruit upon which he was probably feaſting; and that information, whether given in words or in actions, muſt have produced the queſtion with which the ſacred hiſtorian begins his relation of this fatal dialogue. We are told that the woman *ſaw* that the tree was *good for food;* that it was pleaſant to the eyes, and a tree to be *deſired to make one wiſe;* but all this ſhe could not have *ſeen,* had not the ſerpent eaten of its fruit in her preſence. In her walks through the garden, it might have often appeared pleaſant to her eyes; but previous to experience ſhe could not know but that its fruit was the moſt deadly poiſon, far leſs could ſhe conceive it capable of conferring wiſdom. But if the ſerpent eat of it before her, and then extolled its virtues in rapturous and intelligible language, ſhe would at once ſee that it was not deſtructive of animal life, and naturally infer that it had very ſingular qualities. At the moment ſhe was drawing this inference, it is probable that he invited her to partake of the delicious fruit, and that her refuſal produced the conference before us. That ſhe yielded to his temptation need excite no wonder; for ſhe knew that the ſerpent was by nature a mute animal, and if he attributed his ſpeech to the virtues of the tree, ſhe might infer, with ſome plauſibility, that what had power to raiſe the brute mind to human, might raiſe the human to divine, and make her and her huſband, according to the promiſe of the tempter, become as gods, knowing good and evil. Milton, who was an eminent divine as well as the prince of poets, makes her reaſon thus with herſelf.

> Great are thy virtues, doubtleſs, beſt of fruits,
> Tho' kept from man, and worthy to be admir'd;
> Whoſe taſte, too long forborne, at firſt eſſay
> Gave elocution to the mute, and taught
> The tongue not made for ſpeech to ſpeak thy praiſe.
>
> * * * * *
>
> ——— For us alone
> Was death invented? or to us denied
> This intellectual food, for beaſts reſerved?
> For beaſts it ſeems: yet that one beaſt which firſt
> Hath taſted, envies not, but brings with joy
> The good befallen him, author unſuſpect,
> Friendly to man, far from deceit or guile.
> What fear I then, rather what know to fear
> Under this ignorance of good and evil,
> Of God or death, of law or penalty?
> Here grows the cure of all, this fruit divine,
> Fair to the eye, inviting to the taſte,
> Of virtue to make wiſe: what hinders then
> To reach, and feed at once both body and mind?

Paradiſe Loſt, book ix.

Full of theſe hopes of raiſing herſelf to divinity, and not, as has ſometimes been ſuppoſed, led headlong by a ſenſual appetite, ſhe took of the fruit and did eat, and gave to her huſband with her, and he did eat. The great poet makes Adam delude himſelf with the ſame ſophiſtry that had deluded Eve, and infer, that as the ſerpent had attained the language and reaſoning powers of man, they ſhould attain

> Proportional aſcent, which could not be
> But to be gods, or angels, demi-gods.

105 And Adam and Eve turned out of paradiſe. Thus was the covenant, which, on the introduction of our firſt parents into paradiſe, their Creator was graciouſly pleaſed to make with them, broken by their violation of the condition on which they were advanced to that ſupernatural ſtate; and therefore the hiſtorian tells us, that “leſt they ſhould put forth their hand and take alſo of the tree of life and eat, and live for ever, the Lord God ſent them forth from the garden of Eden to till the ground from whence they were taken (N).” Had they been ſo ſent forth without any farther intimation reſpecting their preſent condition or their future proſpects, and if the death under which they had fallen was only a loſs of conſciouſneſs, they would have been in preciſely the ſame ſtate in which they lived before they were placed in the garden of Eden; only their minds muſt now have been burdened with the inward ſenſe of guilt, and they muſt have *known* themſelves to be ſubject to death; of which, though not exempted from it by nature, they had probably no *apprehenſion* till it was revealed to them in the covenant of life which they had ſo wantonly broken.

God, however, did not ſend them forth thus hopeleſs and forlorn from the paradiſe of delights which they had ſo recently

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(N) The ideas which this language conveys are indeed *allegorical;* but they inform us of this, and nothing but this, that *immortal life was a thing extraneous to our nature,* and not put into our paſte or compoſition when firſt faſhioned by the forming hand of the Creator.” *Warburton's Divine Legation*, Book ix. Chap. 1.

Fall of Adam, and its conſequences.

cently forfeited. He determined to puniſh them for their tranſgreſſion, and at the ſame time to give them an opportunity of recovering more than their loſt inheritance. Calling therefore the various offenders before him, and inquiring into their different degrees of guilt, he began with pronouncing judgment on the ſerpent in terms which implied that there was mercy for man. "And the Lord God ſaid unto the ſerpent, Becauſe thou haſt done this, thou art curſed above all cattle, and above every beaſt of the field: upon thy belly ſhalt thou go, and duſt ſhalt thou eat all the days of thy life; and I will put enmity between thee and the woman, and between thy ſeed and her ſeed: it ſhall bruiſe thy head, and thou ſhalt bruiſe his heel."

106 The tempter puniſhed.

That this ſentence has been fully inflicted on the ſerpent, no reaſoning can be neceſſary to evince. Every ſpecies of that reptile is more hateful to man than any other terreſtrial creature; and there is literally a perpetual war between them and the human race. It is remarkable too that the *head* of this animal is the only part which it is ſafe to bruiſe. His tail may be bruiſed, or even cut off, and he will turn with fury and death on his adverſary: but the ſlighteſt ſtroke on the head infallibly kills him. That the ſerpent, or at leaſt the greater part of ſerpents, go on their belly, every one knows; though it is ſaid*, that in ſome parts of the eaſt ſerpents have been ſeen with wings, and others with feet, and that theſe ſpecies are highly beautiful. If there be any truth in this ſtory, we may ſuppoſe that theſe walking and flying ſerpents have been ſuffered to retain their original elegance, that mankind might ſee what the whole genus was before the curſe was denounced on the tempter of Eve: but it is certain that moſt of the ſpecies have neither wings nor feet, and that many of the moſt poiſonous of them live in burning deſerts, where they have nothing to eat but the duſt among which they crawl ‖.

To this degradation of the ſerpent, infidels have objected, that it implies the puniſhment of an animal which was incapable of guilt; but this objection is founded in thoughtleſſneſs and ignorance. The elegant form of any ſpecies of inferior animals adds nothing to the happineſs of the animals themſelves: the aſs is probably as happy as the horſe, and the ſerpent that crawls as he that flies. Fine proportions attract indeed the notice of man, and tend to impreſs upon his mind juſt notions of the wiſdom and goodneſs of the Creator; but ſurely the ſymmetry of the horſe or the beauty of the peacock is more properly diſplayed for this purpoſe than the elegance of the inſtrument employed by the enemy of mankind. The degradation of the ſerpent in the preſence of our firſt parents muſt have ſerved the beſt of purpoſes. If they had ſo little reflection as not yet to have diſcovered that he was only the inſtrument with which a more powerful Being had wrought their ruin, they would be convinced, by the execution of this ſentence, that the forbidden fruit had no power in itſelf to improve the nature either of man or of beaſt. But it is impoſſible that they could be ſo ſtupid as this objection ſuppoſes them. They doubtleſs knew by this time that ſome great and wicked ſpirit had actuated the organs of the ſerpent; and that when enmity was promiſed to be put between its ſeed and the ſeed of the woman, that promiſe was not meant to be fulfilled by ſerpents occaſionally biting the heels of men, and by men in return bruiſing the heads of ſerpents! If ſuch enmity, though it has literally taken place, was all that was meant by this prediction, why was not Adam directed to bruiſe the head of the identical ſerpent which had ſeduced his wife? If he could derive any conſolation from the exerciſe of revenge, ſurely it would be greater from his revenging himſelf on his own enemy, than from the knowledge that there ſhould be a perpetual warfare between his deſcendants and the breed of ſerpents through all generations.

Fall of Adam, and its conſequences.

We are told, that when the foundations of the earth were laid, the morning ſtars ſang together, and all the ſons of God ſhouted for joy; and it is at leaſt probable that there would be ſimilar rejoicing when the ſix days work of creation was finiſhed. If ſo, Adam and Eve, who were but a little lower than the angels, might be admitted into the chorus, and thus be made acquainted with the exiſtence of good and evil ſpirits. At all events, we cannot doubt but their gracious and merciful Creator would inform them that they had a powerful enemy; that he was a rebellious angel capable of deceiving them in many ways; and that they ought therefore to be conſtantly on their guard againſt his wiles. They muſt have known too that they were themſelves animated by ſomething different from matter; and when they found they were deceived by the ſerpent, they might ſurely, without any remarkable ſtretch of ſagacity, infer that their malignant enemy had actuated the organs of that creature in a manner ſomewhat ſimilar to that in which their own ſouls actuated their own bodies. If this be admitted, the degradation of the ſerpent would convince them of the weakneſs of the tempter when compared with their Creator; and confirm their hopes, that ſince he was not able to preſerve unhurt his own inſtrument of miſchief, he ſhould not be able finally to prevail againſt them; but that though he had bruiſed their heels, the promiſed ſeed of the woman ſhould at laſt bruiſe his head, and recover the inheritance which they had loſt. See PROPHECY, n° 9, 10.

107 Sentence paſſed on Adam and Eve.

Having thus puniſhed the original inſtigator to evil, the Almighty Judge turned to the fallen pair, and ſaid to the woman, "I will greatly multiply thy ſorrow and thy conception: in ſorrow ſhalt thou bring forth children; and thy deſire ſhall be to thy huſband, and he ſhall rule over thee. And unto Adam he ſaid, Becauſe thou haſt hearkened unto the voice of thy wife, and haſt eaten of the tree of which I commanded thee, ſaying, Thou ſhalt not eat of it; curſed is the ground for thy ſake; in ſorrow ſhalt thou eat of it all the days of thy life. Thorns alſo and thiſtles ſhall it bring forth unto thee, and thou ſhalt eat the herb of the field. In the ſweat of thy face ſhalt thou eat bread till thou return unto the ground; for out of it waſt thou taken: for duſt thou art, and unto duſt ſhalt thou return."

Here is a terrible denunciation of toil and miſery and death upon two creatures; who, being inured to nothing, and formed for nothing but happineſs, muſt have felt infinitely more horror from ſuch a ſentence, than we, who are familiar with death, intimate with miſery, and "born to ſorrow as the ſparks fly upward," can form any adequate conception of. The hardſhip of it, too, ſeems to be aggravated by its being ſeverer than what was originally threatened againſt the breach of the covenant of life. It was indeed ſaid, "In the day thou eateſt thereof, thou ſhalt ſurely die:" but no mention was made of the woman's incurring ſorrow in conception, and in the bringing forth of children; of the curſe to be inflicted on the ground; of its bringing forth thorns and thiſtles inſtead of food for the uſe of man; and of Adam's eating bread in ſorrow and the ſweat of his face till he ſhould return to the duſt from which he was taken.

108 An obſcure intimation given them of deliverance from it.

Theſe ſeeming aggravations, however, are in reality inſtances of divine benevolence. Adam and Eve were now ſubjected to death; but in the ſentence paſſed on the ſerpent, an obſcure intimation had been given them that they were not to remain for ever under its power. It was therefore their intereſt, as well as their duty, to reconcile themſelves as much as poſſible to their fate; to wean their affections from this world, in which they were to live only for a

time;

* Delanay's Rev. examined with candour.

‖ See Bochart and Pliny on Serpents, with Bruce's Travels.

time; and to hope, with humble confidence, in the promiſe of their God, that, upon their departure from it, they ſhould be received into ſome better ſtate. To enable them to wean their affections from earth, nothing could more contribute than to combine ſenſual enjoyment with ſorrow, and lay them under the neceſſity of procuring their means of ſubſiſtence by labour, hard and often fruitleſs. This would daily and hourly impreſs upon their minds a full conviction that the preſent world is not a place fit to be an everlaſting habitation; and they would look forward, with pious reſignation, to death, as putting a period to all their woes. Had they indeed been furniſhed with no ground of hope beyond the grave, we cannot believe that the Righteous Judge of all the earth would have added to the penalty originally threatened. That penalty they would doubtleſs have incurred the very day on which they fell; but as they were promiſed a deliverance from the conſequences of their fall, it was proper to train them up by ſevere diſcipline for the happineſs reſerved for them in a future ſtate.

After the paſſing of their ſentence, the man and woman were turned out into the world, where they had formerly lived before they were placed in the garden of Eden; and all future acceſs to the garden was for ever denied them. They were not, however, in the ſame ſtate in which they were originally before their introduction into Paradiſe: They were now conſcious of guilt; doomed to ſevere labour; liable to ſorrow and ſickneſs, diſeaſe and death: and all theſe miſeries they had brought, not only upon themſelves, but alſo, as we learn from different paſſages of the New Teſtament, upon their unborn poſterity to the end of time. It may ſeem indeed to militate againſt the moral attributes of God, to inflict miſery upon children for the ſins of their parents; but before any thing can be pronounced concerning the Divine goodneſs and juſtice in the preſent caſe, we muſt know preciſely how much we ſuffer in conſequence of Adam's tranſgreſſion, and whether we have ourſelves any ſhare in that guilt which is the cauſe of our ſufferings.

109
Doubtful whether men would have been exempted from pain under the firſt covenant,

That women would have had leſs ſorrow in conception and in the bringing forth of children; that we ſhould have been ſubjected to leſs toil and exempted from death, had our firſt parents not fallen from their paradiſaical ſtate—are truths incontrovertible by him who believes the inſpiration of the Holy Scriptures; but that mankind would in that ſtate have been wholly free from pain and every bodily diſtreſs, is a propoſition which is not to be found in the Bible, and which therefore no man is bound to believe. The bodies of Adam and Eve conſiſted of fleſh, blood, and bones, as ours do; they were ſurrounded by material objects as we are; and their limbs were unqueſtionably capable of being fractured. That their ſouls ſhould never be ſeparated from their bodies while they abſtained from the forbidden fruit, they knew from the infallible promiſe of him who formed them, and breathed into their noſtrils the breath of life; but that not a bone of themſelves or of their numerous poſterity ſhould ever be broken by the fall of a ſtone or of a tree, they were not told, and had no reaſon to expect. Of ſuch fractures, pain would ſurely have been the conſequence; though we have reaſon to believe that it would have been quickly removed by ſome infallible remedy, probably by the fruit of the tree of life.

Perhaps it may be ſaid, that if we ſuppoſe our firſt parents or their children to have been liable to accidents of this kind in the garden of Eden, it will be difficult to conceive how they could have been preſerved from death, as a ſtone might have fallen on their heads as well as on their feet, and have at once deſtroyed the principle of vitality. But this can be ſaid only by him who knows little of the phyſical world, and ſtill leſs of the power of God. There are many animals which are ſuſceptible of pain, and yet not eaſily killed; and man in Paradiſe might have reſembled theſe. At any rate, we are ſure that the Omnipotent Creator could and would have preſerved him from death; but we have no reaſon to believe that, by a conſtant miracle, he would have preſerved him from every kind of pain. Indeed, if, under the firſt covenant, mankind were in a ſtate of probation, it is certainly conceivable that ſome one individual of the numerous race might have fallen into ſin, without actually breaking the covenant by eating the fruit of the tree of knowledge; and ſuch a ſinner would undoubtedly have been puniſhed by that God who is of purer eyes than to behold iniquity: but how puniſhment could have been inflicted on a being exempted from all poſſibility of pain as well as of death, we confeſs ourſelves unable to imagine. Remorſe, which is the inſeparable conſequence of guilt, and conſtitutes in our preſent ſtate great part of its puniſhment, flows from the fearful looking for of judgment, which the ſinner knows ſhall, in a future ſtate, devour the adverſaries of the goſpel of Chriſt; but he, who could neither ſuffer pain nor death, had no cauſe to be afraid of future judgment, and was therefore not liable to the tortures of remorſe. We conclude, therefore, that it is a miſtake to ſuppoſe pain to have been introduced into the world by the fall of our firſt parents, or at leaſt that the opinion contrary to ours has no foundation in the word of God.

110
Though they would from death.

Death, however, was certainly introduced by their fall; for the inſpired apoſtle aſſures us, that in *Adam all die*[*]; and again, that *through the offence of* ONE *many are dead*[†]. But concerning the full import of the word *death* in this place, and in the ſentence pronounced upon our firſt parents, divines hold opinions extremely different. Many contend, that it includes death *corporal, ſpiritual,* or *moral* and *eternal*; and that all mankind are ſubjected to theſe three kinds of death, on account of their ſhare in the guilt of the original tranſgreſſion, which is uſually denominated *original ſin,* and conſidered as the ſource of all moral evil.

That all men are ſubjected to death corporal in conſequence of Adam's tranſgreſſion, is univerſally admitted; but that they are in any ſenſe partakers of his guilt, and on that account ſubjected to death ſpiritual and eternal, has been very ſtrenuouſly denied. To diſcover the truth is of great importance; for it is intimately connected with the Chriſtian doctrine of redemption. We ſhall therefore ſtate, with as much impartiality as we can, the arguments commonly urged on each ſide of this much agitated queſtion: but ſhould the reader perceive, as very probably he may, that we lean more to the one ſide than to the other, he will do well to ſhut our book, and, diſregarding all artificial ſyſtems, ſtudy, with an unbiaſſed mind, the writings only of the prophets and apoſtles.

111
Doctrine of original ſin ſtated.

Thoſe who maintain that all men ſinned in Adam, generally ſtate their doctrine thus: "The covenant being made with Adam, as a public perſon, not for himſelf only but for his poſterity, all mankind deſcending from him by ordinary generation *ſinned* in him and fell with him in that firſt tranſgreſſion; whereby they are deprived of that original righteouſneſs in which he was created, and are utterly indiſpoſed, diſabled, and made oppoſite to all that is ſpiritually good, and wholly inclined to all evil, and that continually; which is commonly called *original ſin,* and from which do proceed all actual tranſgreſſions, ſo as we are by nature children of wrath, bond-ſlaves to Satan, and juſtly liable to all puniſhments in this world and in that which is to come, even to everlaſting ſeparation from the comfortable preſence of God, and to moſt grievous torments in ſoul and body, without intermiſſion, in hell fire for ever."

That which in this paſſage we are firſt to examine, is the ſentence

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[*] 1 Cor. xv. 22.

[†] Rom. v. 15.

Fall of Adam and its conſequences.

ſentence which affirms all mankind deſcending from Adam by ordinary generation to have *ſinned* in him and fallen with him in his firſt tranſgreſſion; the truth of which is attempted to be proved by various texts of Holy Scripture. Thus St Paul ſays expreſsly, that "by one man ſin entered into the world and death by ſin; and ſo death paſſed upon all men, for that *all have ſinned*. But not as the offence, ſo alſo is the free gift. For if, through the *offence* of *one*, *many* be *dead*; much more the grace of God, and the gift by grace, which is by one man, Jeſus Chriſt, hath abounded unto many; and not as it was by one that ſinned, ſo is the gift (for the *judgment* was by *one* unto *condemnation*); but the free gift is of many offences unto juſtification. For if by one man's offence, death reigned by one; much more they, who receive the abundance of grace and of the gift of righteouſneſs, ſhall reign in life by one, Jeſus Chriſt. Therefore as, by the *offence of one*, *judgment* came upon *all men* to *condemnation*; even ſo, by the righteouſneſs of One, the free gift came upon all men unto juſtification of life. For as by one man's diſobedience *many were made ſinners*; ſo by the obedience of one ſhall many be made righteous‡." In this paſſage the apoſtle aſſures us, that all upon whom death hath paſſed have *ſinned*; but death hath paſſed upon infants, who could not commit actual ſin. Infants therefore muſt have ſinned in Adam, ſince death hath paſſed upon them; for death "is the wages only of ſin." He tells us likewiſe, that by the offence of one, judgment came upon all men to condemnation; and therefore, ſince the Righteous Judge of heaven and earth never condemns the innocent with the wicked, we muſt conclude, that all men partake of the guilt of that offence for which judgment came upon them to condemnation. Theſe concluſions are confirmed by his ſaying expreſsly, that "by one man's diſobedience many (*i. e.* all mankind) were *made ſinners*;" and elſewhere*, that "there is none righteous, no *not one*;" and that his Epheſian converts "were dead in treſpaſſes and ſins, and were by *nature* children of wrath even as *others*." The ſame doctrine, it is ſaid, we are taught by the inſpired writers of the Old Teſtament. Thus Job, expoſtulating with God for bringing into judgment with him ſuch a creature as man, ſays, "Who can bring a clean thing out of an unclean? Not one." And Eliphaz, reproving the patient patriarch for what he deemed preſumption, aſks‡, "What is man that he ſhould be clean, or he who is born of a woman that he ſhould be righteous?" From theſe two paſſages it is plain, that Job and his unfeeling friend, though they agreed in little elſe, admitted as a truth unqueſtionable, that man inherits from his parents a ſinful nature, and that it is impoſſible for any thing born of a woman by ordinary generation to be righteous. The Pſalmiſt talks the very ſame language; when acknowledging his tranſgreſſions, he ſays§, "Behold I was ſhapen in iniquity, and in ſin did my mother conceive me."

112 Arguments for it.

113 Adam's guilt imputed to his poſterity.

Having thus proved the fact, that all men are made ſinners by Adam's diſobedience, the divines, who embrace this ſide of the queſtion, proceed to inquire how they can be partakers in guilt which was incurred ſo many ages before they were born. It cannot be by imitation; for infants, according to them, are involved in this guilt before they be capable of imitating any thing. Neither do they admit that ſin is by the apoſtle put for the conſequences of ſin, and many ſaid to be made ſinners by one man's diſobedience, becauſe by that diſobedience they were ſubjected to death, which is the wages of ſin. This, which they call the doctrine of the Arminians, they affirm to be contrary to the whole ſcope and deſign of the context; as it confounds together ſin and death, which are there repreſented, the one as the cauſe, and the other as the effect. It likewiſe exhibits the apoſtle reaſoning in ſuch a manner as would, in their opinion, diſgrace any man of common ſenſe, and much more an inſpired writer; for then the ſenſe of theſe words, "Death hath paſſed upon all men, for that all have ſinned," muſt be, death hath paſſed upon all men, becauſe it hath paſſed upon all men; or, all men are obnoxious to death, becauſe they are obnoxious to it. The only way therefore, continue they, in which Adam's poſterity can be made ſinners through his diſobedience, is by the IMPUTATION of his diſobedience to them; and this imputation is not to be conſidered in a *moral* ſenſe, as the action of a man committed by himſelf, whether good or bad, is reckoned unto him as his own; but in a *forenſic* ſenſe, as when one man's debts are in a legal way placed to the account of another. Of this we have an inſtance in the apoſtle Paul, who ſaid to Philemon concerning Oneſimus, "If he hath wronged thee, or oweth thee any thing (ελλογει) let it be imputed to me," or placed to and put on my account. And thus the poſterity of Adam are made ſinners by his diſobedience; that being imputed to them and put to their account, as if it had been committed by them perſonally, though it was not.

Some few divines of this ſchool are indeed of opinion, that the phraſe, "By one man's diſobedience many were made ſinners," means nothing more than that the poſterity of Adam, through his ſin, derive from him a corrupt nature. But though this be admitted as an undoubted truth, the more zealous abettors of the ſyſtem contend, that it is not the whole truth. "It is true (ſay they) that all men are made of one man's blood, and that blood tainted with ſin; and ſo a clean thing cannot be brought out of an unclean. What is born of the fleſh is fleſh, carnal and corrupt: every man is conceived in ſin and ſhapen in iniquity: but then there is a difference between being *made ſinners* and *becoming* ſinful. The one reſpects the *guilt*, the other the *pollution* of nature; the one is previous to the other, and the foundation of it. Men receive a corrupt nature from their immediate parents; but they are made ſinners, not by any act of their diſobedience, but only by the imputation of the ſin of Adam."

114 The puniſhment of imputed guilt.

To confirm and illuſtrate this doctrine of imputed ſin, they obſerve, that the word κατεσταθησαν, uſed by the apoſtle, ſignifies *conſtituted* in a judicial way, ordered and appointed in the diſpenſation of things that ſo it ſhould be; juſt as Chriſt was made ſin or a ſinner by imputation, or by that conſtitution of God which laid upon him the ſins of all his people, and dealt with him as if he had been the guilty perſon. That this is the ſenſe of the paſſage, they argue further from the puniſhment inflicted on men for the ſin of Adam. The puniſhment threatened to that ſin was death; which includes death corporal, moral, and eternal. Corporal death, ſay they, is allowed by all to be ſuffered on account of the ſin of Adam; and if ſo, there muſt be guilt, and that guilt made over to the ſufferer, which can be done only by *imputation*. A moral death is no other than the loſs of the image of God in man, which conſiſted in righteouſneſs and holineſs; and particularly it is the loſs of original righteouſneſs, to which ſucceeded unrighteouſneſs and unholineſs. It is both a ſin and a puniſhment for ſin; and ſince it comes upon all men as a puniſhment, it muſt ſuppoſe preceding ſin, which can be nothing but Adam's diſobedience; the guilt of which is made over to his poſterity by *imputation*. This appears ſtill more evident from the poſterity of Adam being made liable to eternal death in conſequence of his tranſgreſſion; for the wages of ſin, we are aſſured, is death, even death eternal, which never can be inflicted on guiltleſs perſons. But from the paſſage before us we learn, that "by the offence of *one* judgment came upon all men to condemnation ;" and therefore the guilt of that offence muſt be reckoned to all men, or they could not be juſtly condemned for it. That Adam's ſin is imputed to his poſterity, appears not only from the words, "by one man's diſobedience many were made ſinners ;" but likewiſe from the oppoſite clauſe, "ſo by the obedience of One ſhall many be made righteous ;" for the many ordained to eternal life, for whom Chriſt died, are made righteous, or juſtified, only through the imputation of his righteouſneſs to them ; and therefore it follows, that all men are made ſinners only through the imputation of Adam's diſobedience.

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‡ Rom. v. 12,15—20.

* Rom. iii. 10. and Eph. ii. 1. and 3.

‡ Job xiv. 4. and xv, 14.

§ Pſalm li. 5.

115 Adam a federal head to his poſterity.

To this doctrine it is ſaid to be no objection that Adam's poſterity were not in being when his ſin was committed : for though they had not then actual being, they had yet a virtual and repreſentative one. They were in him both *ſeminally* and *federally*, and ſinned in him * ; juſt as Levi was in the loins of Abraham, and paid in him tithes to Melchizedeck †. From Adam, as their common parent, they derive a corrupt nature ; but it is only from him, as their federal head, that they derive a ſhare of his guilt, and are ſubjected to his puniſhment. That he was a federal head to all his poſterity, the divines of this ſchool think evident from his being called a figure of Chriſt ‡ ; and the firſt Adam deſcribed as natural and earthly, in contradiſtinction to Chriſt the ſecond Adam deſcribed as ſpiritual and the Lord from heaven ; and from the puniſhment threatened againſt his ſin being inflicted not on himſelf only, but on all his ſucceeding offſpring. He could not be a figure of Chriſt, ſay they, merely as a man ; for all the ſons of Adam have been men as well as he, and in that ſenſe were as much figures of Chriſt as he ; yet Adam and Chriſt are conſtantly contraſted, as though they had been the only two men that ever exiſted, becauſe they were the only two heads of their reſpective offſpring. He could not be a figure of Chriſt on account of his extraordinary production ; for though both were produced in ways uncommon, yet each was brought into the world in a way peculiar to himſelf. The firſt Adam was formed of the duſt of the ground ; the ſecond, though not begotten by a man, was born of a woman. They did not therefore reſemble each other in the manner of their formation, but in their office as covenant-heads ; and in that alone the compariſon between them is exact.

116 No cauſe of complaint in this conſtitution of things.

Nor have any of the poſterity of Adam, it is ſaid, reaſon to complain of ſuch a procedure. Had he ſtood in his integrity, they would have been, by his ſtanding partakers of all his happineſs ; and therefore ſhould not murmur at receiving evil through his fall. If this do not ſatisfy, let it be conſidered, that ſince God, in his infinite wiſdom, thought proper that men ſhould have a head and repreſentative, in whoſe hands their good and happineſs ſhould be placed, none could be ſo fit for this high ſtation as the common parent, made after the image of God, ſo wiſe, ſo holy, juſt, and good. Laſtly, to ſilence all objections, let it be remembered, that what God gave to Adam as a federal head, relating to himſelf and his poſterity, he gave as the Sovereign of the univerſe, to whom no created being has a right to aſk, "What doſt thou * ?

117 St Auguſtine the author of this doctrine.

Such are the conſequences of Adam's fall, and ſuch the doctrine of original ſin, as maintained by the more rigid followers of Calvin. That great reformer, however, was not the author of this doctrine. It had been taught, ſo early as in the beginning of the fifth century, by St Auguſtine, the celebrated biſhop of Hippo (ſee AUGUSTINE); and the authority of that father had made it more or leſs prevalent in both the Greek and Roman churches long before the Reformation. Calvin was indeed the moſt eminent modern divine by whom it has been held in all its rigour ; and it conſtitutes one great part of that theological ſyſtem, which, from being taught by him, is now known by the name of *Calviniſm*. Thoſe by whom it is embraced maintain it with zeal, as, in their opinion, forming together with the other tenets of their maſter, the only pure ſyſtem of evangelical truths ; but it hath met with much oppoſition in ſome of the Lutheran churches, as well as from private divines in the church of England, and from the great body of Dutch remonſtrants (ſee CALVINISM, ARMINIANS, and SYNOD OF DORT) ; and of their objections it is now our duty to give a candid view, as well as of the doctrine which they ſubſtitute in its ſtead.

118 Objections to it,

They begin then with alleging, that if it was as ſovereign of the univerſe that God gave to Adam what he received in paradiſe relating to himſelf and his poſterity, Adam could in no ſenſe of the words be a federal head ; becauſe, upon this ſuppoſition, there was no covenant. The Sovereign of the Univerſe may unqueſtionably diſpenſe his benefits, or withhold them, as ſeems expedient to his infinite wiſdom ; and none of his ſubjects or creatures can have a right to ſay to him, What doſt thou ? But the diſpenſing or withholding of benefits is a tranſaction very different from the entering into covenants ; and a judgment is to be formed of it upon very different principles. Every thing around us proclaims that the Sovereign of the Univerſe is a being of perfect benevolence ; but, ſay the diſciples of the ſchool now under conſideration, the diſpenſation given to Adam in paradiſe was ſo far from being the offſpring of benevolence, that, as it is underſtood by the followers of Calvin, it cannot poſſibly be reconciled with the eternal laws of equity. The ſelf-exiſtent and all-ſufficient God might or might not have created ſuch a being as man ; and in either caſe there would have been no reaſon for the queſtion "What doſt thou ?" But as ſoon as he determined to create him capable of happineſs or miſery, he would not have been either benevolent or juſt, if he had not placed him in a ſtate where, by his own exertions, he might, if he choſe, have a greater ſhare of happineſs than of miſery, and find his exiſtence, upon the whole, a bleſſing. They readily acknowledge, that the exiſtence of any created being may be of longer or ſhorter duration, according to the good pleaſure of the Creator ; and therefore they have no objection to the apoſtolic doctrine, that "in Adam all die :" for immortality being not a debt, but a *free gift*, may be beſtowed upon any terms whatever, and with perfect juſtice withdrawn when theſe terms are not complied with. Between death, however, as it implies a loſs of conſciouſneſs, and the extreme miſery of eternal life in torments, there is an immenſe difference. To death all mankind might juſtly be ſubjected through the offence of one ; becauſe they had originally no claim of right to be exempted from it, though that one and they too had remained for ever innocent : but eternal life in torments is a puniſhment which a God of juſtice and benevolence can never inflict but upon perſonal guilt of the deepeſt die. That we can perſonally have incurred guilt from a crime committed ſome thouſands of years before we were born, is impoſſible. It is indeed a notion, if ſuch a notion can be formed, as contrary to Scripture as to reaſon and common ſenſe : for the apoſtle expreſsly informs us *, "that ſin is the tranſgreſſion of ſome law ; and the ſin of Adam was the tranſgreſſion of a law which it was never in our power either to obſerve or to break. Another apoſtle † aſſures us, that "where no law is, there is no tranſgreſſion ;" but there is now no law, nor has been any theſe 5000 years, forbidding mankind to eat of a particular fruit ; for, according to the Calviniſts themſelves ‡, Adam had no ſooner committed his firſt ſin, by which the covenant with him was broken, than he ceaſed to be a covenant-head. The law given

119 As inconſiſtent with the juſtice of God.

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* Rom. v. 12.

† Heb. vii. 9, 10.

‡ Rom. v. 14.

* See Gill's Body of Divinity.

* 1 John iii. 4.

† Rom. iv. 15.

‡ Gill's Body of Divinity, book iii. ch. 10.

120 The ſcripture, and the nature of things.

given him was no more; the promiſe of life by it ceaſed; and its ſanction, death, took place. But if this be ſo, how is it poſſible that his unborn poſterity ſhould be under a law which had no exiſtence, or that they ſhould be in a worſe ſtate in conſequence of the covenant being broken, and its promiſe having ceaſed, than he himſelf was before the covenant was firſt made? He was originally a mortal being, and was promiſed the ſupernatural gift of immortality on the ſingle condition of his abſtaining from the fruit of the tree of knowledge of good and evil. From that fruit he did not abſtain; but by eating it fell back into his natural ſtate of mortality. Thus far it is admitted that his poſterity fell with him; for they have no claim to a ſupernatural gift which he had forfeited by his tranſgreſſion. But we cannot admit, ſay the divines of this ſchool, that they fell into his guilt; for to render it poſſible for a man to incur guilt by the tranſgreſſion of a law, it is neceſſary not only that he have it in his power to keep the law, but alſo that he be capable of tranſgreſſing it by a *voluntary* deed. But ſurely no man could be capable of voluntarily eating the forbidden fruit 5000 years before he himſelf or his volitions exiſted. The followers of Calvin think it a ſufficient objection to the doctrine of tranſubſtantiation, that the ſame numerical body cannot be in different places at the ſame inſtant of time. But this ubiquity of body, ſay the remonſtrants, is not more palpably abſurd, than the ſuppoſition that a man could exert volitions before he or his will had any exiſtence. If indeed there be any difference between the two caſes, it is in favour of the Catholic doctrine of the real preſence; for we are by no means ſo intimately acquainted with the internal ſubſtance of body, and what can be predicated of it, as we are with the nature of guilt and the exerciſe of volition. Theſe we know thoroughly as they really are in themſelves; the former only relatively as it is ſeen in its qualities.

121 The word IMPUTATION removes no difficulties.

Nor will the introduction of the word *imputation* into this important queſtion remove a ſingle difficulty. For what is it that we mean by ſaying that the ſin of Adam is imputed to his poſterity? Is the guilt of that ſin transferred from him to them? So ſurely thought Dr. Gill, when he ſaid that it *is made over to them*. But this is the ſame abſurdity as the making over of the ſenſible qualities of bread and wine to the internal ſubſtance of our Saviour's body and blood! This imputation either found the poſterity of Adam guilty of his ſin, or it made them ſo. It could not find them guilty for the reaſon already aſſigned; as well as becauſe the apoſtle ſays expreſsly, that for the offence of *one* judgment came upon *all* men, which would not be true had *all* offended. It could not make them guilty; for this reaſon, that if there be in phyſics or metaphyſics a ſingle truth ſelf-evident, it is, that the numerical powers, actions, or qualities, of one being cannot poſſibly be transferred to another, and be made its powers, actions, or qualities. Different beings may in diſtant ages have qualities of the ſame kind; but as eaſily may 4 and 3 be made equal to 9, as two beings be made to have the ſame identical quality. In Scripture we nowhere read of the actions of one man being imputed to another. "Abraham (we are told) believed in God, and it was counted to him for righteouſneſs;" but it was his *own* faith, and not the faith of another man, that was ſo counted. "To him that worketh not, but believeth, his faith (not another's) is imputed for righteouſneſs." And of our faith in him that raiſed Chriſt from the dead, it is ſaid, that "it ſhall be imputed, not to our fathers or our children, but to us for righteouſneſs."

122 Meaning of that word in ſcripture.

When this phraſe is uſed with a negative, not only is the man's own perſonal ſin ſpoken of, but the non-imputation of that ſin means nothing more but that it brings not upon the ſinner condign puniſhment. Thus when Shemei "ſaid unto David, Let not my lord *impute* iniquity unto me;" it could not be his meaning that the king ſhould not think that he had offended; for with the ſame breath he added, "Neither do thou remember that which thy ſervant *did perverſely*, the day that my lord the king went out of Jeruſalem, that the king ſhould take it to his *heart*. For thy ſervant doth *know* that *I have ſinned*." Here he plainly confeſſes his ſin, and declares, that by intreating the king not to *impute it to him*, he wiſhed only that it ſhould not be ſo remembered as that the king ſhould take it to heart, and puniſh him as his perverſeneſs deſerved. When therefore it is ſaid*, that "God was in Chriſt reconciling the world to himſelf, not imputing to them their iniquities, the meaning is only that for Chriſt's ſake he was pleaſed to exempt them from the puniſhment due to their ſins. In like manner, when the prophet, foretelling the ſufferings of the Meſſiah, ſays, that "the Lord laid on him the iniquity of us all," his meaning cannot be, that the Lord by *imputation* made his immaculate Son guilty of all the ſins that men have ever committed; for in that caſe it would not be true that the "juſt ſuffered for the unjuſt," as the apoſtle expreſsly teaches §: but the ſenſe of the verſe muſt be as Biſhop Coverdale tranſlated it, "through him the Lord pardoneth all our ſins." This interpretation is countenanced by the ancient verſion of the Seventy, και Κυριος παρεδωκεν αυτον ταις ἁμαρτιαις ἡμων; words which expreſs a notion very different from that of imputed guilt. The Meſſiah was, without a breach of juſtice, delivered for ſins of which he had voluntarily offered to pay the penalty; and St Paul might have been juſtly charged by Philemon with the debts of Oneſimus, which he had deſired might be placed to his account. Had the apoſtle, however, expreſſed no ſuch deſire, ſurely Philemon could by no deed of his have made him liable for debts contracted by another; far leſs could he by *imputation*, whatever that word may mean, have made him virtually concur in the contracting of thoſe debts. Juſt ſo it ſeems to be with reſpect to the ſufferings of Chriſt for the ſins of men: He could not have been juſtly ſubjected to ſuffering without his own conſent; and he could not poſſibly have been made guilty of the ſins of thoſe for whom he ſuffered.

The doctrine of imputed guilt therefore, as underſtood by the Calviniſts, is, in the opinion of their opponents, without foundation in Scripture, and contrary to the nature of things. It is an impious abſurdity (ſay they), to which the mind can never be reconciled by the hypotheſis, that all men were in Adam both ſeminally and federally, and ſinned in him, as Levi paid tithes to Melchizedeck in the loins of Abraham. The apoſtle, when he employs that argument to leſſen in the minds of his countrymen the pride of birth and the lofty opinions entertained of their prieſthood, plainly intimates, that he was uſing a bold figure, and that Levi's paying tithes is not to be underſtood in a ſtrict and literal ſenſe. "Now conſider (ſays he) how great this man was, unto whom even the patriarch Abraham gave the tenth of his ſpoils. And, *as I may ſo ſay*, Levi alſo, who receiveth tithes, paid tithes in Abraham: for he was yet in the loins of his father when Melchizedeck met him." This is a very good argument to prove that the Levitical prieſthood was inferior in dignity to that of Melchizedeck; and by the apoſtle it is employed for no other purpoſe. Levi could not be greater than Abraham, and yet Abraham was inferior to Melchizedeck. This is the whole of St Paul's reaſoning, which lends no ſupport to the doctrine of original ſin, unleſs it can be ſhown that Levi and all his deſcendants contracted from this circumſtance ſuch a ſtrong propenſity to the *paying* of tithes, as made it a matter of extreme difficulty for them, in every ſubſequent generation, to

123 Moral guilt cannot be tranſmitted from father to ſon.

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* 2 Cor. v. 19.

§ 1 Peter iii. 18.

to comply with that part of the divine law which conſtituted them *receivers* of tythes. That all men were ſeminally in Adam, is granted; and it is likewiſe granted that they may have derived from him, by ordinary generation, diſeaſed and enfeebled bodies: but it is as impoſſible to believe that moral guilt can be tranſmitted from father to ſon by the phyſical act of generation, as to conceive a ſcarlet colour to be a cube of marble, or the ſound of a trumpet a cannon ball. That Adam was as fit a perſon as any other to be entruſted with the good and happineſs of his poſterity, may be true; but there is no fitneſs whatever, according to the Arminians, in making the everlaſting happineſs or miſery of a whole race depend upon the conduct of any fallible individual. "That any man ſhould ſo repreſent me (ſays Dr Taylor*), that when he is guilty, I am to be reputed guilty; when he tranſgreſſes, I ſhall be accountable and puniſhable for his tranſgreſſion; and this before I am born, and conſequently before I am in any capacity of knowing, helping, or hindering, what he doth: all this every one who uſeth his underſtanding muſt clearly ſee to be falſe, unreaſonable, and altogether inconſiſtent with the truth and goodneſs of God." And that no ſuch appointment ever had place, he endeavours to prove, by ſhowing that the texts of Scripture upon which is built the doctrine of the Calviniſts reſpecting original ſin, will each admit of a very different interpretation.

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The ſeveral texts on which this doctrine is built capable of a different interpretation.

One of the ſtrongeſt of theſe texts is Romans v. 19. which we have already quoted, and which our author thus explains. He obſerves, that the apoſtle was a Jew, familiarly acquainted with the Hebrew tongue; that he wrote his epiſtle as well for the uſe of his own countrymen reſiding in Rome, as for the benefit of the Gentile converts; and that though he made uſe of the Greek language, as moſt generally underſtood, he frequently employed Hebrew idioms. Now it is certain that the Hebrew words חטאה and עון, "ſin and iniquity," are frequently uſed in the Old Teſtament to ſignify *ſuffering*, by a figure of ſpeech which puts the effect for the cauſe; and it is ſurely more probable, that in the verſe under conſideration, the apoſtle uſed the correſponding Greek word ἁμαρτωλοι in the ſame Hebrew ſenſe, than that he meant to contradict what he had ſaid in the former verſe, by teaching that all men were made guilty of an act of diſobedience committed thouſands of years before the majority of them had any being. In the preceding verſe he ſays, "that by the offence of one, judgment came upon all men to condemnation." But this cannot be true, if by that offence all men were made ſinners; for then judgment muſt have come upon each for his own ſhare in the original diſobedience. "Any one may ſee (ſays our author) that there is a vaſt difference between a man's making *himſelf* a ſinner by his *own* wicked act, and his being made a ſinner by the wicked act of *another*. In the latter caſe, he can be a ſinner in no other ſenſe but as he is a ſufferer; juſt as Lot would have been made a ſinner with the Sodomites, had he been conſumed in the iniquity of the city §; and as the ſubjects of Abimelech would have been made ſinners, had he, in the integrity of his heart, committed Adultery with Abraham's wife*. That the people of Gerar could have contracted any real guilt from the adultery of their ſovereign, or that he, by lying with a woman whom he had reaſon to believe to be not the wife but the ſiſter of another man, would have incurred all the moral turpitude of that crime, are poſitions which cannot be maintained. Yet he ſays, that Abraham had brought upon him and on his kingdom a *great ſin*; though it appears, from comparing the 6th verſe with the 17th and 18th, that he had not been brought under ſin in any other ſenſe than as he was made to ſuffer for taking Sarah into his houſe. In this ſenſe, "Chriſt, though we are ſure that he knew no ſin, was made ſin for us, and numbered with the tranſgreſſors," becauſe he ſuffered death for us on the croſs; and in this ſenſe it is true, that by the diſobedience of Adam all mankind were made ſinners, becauſe, in conſequence of his offence, they were by the judgment of God made ſubject to death.

But it may be thought that this interpretation of the words *ſin* and *ſinners*, though it might perhaps be admitted in the 19th verſe, cannot be ſuppoſed to give the apoſtle's real meaning, as it would make him employ in the 12th verſe an abſurd argument, which has been already noticed. But it may perhaps be poſſible to get quit of the abſurdity, by examining the original text inſtead of our tranſlation. The words are, και ὁυτως εις παντας ανθρωπους ο θανατος διηλθεν εφ ᾧ παντες ημαρτον. In order to aſcertain the real ſenſe of theſe words, the firſt thing to be done is to diſcover the antecedent to the relative ᾧ. Our tranſlators ſeem to conſider it as uſed abſolutely without any antecedent; but this is inaccurate, as it may be queſtioned whether the relative was ever uſed in any language without an antecedent either expreſſed or underſtood. Accordingly, the Calviniſt critics, and even many Remonſtrants, conſider ενος ανθρωπου in the beginning of the verſe as the antecedent to ᾧ in the end of it, and tranſlate the clauſe under conſideration thus: "And ſo death hath paſſed upon all men, in whom (*viz.* Adam) all have ſinned." θανατος, however, ſtands much nearer to ᾧ than ανθρωπου; and being of the ſame gender, ought, we think, to be conſidered as its real antecedent; but if ſo, the clauſe under conſideration ſhould be thus tranſlated: "and ſo death hath paſſed upon all men, unto which (o) all have ſinned, or, as the Arminians explain it, have ſuffered. If this criticiſm be admitted as juſt, εφ' ᾧ muſt be conſidered as ſtanding here under a particular emphaſis, denoting the utmoſt length of the conſequences of Adam's ſin (p); as if the apoſtle had ſaid, "ſo far have the conſequences of Adam's ſin extended, and ſpread their influence among mankind, introducing not only a curſe upon the earth, and ſorrow and toil upon its inhabitants, but even DEATH, UNIVERSAL DEATH, in every part, and in all ages of the world." His words (ſay the Remonſtrants) will unqueſtionably bear this ſenſe; and it is ſurely much more probable that it is their true ſenſe, than that an inſpired writer ſhould have taught a doctrine ſubverſive of all our notions of right and wrong, and which, if really embraced, muſt make us incapable of judging when we are innocent and when guilty.

When the apoſtle ſays that there is none righteous, no not one, he gives us plainly to underſtand that he is quoting from the 14th Pſalm; and the queſtion to be firſt anſwered is, In what ſenſe were theſe words uſed by the Pſalmiſt?

* Doctrine of Original Sin, part iii.

§ Gen. xix. 15.

* Gen. xx.

(o) That επι, when conſtrued with a dative caſe, often ſignifies *to* or *unto*, is known to every Greek ſcholar. Thus επ' ευδοξια ὁδος, *the way to fame*, (Lucian.) Κακουργος επι τω θανατω, *a criminal unto death*, (Demoſth.) Επι θανατω συλλαβειν, *to carry to death or execution*, (Iſoc.) Υμεις επ ελευθερια εκληθητε, *ye have been called to liberty*, (Gal. 5. 13.) Κτισθεντες εν Χριστω Ιησου επι εργοις αγαθοις, *created in Chriſt Jeſus unto good works*, (Epheſ. ii. 10.) See alſo 1 Theſ. iv. 7.; 2 Tim. ii. 14.; and many other places of the New Teſtament.

(p) Εφ' ᾧ has likewiſe this import, denoting the *terminus ad quem* in Phil. iii. 12. and iv. 10

miſt? That they were not meant to include all the men and women then living, far leſs that have ever lived, is plain from the fifth verſe of the ſame Pſalm, where we are told that thoſe wicked perſons "were in great fear becauſe God was in the congregation of the *righteous*." There was then, it ſeems, a congregation of righteous perſons, in oppoſition to thoſe called the *children of men*, of whom alone it is ſaid that there was none that did good, no not one. The truth is, that the perſons of whom David generally complains in the book of Pſalms, conſtituted a ſtrong party diſaffected to his perſon and government. That faction he deſcribes as proud and oppreſſive, as deviſing miſchief againſt him, as violent men continually getting together for war. He ſtyles them his *enemies*; and ſometimes characterizes them by the appellation which was given to the apoſtate deſcendants of Cain before the deluge. Thus in the 57th Pſalm, which was compoſed when he fled from Saul to the cave in which he ſpared that tyrant's life, he complains, "I lie among them that are ſet on fire, even the SONS OF MEN, whoſe teeth are ſpears," &c.; and again in the 58th Pſalm, he ſays, "Do ye indeed ſpeak righteouſneſs, O congregation? Do ye judge uprightly, O ye ſons of men?" By comparing theſe texts with 1 Sam. xxvi. 19. it will appear evident beyond diſpute, that by the SONS OF MEN mentioned in them, he meant to characterize thoſe enemies who exaſperated Saul againſt him. Now it is well known, that there was a party adhering to the intereſts of the houſe of Saul which continued its enmity to David during the 40 years of his reign, and joined with Abſalom in rebellion againſt him only eight years before his death. But it is the opinion of the moſt judicious commentators§, that the 14th Pſalm was compoſed during the rebellion of Abſalom; and therefore it is ſurely much more probable, that by *the children of men*, of whom it is ſaid "there is none that doth good, no not one," the inſpired poet meant to characterize the rebels, than that he ſhould have directly contradicted himſelf in the compaſs of two ſentences ſucceeding each other. Had he indeed known that all the children of men, as deſcending from Adam, "are utterly indiſpoſed, diſabled, and made oppoſite to all that is ſpiritually good, and wholly and continually inclined to all evil," he could not with the leaſt degree of conſiſtency, have repreſented the Lord as looking down from heaven upon them, to ſee if there were any that did underſtand and ſeek after God;" but if by the children of men was meant only the rebel faction, this ſcenical repreſentation is perfectly conſiſtent, as it was natural to ſuppoſe that there might be in that faction ſome men of good principles miſled by the arts of the rebel chiefs.

Having thus aſcertained the ſenſe of the words as originally uſed by the Pſalmiſt, the Arminian proceeds to inquire for what purpoſe they were quoted by the apoſtle; and in this inquiry he ſeems to find nothing difficult. The averſion of the Jews from the admiſſion of the Gentiles to the privileges of the goſpel, the high opinion which they entertained of their own worth and ſuperiority to all other nations, and the ſtrong perſuaſion which they had that a ſtrict obedience to their own law was ſufficient to juſtify them before God, are facts univerſally known; but it was the purpoſe of the apoſtle to prove that all men ſtood in need of a Redeemer, that Jews as well as Gentiles had been under the dominion of ſin, and that the one could not in that reſpect claim any ſuperiority over the other. He begins his epiſtle, therefore, with ſhewing the extreme depravity of the Heathen world; and having made good that point, he proceeds to prove by quotations from the book of Pſalms, Proverbs, and Iſaiah, that the Jews were in nowiſe better than they, that every mouth might be ſtopped, and all the world become guilty, or inſufficient for their own juſtification before God.

The next proof brought by the Calviniſts in ſupport of their opinion, that all men derive guilt from Adam by ordinary generation, is that text in which St Paul ſays that the Epheſians were by *nature* children of wrath even as others." To this their opponents reply, that the doctrine of original ſin is in this verſe, as in the laſt quoted, countenanced only by our tranſlation, and not by the original Greek as underſtood by the ancient fathers of the Chriſtian church, who were greater maſters of that language than we. The words are και ἡμεν Τεκνα φυσει οργης; in which it is obvious, that τεκνα, though in its original ſenſe it ſignifies the genuine children of parents by natural generation, cannot be ſo underſtood here; becauſe no man was ever begotten by, or born of, the abſtract notion *wrath*. It muſt therefore be uſed figuratively; and in other places of Scripture it often denotes a cloſe relation to any perſon or thing. Thus we read of the children of *God*, of the *kingdom*, the *reſurrection*, *wiſdom*, *light*, *obedience*, and *peace*; whence it is concluded, that by the children of wrath are meant thoſe who are liable to puniſhment or rejection. And becauſe there were in thoſe days ſome children, in a lower and leſs proper ſenſe, by *adoption*, and others, in a higher and more proper ſenſe, by *natural generation*, of whom the relation of the latter to their parents was much cloſer than that of the former; the apoſtle tells the Epheſians, that they were by *nature* children of wrath, to convince them that they were *really* liable to it by the ſtricteſt and cloſeſt relation poſſible. That the word φυσει here is of the ſame import with *really* or *truly*, and that it does not ſignify what we mean by *nature* in the proper ſenſe of that word, the ancient fathers are generally agreed*; and that the modern Greeks, who ſtill ſpeak a dialect of the noble language of their anceſtors, underſtand the word in the ſame ſenſe, is apparent from their verſion of the text before us. In the moſt correct and elegant edition of the New Teſtament in their vernacular tongue, the words under conſideration are thus rendered; και φυσικὰ ημασθαν τεκνα οργης ὥσπερ και ὁι λοιποι, where it is impoſſible that φυσικα can ſignify *natural*, otherwiſe the apoſtle will be made to ſay, not that we are by the nature derived from Adam liable to wrath, but that we were *naturally begotten* by *wrath* in the abſtract! For taking the word φυσει in the ſenſe of *really* or *truly*, both the ancient and modern Greeks appear indeed to have the authority of St Paul himſelf; who, writing to Timothy, calls him γνησιον τεκνον "his true or genuine ſon;" not to ſignify that he was the child of the apoſtle by natural generation, but that he was cloſely related to him in the faith to which St Paul had converted him. That the words τεκνα φυσει οργης can ſignify nothing but *truly* or *really relations to wrath*, is ſtill farther evident from the ground aſſigned of that relation. It is not the ſin of Adam, or the impurity of natural generation, "but the treſpaſſes and ſins in which the Epheſians in time paſt *walked*, according to the courſe of the world, according to the prince of the power of the air," the ſpirit that at the time of the apoſtle's writing "worked in the children of diſobedience." Surely no man can ſuppoſe that the Epheſians at any paſt time *walked* in Adam's treſpaſs and ſin, or that the prince of the power of the air tempted *them* to eat the forbidden fruit.

Having thus commented on the principal texts which are cited from the New Teſtament to prove the doctrine of original ſin, the Arminians treat thoſe which are quoted from the Old Teſtament, in ſupport of the ſame doctrine, with much leſs ceremony. Thus, when Job ſays, "who can

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§ Hammond, &c.

* See Hammond and Whitby on the Text; and Suidas on the word φυσις

Fall of Adam and its conſequences.

can bring a clean thing out of an unclean? Not one," he is ſpeaking, ſay they, not of the pravity of our nature, but of its frailty and weakneſs, of the ſhortneſs and miſery of human life. The ſentence is proverbial; and as it is uſed only to ſignify, that nothing can be more perfect than its original, it muſt, whenever it occurs, be underſtood according to the ſubject to which it is applied. That in the place under conſideration it refers to our mortality, they think plain from the context; and Dr Taylor adds*, with ſome plauſibility, that if the words refer to the guilt which we are ſuppoſed to derive from Adam, they will prove too much to ſerve the common ſcheme of original ſin. They will prove that our natural and inherent pravity, ſo far from rendering us fit ſubjects of wrath, may be urged as a reaſon why God ſhould not even bring us into judgment; for the patriarch's whole expoſtulation runs thus, "Doſt thou open thine eyes upon ſuch a one, and bringeſt me into judgment with thee? Who can bring a clean thing out of an unclean?"

The other text quoted from the ſame book, they think ſtill leſs to the purpoſe; for Eliphaz is evidently contraſting the creature with the Creator; in compariſon with whom, he might well ſay, without alluding to original guilt, "what is man that he ſhould be clean? and he who is born of a woman that he ſhould be righteous? Behold he putteth no truſt in his ſaints; yea the *heavens* are not clean in his ſight. How much more abominable and filthy is man, who drinketh iniquity like water?" He does not ſay, who derives by birth an iniquitous nature; for he knew well, that as we are born, we are the pure workmanſhip of God, "whoſe hands have faſhioned and formed every one of us;" but "who *drinketh* iniquity like water," who maketh himſelf iniquitous by running headlong into every vicious practice.

Of the text quoted from the fifty-firſt Pſalm in ſupport of the doctrine of original ſin, Dr Taylor labours†, by a long and ingenious criticiſm, to prove that our tranſlators have miſtaken the ſenſe. The word which they have rendered *ſhapen*, he ſhews to be uſed once by Iſaiah, and twice in the book of Proverbs, to ſignify *brought forth*; and that which is rendered *conceived me*, is never, he ſays, employed in ſcripture, to denote human conception. In this laſt remark, however, he is contradicted by a great authority, no leſs indeed than that of Mr Parkhurſt‡, who ſays, that the LXX conſtantly render it by κισσαω or εγκισσαω, and the Vulgate generally by *concipio*. Without taking upon us to decide between theſe two eminent Hebrew ſcholars, we ſhall only obſerve, that upon one occaſion || it certainly denotes ideas much groſſer than thoſe which the Pſalmiſt muſt have had of his mother's conception; and that there, at leaſt, Dr Taylor properly tranſlates it *incaleſcebant*, adding, "de hoc vero incaleſcendi genere loqui Davidem nemo ſanus exiſtimare poteſt. Matrem enim incaluiſſe, aut ipſum calefeciſce eo modo quo incaleſcerent Jacobi pecudes Regem dicere, prorſus indecorum et abſurdum." He contends, however, that the original force of the word is *to be hot*, and that it is applied to *conception*, to *reſentment*, to *warmth* by which the body is nouriſhed, to *idolaters* in love with idols, and to the heat of metals. The heat of idolaters, of reſentment, and of metals, are evidently foreign to the Pſalmiſt's purpoſe; and the idea conveyed by the word *incaleſcere* being ſet aſide for the reaſons already aſſigned, there remains only the warmth by which the body is nouriſhed, and of that warmth our author is confident that David ſpoke.

If this criticiſm be admitted, the whole verſe will then run thus: "Behold I was born in iniquity, and in ſin did my mother nurſe me;" which hath no reference to the original formation of his conſtitution, but is a periphraſis of his being a *ſinner from the womb*, and means nothing more than that he was a *great ſinner*, or had contracted *early habits* of ſin. He no more deſigned to ſignify in this verſe, that by ordinary generation he had a nature conveyed to him which was "utterly indiſpoſed, diſabled, and oppoſite to all that is ſpiritually good, and wholly and continually inclined to evil," than he meant in another ‡ to ſignify ſtrictly and properly that the wicked are eſtranged from the womb, and TELL LIES as ſoon as they are born;" or than Job meant to ſignify ||, that from the moment he came from his mother's womb he had been a guide to the widow and a ſuccour to the fatherleſs. All theſe are hyperbolical forms of expreſſion; which, though they appear ſtrained, and perhaps extravagant, to the phlegmatic inhabitants of Europe, are perfectly ſuited to the warm imaginations of the orientals, and to the genius of eaſtern languages. They mean not that Job was *born* with *habits* of *virtue*, that the wicked actually *walked*, and *ſpoke*, and *ſpoke lies* from the inſtant of their *birth*, or that the Pſalmiſt was really *ſhapen* in *ſin*, and *conceived in iniquity*. This laſt ſentence, if interpreted literally, would indeed be groſly impious: it would make the inſpired penman throw the whole load of his iniquity and ſin from off himſelf upon *him* who ſhaped and upon *her* who conceived him; even upon that God "whoſe hands had made him and faſhioned him, and whom he declares that he will praiſe for having made him fearfully and wonderfully," and upon that parent who conceived him with ſorrow, and brought him forth with pain, and to whom the divine law commanded him to render honour and gratitude. "But if, after all (ſays Dr Taylor*), you will adhere to the literal ſenſe of the text for the common doctrine of *original ſin*, ſhew me any good reaſon why you ought not to admit the literal ſenſe of the text, *this is my body* for *tranſubſtantiation*? If you ſay, it is abſurd to ſuppoſe that Chriſt ſpeaks of his real natural body; I ſay, it is likewiſe abſurd to ſuppoſe that the Pſalmiſt ſpeaks of his being really and properly ſhapen in iniquity, and conceived in ſin. If you ſay, that the ſenſe of the words *this is my body* may be clearly explained by other texts of ſcripture where the like forms of ſpeech are uſed; I ſay, and have ſhewn, that the Pſalmiſt's ſenſe may as clearly and evidently be made out by parallel texts, where you have the like kind of expreſſion. If you ſay that tranſubſtantiation is attended with conſequences hurtful to piety, I ſay that the common doctrine of original ſin is attended with conſequences equally hurtful; for it is a principle apparently leading to all manner of iniquity to believe that ſin is natural to us, that it is interwoven and ingrafted into our very conſtitution from our conception and formation in the womb."

125
Conſequences of eating the forbidden fruit, according to the Arminians.

The Arminians having thus, as they think, proved that the poſterity of Adam are not in any ſenſe rendered guilty by his ſin, contend, that the death threatened againſt his eating of the forbidden fruit, and which, in conſequence of his tranſgreſſion, came upon all men, can mean nothing more than the loſs of that vital principle which he received when God breathed into his noſtrils the breath of life, and he became a living ſoul. Every thing beyond this is pure conjecture, which has no foundation in the ſcriptures of truth, and is directly contrary to all the notions of right and wrong which we have been able to acquire from the ſtudy of thoſe very ſcriptures. It is not conceivable from any thing in the hiſtory, that Adam could underſtand it of the loſs of any other life than that which he had lately received, for no other life is ſpoken of to which the threatened death can be oppoſed; and in ſuch circumſtances it was ſtrange

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* Scripture Doctrine, part ii.

† Ubi Supra.

‡ See his Lexicon on the word יחם

|| Gen. xxx. 38, 39, 40, compared with xxxi. 10.

‡ Pſ. lviii. 3.

|| Job xxxi. 18.

* Scripture Doctrine, part ii.

ſtrange indeed, if by the word *death* he underſtood either eternal life in miſery, or a neceſſity of continuing in ſin. The ſenſe therefore of the threatening, ſay they, is this; "I have formed thee of the duſt of the ground, and breathed into thy noſtrils the breath of life; and thus thou art become a living ſoul. But if thou eateſt of the fruit of the tree of knowledge of good and evil, thou ſhalt ceaſe to be a living ſoul; for I will take from thee the breath of life, and thou ſhalt return to the duſt of which thou waſt formed."

126
Some of them admit the depravity of human nature.

Thus far the Arminians of the preſent day (Q) are agreed in oppoſing the doctrine of the rigid Calviniſts, and in ſtating their own notions of the conſequences of Adam's fall; but from that event their adverſaries deduce one conſequence, which ſome of them admit and others deny. It is ſaid, that though we cannot poſſibly be partakers in Adam's guilt, we yet derive from him a moral taint and infection, by which we have a natural propenſity to ſin; that having loſt the image of God, in which he was created, Adam begat ſons in his own image; and in one word, that the ſenſual appetites of human nature were inflamed, and its moral and intellectual powers greatly weakened by the eating of the forbidden fruit. The heathens themſelves acknowledged and lamented this depravity, though they were ignorant of the ſource from which it ſprung. The ſcriptures aſſert it, affirming that no man can be born pure and clean; that whatever is born of the fleſh, or comes into the world by ordinary generation, is fleſh, carnal and corrupt; that the imagination of the thoughts of man's heart is only evil continually; that the heart is deceitful above all things and deſperately wicked; and that out of it proceeds all that is vile and ſinful ||.

127
And illuſtrate it upon principles of natural knowledge.

This depravity of human nature, thus clearly deducible from ſcripture, and confirmed by the teſtimony of ages, an ingenious writer of the moderate Arminian ſchool undertakes to illuſtrate upon the principles of natural knowledge. "We know (ſays he †), that there are ſeveral fruits in ſeveral parts of the world of ſo noxious a nature as to deſtroy the beſt human conſtitution upon earth. We alſo know that there are ſome fruits in the world which inflame the blood into fevers and frenzies; and we are told that the Indians are acquainted with a certain juice, which immediately turns the perſon who drinks it into an idiot, leaving him at the ſame time in the enjoyment of his health and all the powers of this body. Now I aſk, Whether it is not poſſible, nay whether it is not rational, to believe, that the ſame fruit, which, in the preſent infirmity of nature, would utterly deſtroy the human conſtitution, might, in its higheſt perfection, at leaſt diſturb, impair, and diſeaſe it? and whether the ſame fruit, which would now inflame any man living into a fever or a frenzy, might not inflame Adam into a turbulence and irregularity of paſſion and appetite? and whether the ſame fluids, which inflame the blood into irregularity of paſſion and appetite, may not naturally produce infection and impair the conſtitution? That the forbidden fruit had the effect to produce irregularity of appetite, appears as from other proofs, ſo I think fully and clearly from the covering which Adam and Eve made uſe of ſoon after their offence; for there is no imaginable reaſon for that covering but one, and that one ſufficiently demonſtrates, that irregularity and violence of appetite, independent of the dominion of reaſon, was the effect of their offence. But the fruit which inflamed the ſenſual appetite might likewiſe debaſe their rational powers; for I aſk, whether the ſame juice, which now affects the brain of an ordinary man ſo as to make him an idiot, might not affect the brain of Adam ſo as to bring his underſtanding down to the preſent ſtandard of ordinary men? And if this be poſſible, and not abſurd to be ſuppoſed, it is evident that the ſubſequent ignorance and corruption of human nature may be clearly accounted for upon theſe ſuppoſitions; nay, I had almoſt ſaid upon any one of them. For it is univerſally known, that the infections and infirmities of the father affect the children yet in his loins; and if the mother be equally infected, muſt, unleſs removed by proper remedies, affect their poſterity to the end of the world, or at leaſt till the race become extinct. Therefore why all mankind might not by their firſt father's ſin be reduced to the ſame condition of infirmity and corruption with himſelf, eſpecially when the mother was equally infirm and infected, I believe no man any way ſkilled in the knowledge of nature will ſo much as pretend to ſay."

This account of the corruption of human nature ſeems to be generally adopted by moderate divines, as well among the Calviniſts as among the Arminians; but by the high-fliers in both ſchools it is rejected, upon different principles indeed, with great indignation. The zealous Calviniſt contends, that this hereditary corruption is not to be accounted for or attempted to be explained by any principle of phyſical ſcience, ſince it is part of that puniſhment which was inflicted on the race for their original ſin. If we were not partakers of Adam's guilt, ſay they, we ſhould not have been partakers of his corruption. The one is previous to the other, and the foundation of it. The depravity of human nature is a puniſhment for ſin; and ſo it was threatened to Adam, and came upon him as ſuch, and ſo to all his poſterity, by the *ordination* and *appointment of God*; for which there can be no other foundation but the imputation of Adam's diſobedience to them, nor can any thing elſe vindicate the righteouſneſs of God. For if the law of nature

|| Job xiv. 4. John iii. 6. Rom. iii. 9. Gen. vi. 5. Jer. xvii 9. Mat. xv. 19

† Delany's Revelation examined with candour, Diſſert. I. and 7.

(Q) We ſay the Arminians of the *preſent day*; becauſe in the beginning of this century many of them having imbibed the ſcholaſtic notion of the *natural* and *eſſential* immortality of the ſoul, ſeem to have been at a loſs to conceive how it was to have been diſpoſed of, had there been no redemption from Adam's curſe. They were perſuaded, that for his ſin the ſouls of his poſterity did not deſerve eternal puniſhment; and as eternal *life* is every where in the New Teſtament repreſented as the gift of God through Jeſus Chriſt, they thus expreſſed themſelves concerning the death incurred by the fall of Adam. "It is well to be obſerved, that the *death* wherewith God threatened man as his puniſhment if he broke the covenant, is not in reaſon to be underſtood of *eternal death*, any farther than as by eternal death may be ſignified only the *eternal ſeparation* of the *ſoul from the body*, and alſo the *eternal excluſion* of the *ſoul from God*, or *heavenly bliſs*." That the death threatened implied the annihilation of the ſoul, ſeems never to have occurred to them, though the apoſtle expreſsly ſays, that if there be no reſurrection, "then they who are fallen aſleep in Chriſt are periſhed, απωλοντο "are loſt." They ſuppoſed that the ſin of Adam would have ſeparated the ſoul from the body, and excluded the former both from heaven and from hell; but what would have become of it in that ſtate of excluſion, both from future happineſs and future miſery, we do not remember at preſent that any one of them has hazarded a conjecture. See *Dr Well's Help for the Right Underſtanding of the Several Divine Laws and Covenants*; and biſhop Bull's *Harmonica Apoſtolica*, with its ſeveral defences.

ture was ſufficient, why ſhould this *original* taint inſect men rather than the ſins of their immediate parents †?"

128 Whilſt others reject the doctrine

The more violent Arminians, on the other hand, deny that we inherit any moral taint whatever from Adam, or that the rational powers of our minds are naturally weaker than his were. Of that wonderful degree of perfection which is uſually attributed to the firſt pair, they find no evidence in ſcripture. All that we learn of them, ſay they, is, that they fell from a ſtate of exquiſite happineſs by yielding to a temptation leſs powerful by far than ſome others which many of their degenerate ſons have ſucceſsfully reſiſted. "I leave you to judge (ſays Dr Taylor ‡), whether Joſeph, when he reſiſted the ſolicitations of his miſtreſs, and Moſes when he refuſed to be called the ſon of Pharaoh's daughter, chooſing rather to ſuffer affliction with the people of God than to enjoy the pleaſures of ſin for a ſeaſon, eſteeming the reproach of true religion greater riches than the treaſures of Egypt, did not exhibit proofs of regularity of paſſions and appetites equal at leaſt to what Adam diſplayed in the garden of Eden. When the three young men mentioned in the book of Daniel ſubmitted to be burnt alive in a fiery furnace rather than worſhip Nebuchadnezzar's golden image; when Daniel himſelf reſolved, rather than conceal the worſhip of God for one month only for his life, to be torn in pieces by hungry lions; and, to come nearer to our own times, when numbers of men and women, during the reign of Mary Queen of England, choſe rather to be burnt at a ſtake than renounce the reformed religion and embrace the errors of popery—ſurely all theſe perſons exhibited a virtue, a faith in God, and a ſteady adherence to what they believed to be the truth, far ſuperior to what Adam diſplayed, when his wife gave him of the forbidden fruit, and he did eat." If it be ſaid that theſe perſons were ſupported under their trials by the grace of God ſtrengthening them, the ſame will be ſaid of Adam. He was undoubtedly ſupplied with every aid from the ſpirit of grace which was neceſſary to enable him to fulfil his duty; for being deſigned for more than mere animal life, even for the refined enjoyments of heaven, there is every reaſon to believe, as we have already obſerved, that he was put under the guidance of the Holy Ghoſt, to train him for that ſupernatural ſtate of felicity. Theſe communications of the ſpirit would of courſe be withdrawn when he forfeited his right to thoſe privileges, on account of which they were originally vouchſafed to him; but that any poſitive malignity or taint was infuſed into his nature, that his mere rational powers were weakened, or his appetites inflamed by the forbidden fruit, there is no evidence to be found in ſcripture, or in the known conſtitution of things.

129 And deem the phyſical illuſtration of it whimſical.

The attributing of this ſuppoſed hereditary taint to the noxious qualities of the forbidden fruit, is a whimſical hypotheſis, which receives no countenance from any well authenticated fact in natural hiſtory. After the numberleſs falſehoods that have been told of the poiſon tree of Java (ſee *Poison Tree*), ſomething more would be requiſite than the common evidence of a lying voyager to give credit to the qualities of the Indian tree, of which the fruit inſtantly turns the wiſeſt man into an idiot: and yet for this ſingular ſtory our ingenious author vouchſafes not even that evidence, ſlight as it generally is. The inference drawn from the covering uſed by our firſt parents is contradicted by every thing that we know of human nature; for ſurely no man, inflamed to the utmoſt with the fire of animal love, ever turned his eyes from a naked beauty ready and eager to receive him to her embrace. Yet this, it ſeems, was the behaviour of Adam and Eve in ſuch a ſtate! According to our author, the juice of the forbidden fruit had rendered their carnal appetites violent and independent of reaſon; according to the ſcripture, they were both naked; and as they were huſband and wife, there was no law prohibiting them from gratifying theſe inflamed appetites. In ſuch circumſtances, how did they conduct themſelves? One would naturally imagine that they immediately retired to ſome ſhady grove, and pleaſed themſelves in all the ſoft dalliancies of wedded love. Their conduct, however, was very different. We are told, that "they ſewed fig-leaves together, and made themſelves aprons to cover their nakedneſs:" And this tranſaction is brought as a proof of the impetuoſity of their carnal appetites (R). The truth is, that the carnal appetite appears not to be naturally more violent than is neceſſary to anſwer the end for which it was implanted in the human conſtitution. Among ſavages the deſires of animal love are generally very moderate; and even in ſociety they have not often, unleſs inflamed by the luxurious arts of civil life, greater ſtrength than is requiſite to make mankind attend to the continuation of their ſpecies. In the decline of empires highly poliſhed, where the difference of rank and opulence is great, and where every man is ambitious of emulating the expence of his immediate ſuperiors, early marriages are prevented by the inability of moſt people to provide for a family in a way ſuitable to what each is pleaſed to conſider as his proper ſtation; and in that ſtate of things the violence of animal love will indeed frequently produce great irregularities. But for that ſtate of things, as it was not intended by the Author of nature, it is perhaps unreaſonable to ſuppoſe that proviſion ſhould be made; and yet we believe it will be found, upon due conſideration, that if the deſires of animal love were leſs violent than they are, the general conſequences would be more pernicious to ſociety than all the irregularities and vices which theſe deſires now accidentally produce; for there would then be no intercourſe between the ſexes whatever except in the very higheſt ſtations of life. That our conſtitution is attended with many ſenſual appetites and paſſions, which, if ſuffered to grow exceſſive or irregular, become ſinful, is true; and that there is great danger of their becoming exceſſive and irregular in a world ſo full of temptation as ours is, is alſo true; but there is no evidence that all this is the conſequence of Adam's fall, and far leſs that it amounts to a *natural propenſity* to ſin.

130 Maintaining that we have no natural propenſity to ſin.

"For I preſume (ſays Dr Taylor, that by a natural propenſity is meant a neceſſary inclination to ſin, or that we are neceſſarily ſinful from the original bent and bias of our natural powers. But this muſt be falſe; for then we ſhould not be

† Gill's Body of Divinity, book iii. ch. 10, 11. and 13.

‡ Scripture Doctrine, &c.

(R) We have never met with a ſatisfactory reaſon for the expedient of theſe fig-leave-coverings. To us the following has ſometimes occurred as an account of the matter, at leaſt more plauſible than that which has been aſſigned by Dr Delany. Perſons under the agonies of remorſe, or with the proſpect of immediate death before them, have no reliſh for the pleaſures of love; and as our firſt parents, upon eating the forbidden fruit, muſt have been in the one or other of theſe ſituations, they might think of ſewing fig-leaves together, and making themſelves aprons, as a mean of ſubduing an appetite, of which, at that inſtant, they muſt have abhorred the gratification. If they had any hope of a reprieve from death, and yet knew all the conſequences of their ſin, their moſt ardent wiſh would be to have no children; and not being acquainted as we are with the effects of dreſs, they would naturally imagine that their propoſed coverings would diminiſh the force of the ſexual appetite.

be ſinful at all, becauſe that which is neceſſary, or which we cannot help, is not ſin. That we are weak and liable to temptation, is the will of God holy and good, and for glorious purpoſes to ourſelves; but if we are wicked, it muſt be through our own fault, and cannot proceed from any conſtraint, or neceſſity, or taint in our conſtitution."

131 The opinions of moderate men among the Calviniſts and Arminians the ſame, and countenanced by general tradition.

Thus have we given as full and comprehenſive a view as our limits will permit of the different opinions of the Calviniſts and Arminians reſpecting the conſequences of Adam's fall. If we have dwelt longer upon the ſcheme of the latter than of the former, it is becauſe every Arminian argument is built upon criticiſm, and appeals to the original text; whilſt the Calviniſts reſt their faith upon the plain words of ſcripture as read in our tranſlation. If we might hazard our own opinion, we ſhould ſay that the truth lies between them, and that it has been found by the moderate men of both parties, who, while they make uſe of different language, ſeem to us to have the ſame ſentiments. That all mankind really ſinned in Adam, and are on that account liable to moſt grievous torments in ſoul and body, without intermiſſion, in hell fire for ever, is a doctrine which cannot be reconciled to our natural notions of God. On the other hand, if human nature was not ſomehow debaſed by the fall of our firſt parents, it is not eaſy to account for the numberleſs phraſes in ſcripture which certainly ſeem to ſpeak that language, or for the very general opinion of the Pagan philoſophers and poets reſpecting the golden age and the degeneracy of man. Cicero, in a quotation preſerved by St Auguſtine from a work that is now loſt, has theſe remarkable words, "Homo non ut a matre ſed ut a noverca natura editus eſt in vitam corpore nudo, et fragili, et infirmo: animo autem anxio ad moleſtias, humili ad timores, molli ad labores, prono ad libidines; in *quo tamen ineſt tanquam obrutus quidam divinus ignis ingenii et mentis* †." Nor do we readily perceive what ſhould induce the more zealous Arminians to oppoſe ſo vehemently this general opinion of the corruption of human nature. Their deſire to vindicate the juſtice and goodneſs of God does them honour; but the doctrine of inherent corruption militates not againſt theſe attributes; for what we have loſt in the firſt Adam has been amply ſupplied to us in the ſecond; and we know from the higheſt authority that the duties required of us are in proportion to our ability, ſince we are told, that "unto whomſoever much is given, of him ſhall much be required."

SECT. IV. *View of Theology from the fall of Adam to the coming of Chriſt.*

We have dwelt long on the original ſtate of man, his introduction into the terreſtrial paradiſe, the privileges to which he was there admitted, his forfeiture of thoſe privileges, and the ſtate to which he was reduced by tranſgreſſing the law of his Maker; but the importance of theſe events renders them worthy of all the attention that we have paid to them. They paved the way for the coming of Chriſt and the preaching of the goſpel; and unleſs we thoroughly underſtand the origin of the goſpel, we cannot have an adequate conception of its deſign. By contraſting the firſt with the ſecond Adam, St. Paul gives us clearly to underſtand, that one purpoſe for which Chriſt came into the world and ſuffered death upon the croſs, was to reſtore to mankind that life which they had loſt by the fall of their original progenitor. The preaching of the goſpel therefore commenced with the firſt hint of ſuch a reſtoration; and the promiſe given to Adam and Eve, that "the ſeed of the woman ſhould bruiſe the head of the ſerpent, was as truly evangelical as theſe words of the apoſtle, by which we are taught, that "this is a faithful ſaying and worthy of all acceptation, that Chriſt Jeſus came into the world to ſave ſinners *." The former text taken by itſelf is indeed obſcure, and the latter is explicit; but both belong to the ſame ſyſtem, for the ſcriptures contain but two covenants or diſpenſations of God to man, in which the whole race is included.

132 Chriſtianity may be ſaid to have commenced with the fall.

Chriſtianity therefore is indeed very near as old as the creation; but its principles were at firſt obſcurely revealed and afterwards gradually developed under different forms as mankind became able to receive them, (ſee PROPHECY, nº 5, &c.). All that appears to have been at firſt revealed to Adam and Eve was, that by ſome means or other one of their poſterity ſhould in time redeem the whole race from the curſe of the fall; or if they had a diſtinct view of the means by which that redemption was to be wrought, it was probably communicated to them at the inſtitution of ſacrifices, (ſee SACRIFICE). This promiſe of a future deliverer ſerved to comfort them under their heavy ſentence; and the inſtitution of ſacrifices, whilſt it impreſſed upon their minds lively ideas of the puniſhment due to their tranſgreſſion, was admirably calculated to prepare both them and their poſterity for the great atonement which, in due time, was to take away the ſins of the world.

133 Revelation frequent in the early ages of the world,

Our firſt parents, after their fall, were ſo far from being left to fabricate a mode of worſhip for themſelves by thoſe innate powers of the human mind of which we daily hear ſo much and feel ſo little, that God was graciouſly pleaſed to manifeſt himſelf to their *ſenſes*, and viſibly to conduct them by the angel of his preſence in all the rites and duties of religion. This is evident from the different diſcourſes which he held with Cain, as well as from the complaint of that murderer of being hid from his face, and from its being ſaid, that "he went out from the preſence of the Lord and dwelt on the eaſt of Eden." Nor does it appear that God wholly withdrew his viſible preſence, and left mankind to their own inventions, till their wickedneſs became ſo very great that his ſpirit could no longer ſtrive with them. The infant ſtate of the world ſtood in conſtant need of his ſupernatural guidance and protection. The early inhabitants of this globe cannot be ſuppoſed to have been able, with Moſes *, to look up to him who is *inviſible*, and perform a worſhip purely rational and ſpiritual. They were all tillers of the ground, or keepers of cattle; employed in cultivating and repleniſhing this new world; and, through the curſe brought upon it by their forefather, forced, with him, to eat their bread "in the ſweat of their brow." Man in ſuch circumſtances could have little leiſure for ſpeculation; nor has mere ſpeculation, unleſs furniſhed with principles from another ſource, ever generated in the human mind adequate notions of God's nature or providence, or of the means by which he can be acceptably worſhipped. Frequent manifeſtations, therefore, of his preſence would be neceſſary to keep up a tolerable ſenſe of religion among them, and ſecure obedience to the divine inſtitutions; and that the Almighty did not exhibit ſuch manifeſtations, cannot be inferred from the ſilence of that very ſhort hiſtory which we have of thoſe early ages. Adam himſelf continued 930 years a living monument of the juſtice and mercy of God; of his extreme hatred and abhorrence of ſin, as well as of his love and long-ſuffering towards the ſinner. He was very ſenſible how ſin had entered into the world, and he could not but appriſe his children of its author. He would at the ſame time inform them of the unity of God, and his dominion over the evil one; of the means by which he had appointed himſelf to be worſhipped; and of his promiſe of future deliverance from the curſe of the fall. Such information would produce a tolerable idea of the Divine Being

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† Vide D. Aug. lib. iv. contra Pelagium. Vide etiam M. Tull. Cicer. Conſol.

* 1 Tim. i. 15.

* Heb. xi. 23.

ing, and afford ſufficient motives to obey his will. The effects of it accordingly were apparent in the righteous family of Seth, who ſoon diſtinguiſhed themſelves from the poſterity of Cain, and for their eminent piety were honoured with the appellation of *the ſons of God*. Of this family ſprang a perſon ſo remarkable for virtue and devotion, as to be exempted from Adam's ſentence and the common lot of his ſons; for after he had walked with God 300 years, and prophecied to his brethren, he was tranſlated that he ſhould not ſee death. Of this miraculous event there can be no doubt but that his contemporaries had ſome viſible demonſtration; and as the fate of Abel was an argument to their reaſon, ſo the tranſlation of Enoch was a proof to their ſenſes of another ſtate of life after the preſent. To Adam himſelf, if he was then alive (s), it muſt have been a lively and affecting inſtance of what he might have enjoyed, had he kept his innocence; it muſt have been a comfortable earneſt of the promiſed victory over the evil one; and have confirmed his hope, that when the head of the ſerpent ſhould be completely bruiſed, he and his poſterity would be reſtored to the favour of their Maker, and behold his preſence in bliſs and immortality.

134
Yet vice, and probably idolatry ſoon became prevalent.

Notwithſtanding this watchful care of God over his fallen creature man, vice, and probably idolatry, ſpread through the world with a rapid pace. The family of Seth married into that of Cain, and adopted the manners of their new relations. Rapine and violence, unbounded luſt and impurity of every kind, prevailed univerſally; and when thoſe giants in wickedneſs had filled the earth with tyranny, injuſtice, and oppreſſion; when the whole race was become entirely carnal—God, after raiſing up another prophet to give them frequent warnings of their fate for the ſpace of 120 years, was at length obliged, in mercy to themſelves as well as to the ſucceeding generations of men, to cut them off by a general deluge. See **Deluge**.

135
Pure religion for ſome time after the flood;

Thus did God, by the ſpirit of prophecy, which is by ſome ſuppoſed to have been hereditary in the heads of families; by frequent manifeſtations of his own preſence; and by uninterrupted tradition—make ample proviſion for the inſtruction and improvement of the world for the firſt 1600 years. After the deluge he was pleaſed to converſe again with Noah, and make in his perſon a new and extenſive covenant with mankind, (ſee **Prophecy**, nº 11.). Of his power, juſtice, and goodneſs; of his ſupreme dominion over the earth and the heavens; of his abhorrence of ſin, and his determination not to let it go unpuniſhed—that patriarch and his family had been moſt awfully convinced; nor could they or their children, for ſome time, want any other argument to enforce obedience, fear, and worſhip. The ſons of Noah were an 100 years old when the deluge overwhelmed the earth. They had long converſed with their anceſtors of the old world, had frequented the religious aſſemblies, obſerved every Sabbath day, and been inſtructed by thoſe who had ſeen Adam. It is therefore impoſſible that they could be ignorant of the creation of the world, of the fall of man, or of the promiſe of future deliverance from the conſequences of that fall; or that they could offer their ſacrifices, and perform the other rites of the inſtituted worſhip, without looking forward with the eye of faith to that deliverance ſeen, perhaps obſcurely, through their typical oblations.

In this ſtate of things, with the awful remembrance of the deluge continually preſent to their minds, religion might for ſome time be ſafely propagated by tradition. But when by degrees mankind corrupted that tradition in its moſt eſſential parts; when, inſtead of the one Supreme God, they ſet up ſeveral orders of inferior deities, and worſhipped all the hoſt of heaven; when, at the ſame time they were uniting under one head, and forming a univerſal empire under the patronage of the Sun their chief divinity (ſee **Babel**)—God ſaw it neceſſary to diſperſe them into diſtinct colonies, by cauſing ſuch diſcord among them as rendered it impoſſible for any one ſpecies of idolatry to be at once univerſally eſtabliſhed.

136
Idolatry, however, the cauſe of the diſperſion from Babel.

After this diſperſion, there is reaſon to believe that particular revelations were vouchſafed wherever men were diſpoſed to regard them. Peleg had his name prophetically given him from the diſperſion which was to happen in his days; and not only his father Eber, but all the heads of families mentioned from Noah to Abraham, are with much plauſibility ſuppoſed to have had the ſpirit of prophecy on many occaſions. Noah was undoubtedly both prieſt and prophet; and living till within two years of the birth of Abraham, or, according to others, till that patriarch was near 60 years old, he would ſurely be able to keep up a tolerable ſenſe of true religion among ſuch of his deſcendants as ſojourned within the influence of his doctrine and example. His religious ſon Shem, who lived till after the birth of Iſaac, could not but preſerve in tolerable purity the faith and worſhip of the true God among ſuch of his own deſcendants as lived in his neighbourhood.

But though the remains of true religion were thus preſerved among a few righteous men, idolatry, with its inſeparable attendants, unnatural luſts and cruel ſuperſtition (T), had in a ſhort time prevailed ſo far among the ſons of Noah, that God, in his infinite wiſdom, ſaw it expedient not only to ſhorten the lives of men, but alſo to withdraw his preſence from the generality, who had thus rendered themſelves unworthy of ſuch communications; and to ſelect a particular family in which his worſhip might be preſerved pure amidſt the various corruptions that were overſpreading the world. With this view Abraham was called; and after many remarkable trials of his faith and conſtancy, admitted to a particular intimacy and friendſhip with his Maker. God entered into a peculiar covenant with him, engaging to be his preſent guide, protector, and defender; to beſtow all temporal bleſſings upon him and his ſeed; and to make ſome of thoſe ſeed the inſtruments of conveying bleſſings of a higher kind to all the nations of the earth.

137
The call of Abraham was

138
To prevent the univerſal ſpreading of idolatry,

It was doubtleſs for his ſingular piety that Abraham was fixed upon to be the parent of that people, who ſhould preſerve the knowledge of the unity of God in the midſt of an idolatrous and polytheiſtic world; but we are not to imagine that it was for his ſake only that all this was done, or that his leſs worthy deſcendants were by the equal Lord of all, treated with partial fondneſs for the virtues of their anceſtor; it was for the benefit of mankind in general that he was called from his country, and from his father's houſe, that he might preſerve the doctrine of the Divine unity in his own family, and be an inſtrument in the hand of Providence (and a fit one he was) to convey the ſame faith to the nations around him. Accordingly, we find him diſtinguiſhed among the neighbouring princes, and kings reproved for his ſake; who being made acquainted with his prophetic character, deſire his interceſſion with God. Hiſtory tells us of his converſing on the ſubject of religion with the moſt learned

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(s) According to the Samaritan chronology, he was alive; according to the Hebrew, he had been dead 57 years.

(T) See the effects of idolatry well deſcribed in the Apocryphal book of Wiſdom, chap. xiv.

Theology from the fall of Adam to the coming of Chriſt.

ed Egyptians, who appear to have derived from him or ſome of his deſcendants the rite of circumciſion, and to have been for a while ſtopt in their progreſs towards the laſt ſtage of that degrading idolatry which afterwards rendered their national worſhip the opprobrium of the whole earth, (ſee Polytheism, n° 28). We are informed that his name was had in the greateſt veneration all over the Eaſt; that the Magians, Sabians, Perſians, and Indians, all glory in him as the great reformer of their reſpective religions: and to us it appears extremely probable, that not only the Brachmans, but likewiſe the Hindoo god Brahma*, derive their names from the father of the faithful. As he was let into the various counſels of the Almighty, and taught to reaſon and reflect upon them; as he was fully appriſed of the overthrow of Sodom and Gomorrah, with the particular circumſtances of that miraculous event; and as he had frequent revelations of the promiſed Redeemer, whoſe day he longed earneſtly to ſee, and ſeeing it was glad—there can be no doubt but that he and his family took care to propagate theſe important doctrines in every nation which they viſited; for the only reaſon which we can conceive for his being made to wander from place to place was, that different people might be induced to inquire after his profeſſion, his religion, and his hopes.

*See Aſiatic Reſearches and Newt. Chron.

139
Occaſional revelations given to other pious men.

But though the Supreme Being was pleaſed to manifeſt himſelf in a more frequent and familiar manner to Abraham, he by no means left the reſt of the world without ſufficient light. Lot profeſſed the true religion in the midſt of Sodom. In Canaan we meet with Melchizedeck, king and prieſt of the moſt high God, who bleſſed Abraham, and to whom that patriarch himſelf did homage. Abimelech king of Gerar receiving an admonition from the Lord, immediately paid a due regard to it; and the ſame ſenſe of religion and virtue deſcended to his ſon. Laban and Bethuel acknowledged the Lord, and the former of them was even favoured with a viſion. In Arabia, we find Job and his three friends, all men of high rank, entering into the deepeſt diſquiſitions in theology; agreeing about the unity, omnipotence, and ſpirituality of God; the juſtice of his providence, with other fundamental articles of true religion; and mentioning divine inſpiration or revelation as a thing not uncommon in their age and country* (u). Balaam appears to have been a true prophet; and as he was unqueſtionably a man of bad morals, the natural inference is, that the gift of prophecy was then, as afterwards, beſtowed on individuals, not for their own ſakes, but for the ſake of the public; and that, as in "every nation, he who feareth God and worketh righteouſneſs is accepted of him;" ſo in thoſe early ages of the world, when mankind were but children in religious knowledge, they were bleſſed with the light of divine revelation wherever they were diſpoſed to make a proper uſe of it.

* Job iv. 12, 15, 16, 17. vi. 10. xxiii. 12.

140
A ſecond purpoſe for which Abraham was called.

Very few, however, appear to have had this diſpoſition; and therefore God was pleaſed to adopt Abraham and part of his poſterity as the race from which the great Redeemer was to ſpring, to train them up by degrees in ſuitable notions of their Creator, and gradually to open up to them, as they were able to receive it, the nature of that diſpenſation under which "all the nations of the earth were to be bleſſed in the patriarch's ſeed, (ſee Prophecy, n° 13). For this purpoſe, he held frequent correſpondence with them; and to ſtrengthen and confirm their faith, to fix and preſerve their dependence on the one God of heaven and earth, he daily gave them new promiſes, each more magnificent than that which preceded it. He bleſſed Iſaac, miraculouſly increaſed his ſubſtance, and ſoon made him the envy of the neighbouring princes. He foretold the condition of his two ſons, renewed the promiſe made to Abraham, and bleſſed the adopted ſon Jacob, with whom he condeſcended to converſe as he had converſed with Abraham and Iſaac; renewing to him the great promiſe; beſtowing upon him all kinds of riches; and impreſſing ſuch terror upon all the cities which were round about him as prevented them from hurting either him or his family.

Theology from the fall of Adam to the coming of Chriſt.

All this was indeed little enough to keep alive even in the mind of Jacob a tolerable ſenſe of duty and dependence on his Creator. After the firſt viſion he is ſurpriſed, and heſitates, ſeeming inclined to make a kind of ſtipulation with his Maker. "If (ſays he) God will be with me, and will keep me in this way that I go, and will give me bread to eat, and raiment to put on, ſo that I come again to my father's houſe in peace, *then* ſhall the Lord be my God‖:" It appears not to have been till after many ſuch revelations, bleſſings, and deliverances, and being reminded of the vow which on this occaſion he had vowed, that he ſet himſelf in good earneſt to reform the religion of his own family, and to drive out from it all ſtrange gods*. So little able, in that age, were the boaſted powers of the human mind to preſerve in the world juſt notions of the unity of the Godhead, that we ſee there was a neceſſity for very frequent revelations, to prevent even the beſt men from running headlong into polytheiſm and idolatry.

‖ Gen. xxviii. 20, 21.

* Gen. xxxv. 2.

Thus was God obliged to treat even with the patriarchs themſelves, by way of poſitive covenant and expreſs compact; to promiſe to be their God if they would be his people; to give them a portion of temporal bleſſings as introductory to future and ſpiritual ones; and to engage them in his ſervice by immediate rewards, till they could be led on to higher views, and prepared by the bringing in of a better hope to worſhip him in ſpirit and in truth. With regard to what may be called the *theory* of religion, mankind were yet ſcarcely got out of their childhood. Some extraordinary perſons indeed occaſionally appeared in different countries, ſuch as Enoch, Noah, Abraham, and Job, with many others, who had a more enlarged proſpect of things, and entertained more worthy ſentiments of the divine diſpenſations and of the ultimate end of man; but theſe were far ſuperior to the times in which they lived, and appear to have been providentially raiſed up to prevent the ſavage ſtate and ſavage idolatry from becoming univerſal among men. See Savage.

141
The patriarchal worſhip of thoſe early ages performed in faith.

The worſhip which was practiſed by thoſe holy men appears to have conſiſted principally of the three kinds of ſacrifice mentioned elſewhere (ſee Sacrifice); to which were doubtleſs added prayers and praiſes, with the more valuable oblation of pure hands and devout hearts. Such of them as looked forward to a future redemption, and had any tolerable notion of the means by which it was to be effected, as Abraham certainly had, muſt have been ſenſible that the blood of bulls and of goats could never take away ſin, and that their ſacrifices were therefore valuable only when they were offered in faith of that great promiſe, "which they, having

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(u) There are great diſputes among the learned reſpecting the antiquity and the author of the *book* of Job, and whether it be a hiſtory of events, or a poem which has its foundation in hiſtory. All ſober men, however, are agreed, that there really was ſuch a *perſon* as Job, eminent for patience under uncommon ſufferings; and that he was of very remote antiquity. The LXX. give us the names of his father and mother, and ſay that he was the fifth from Abraham.

having ſeen it afar off, were perſuaded of, and embraced ; and confeſſed that they were ſtrangers and pilgrims upon earth."

That ſuch perſons looked for "a better country, even a heavenly one," in a future ſtate, cannot be queſtioned ; for they knew well how ſin and death had entered into the world, and they muſt have underſtood the promiſe made to their original progenitor, and repeatedly renewed to themſelves, to include in it a deliverance at ſome period from every conſequence of the firſt tranſgreſſion. They were to all intents and purpoſes Chriſtians as well as we.

142 Of a future Redeemer ;

They indeed placed their confidence in a Redeemer, who in the fulneſs of time was to appear upon earth, while we place ours in a redeemer that has been already manifeſted ; they expreſſed that confidence by one mode of worſhip, we expreſs it by another ; but the patriarchal worſhip had the ſame end in view with the Chriſtian—the attainment of everlaſting life in heaven.

143 Such faith, however, not general.

The generality of men, however, appear not, in the early age of which we now write, to have extended their views beyond the preſent life. From the confuſed remains of ancient tradition, they acknowledged indeed ſome ſuperior power or powers, to whom they frequently applied for direction in their affairs ; but in all probability it was only for direction in temporal affairs, ſuch as the cultivation of the ground, or their tranſactions with each other. In the then ſtate of things, when no part of the world was overſtocked with inhabitants, and when luxury with its conſequences were every where unknown, virtue and vice muſt have produced their natural effects ; and the good man being happy here, and the wicked man miſerable, reaſon had no data from which to infer the reality of a future ſtate of rewards and puniſhments. Thoſe who were bleſſed with the light of revelation undoubtedly looked forward to that ſtate with a holy joy ; but the reſt worſhipped ſuperior powers from worldly motives. How many of thoſe powers there might be, or how far their influence might reach, they knew not. Uncertain whether there be one Supreme Governor of the whole world, or many co-ordinate powers preſiding each over a particular country, climate, or place—gods of the hills and of the valleys, as they were afterwards diſtinguiſhed—they thought that the more of theſe they could engage in their intereſt the better. Like the Samaritans therefore, in after times, they ſought, wherever they came, the "manners of the god of the land," and ſerved him, together with their own gods.

144 The purpoſe for which the Iſraelites were made to ſojourn in Egypt.

Thus was the world ready to loſe all knowledge of the true God and his worſhip, had not he been graciouſly pleaſed to interpoſe, and take effectual care to preſerve that knowledge in one nation, from which it might be conveyed to the reſt of mankind at different times, and in greater or leſs degrees, as they ſhould be capable of receiving it. To this purpoſe he made way for the removal of Jacob and his family to one of the moſt improved and poliſhed countries of the world ; and introduced them into it in a manner ſo advantageous, as to give them an opportunity of imparting much religious knowledge to the natives. The natives, however, were groſs idolaters ; and that his choſen people might be as far as poſſible from the contagion of their example, he placed them upon the borders of Egypt, where, though they multiplied exceedingly, they were by their very occupation † ſtill kept a ſeparate people, and muſt have been rendered, by a long and ſevere oppreſſion, in a great degree averſe from the manners and religion of their neighbours. This averſion, however, ſeems to have gradually become leſs and leſs ; and before they were miraculouſly redeemed from their houſe of bondage, they had certainly loſt all correct notions of the unity of God, and the nature of his worſhip, and had adopted the greater part of the ſuperſtitions of their taſk-maſters. Of this we need no other proof than what is implied in the words of Moſes *, when he ſaid unto God, "Behold, when I come unto the children of Iſrael, and ſay unto them, the God of your fathers hath ſent me unto you ; and they ſhall ſay unto me, WHAT IS HIS NAME ? what ſhall I ſay unto them ?"

145 Conſequences of it.

Had not the deſtined lawgiver of the Hebrews been aware that his countrymen had adopted a plurality of gods, this difficulty could not have occurred to him ; for *names* are never thought of but to diſtinguiſh from each other beings of the ſame kind ; and he muſt have remembered, that in Egypt, where the multitude of gods was marſhalled into various claſſes, the knowledge of their names was deemed of great importance. This we learn likewiſe from Herodotus, who informs us * that the Pelaſgi, after ſettling in Greece, thought it neceſſary to conſult the oracle of Dodona, whether it would be proper to give to their own gods the names of the Egyptian divinities ? and that the oracle, as might have been ſuppoſed, aſſured them that it would. Indeed the Hebrews during their reſidence in Egypt had acquired ſuch an attachment to the idolatrous worſhip of the country, that it appears never to have left them entirely till many ages afterwards, when they were carried captive into Babylon, and ſeverely puniſhed for their repeated apoſtacies ; and ſo completely were they infatuated by theſe ſuperſtitions at the era of their exodus, that, as the prophet Ezekiel informs us*, they rebelled againſt God, and would not caſt away their abominations, or forſake the idols of Egypt, even in the *very day* that the hand of Omnipotence was lifted up to bring them forth of that land in which they had been ſo long and ſo cruelly oppreſſed. In ſuch a ſtate of things, to have ſuffered them to remain longer in Egypt, could have ſerved no good purpoſe : and therefore to fulfil the promiſe which he had given to Abraham, God determined to deliver them out of the hand of the Egyptians by means which ſhould convince both them and their offspring of his own ſupremacy over heaven and earth.

146 Moſes appointed to bring them out of Egypt.

As Moſes was the perſon appointed to deliver God's meſſage to Pharaoh, and to demand of him leave for the Iſraelites to go three days journey into the wilderneſs to ſerve the God of their fathers, it was neceſſary that he ſhould be endowed with the power of working miracles to evince the reality of his divine miſſion. Without a conviction that his claims were well-founded, neither Pharaoh nor his own countrymen could reaſonably have been expected to liſten to the propoſals of a man who, though bleſſed in his youth with a princely education, had come directly on his embaſſy from the humble employment of a ſhepherd, which he had for many years exerciſed in the country of Midian. To prove that he was really ſent by God, any viſible and undoubted controul of the laws of nature would have been abundantly ſufficient ; but he was to prove not only this truth, but alſo the unity of the Divine nature ; and the miracles which he was directed to work were executions of judgments againſt the very gods of Egypt*.

147 The propriety of the miracles which he wrought

When Pharaoh firſt turned a deaf ear to his requeſt, tho' enforced by the converſion of a rod into a ſerpent, at the command of Jehovah he ſmote with the ſame rod upon the waters in the river, which were inſtantly converted into blood, and occaſioned the death of all the fiſhes that ſwam in them. To any people this miracle would have been a proof of Divine agency : but it was in a particular manner calculated to open the eyes of the blind and infatuated Egyptians, who conſidered the Nile as one of their greateſt gods, and all the fiſhes that it contained as ſubordinate divinities. They called that noble river ſometimes *Sirius*, ſometimes *Oſiris*, ſometimes *Canobus* (ſee CANOBUS), and

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† Gen. xlvi. 33, 34.

* Exod. iii.

* Lib. ii. cap. 52, 53.

* Ch. xx.

* Exod. xii. 12.

not unfrequently Ωκιανος (x); and adored it as the parent of all their deities. What then muſt the people have thought when they found their moſt revered god, at the command of a ſervant of Jehovah, converted into blood, and all his ſacred offspring into ſtinking carcaſes? To conceive their conſternation, if it can be conceived, the reader muſt remember, that the Egyptian prieſts held blood in the utmoſt abhorrence, as a thing of which the very touch would deeply pollute them, and require immediate and ſolemn expiation. The ſame ſacred river was a ſecond time polluted, when it ſent forth frogs, which covered all the land of Egypt, and died in the houſes, in the villages, and in the fields; thus rendering it impoſſible for the people to avoid the touch of dead bodies, though from every ſuch contact they believed themſelves to contract an impurity, which, in the caſe before us, muſt have been the more grievous, that in the whole country there was not left a pool of uninfected water to waſh away the ſtain.

148
To evince the vanity of idol worſhip.

The third plague inflicted upon the Egyptians was, the converting of the duſt of the land into lice, upon man and upon beaſt, throughout the whole kingdom. To ſee the propriety of this miracle as a judgment upon their idolatry, we muſt recollect their utter abhorrence of all kinds of vermin, and their extreme attention to external purity above every other people perhaps that has hitherto exiſted on the face of the earth. Upon this head they were more particularly ſolicitous when about to enter the temples of their gods; for Herodotus informs us, that their prieſts wore linen raiment only, and ſhaved off every hair from their heads and bodies, that there might be no *louſe* or other deteſtable object upon them when performing their duty to the gods. This plague therefore, while it laſted, made it impoſſible for them to perform their idolatrous worſhip, without giving ſuch offence to their deities as they imagined could never be forgiven. Hence we find, that on the production of the lice, the prieſts and magicians perceived immediately from what hand the miracle had come, and exclaimed, "This is the finger of God!" The fourth plague ſeems to have been likewiſe acknowledged to be the finger of God, if not by the magicians, at leaſt by Pharaoh; for in a fit of terror he agreed that the Iſraelites ſhould go and ſerve the Lord. That he was terrified at the ſwarms of flies which infeſted the whole country, except the land of Goſhen, will excite no wonder, when it is known that the worſhip of the fly originated in Egypt; whence it was carried by the Caphtorim to Paleſtine; by the Phœnicians to Sidon, Tyre, and Babylon; and from theſe regions to other parts of the world. The denunciation of this plague was delivered to Pharaoh early in the morning, when he was on the banks of the Nile, probably paying his accuſtomed devotion to his greateſt god; and when he found himſelf and his people tormented by a ſwarm of ſubordinate divinities, who executed the judgment of Jehovah in defiance of the power of the ſupreme *numen* of Egypt, he muſt have been convinced, had any candour remained in his mind, that the whole ſyſtem of his ſuperſtition was a maſs of abſurdities, and that his gods were only humble inſtruments at the diſpoſal of a Superior Power. He was not, however, convinced; he was only alarmed, and quickly relapſed into his wonted obſtinacy. The fifth plague therefore, the murrain among the cattle, brought death and deſtruction upon his moſt revered gods themſelves. Neither Oſiris, nor Iſis, nor Ammon, nor Pan, had power to ſave his brute repreſentatives. The ſacred bull, and heifer, and ram, and goat, were carried off by the ſame malady which ſwept away all the other herds of deities, theſe *dii ſtercorei*, who lived on graſs and hay. The impreſſion of this puniſhment muſt have been awful upon the minds of the Egyptians, but perhaps not equal to that which ſucceeded it.

In Egypt there were ſeveral altars on which human ſacrifices were offered; and from the deſcription of the perſons qualified to be victims, it appears that thoſe unhappy beings muſt have been foreigners, as they were required to have bright hair and a particular complexion. The hair of the Iſraelites was much brighter than that of the Egyptians, and their complexions fairer; and therefore there can be little doubt but that, during their reſidence in Egypt, they were made to furniſh the victims demanded by the bloody gods. Theſe victims being burnt alive on a high altar, and thus ſacrificed for the good of the nation, their aſhes were gathered together by the prieſts, and ſcattered upwards in the air, that a bleſſing might be entailed on every place to which an atom of this duſt ſhould be wafted. Moſes too, by the direction of the true God, took aſhes of the furnace, probably of one of thoſe very furnaces in which ſome of his countrymen had been burnt, and ſprinkling them towards heaven in the ſight of Pharaoh, brought boils and blains upon all the people, of ſo malignant a nature, that the magicians and the other miniſters of the medical gods, with which Egypt abounded beyond all other countries, could not themſelves eſcape the infection.

The powers of darkneſs were thus foiled; but the heart of the monarch was ſtill hardened. Deſtruction was therefore next brought upon him and his country by the elements, which were among the earlieſt idol deities not only of the Egyptians, but of every other polytheiſtic nation. "The Lord rained hail upon the land of Egypt; ſo that there was hail, and fire mingled with the hail, ſuch as there was none like it in all the land of Egypt ſince it became a nation. And the hail ſmote throughout all the land of Egypt all that was in the field, both man and beaſt; and the hail ſmote every herb of the field, and broke every tree of the field." This was a dreadful calamity in itſelf; and the horror which it excited in the minds of the people muſt have been greatly aggravated by the well-known fact, that Egypt is bleſſed with a ſky uncommonly ſerene; that in the greateſt part of it rain has never been ſeen at any other time ſince the creation of the world; and that a ſlight and tranſient ſhower is the utmoſt that in the ordinary courſe of nature falls anywhere throughout the country. The ſmall quantity of vegetables which was left undeſtroyed by the fire and the hail was afterwards devoured by locuſts, which by a ſtrong eaſt wind were brought in ſuch numbers from Arabia, where they abound at all times, that they covered the whole face of the earth, and did eat every herb of the land, and all the fruit of the trees, ſo that there remained not any green thing in the trees or in the herbs of the field through all the land of Egypt.

The ninth plague which the obſtinacy of Pharaoh brought upon his country, whilſt it ſeverely puniſhed the Egyptians for their cruelty to the Hebrews, ſtruck at the very foundation of all idolatry. We have elſewhere ſhown, that the firſt objects of idolatrous worſhip were the contending powers of light and darkneſs (ſee Polytheism); and that the benevolent principle, or the power of light, was everywhere believed to maintain a conſtant ſuperiority over the power of darkneſs. Such was the faith of the ancient Perſians; and ſuch, as a very learned writer has lately proved, was likewiſe

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(x) Whence came the Greek word οκιανος, *the ocean*.

wiſe the faith of the earlier Egyptians. It was therefore with wiſdom truly divine, that God, to ſhow the vanity of their imaginations, brought upon thoſe votaries of light, who fancied themſelves the offspring of the ſun, a preternatural darkneſs, which, for three days, all the powers of their ſupreme deity and his ſubordinate agents could not diſpel.

The tenth and laſt plague brought upon this idolatrous people was more univerſally and ſeverely felt than any which had preceded it. It was likewiſe, in ſome ſenſe, an inſtance of the *lex talionis*, which requires an eye for an eye, and a tooth for a tooth, &c. Moſes was commanded, at his firſt interview with Pharaoh, to ſay, "Thus ſaith the Lord, Iſrael is my ſon, even my firſt-born. Let my ſon go that he may ſerve me: and if thou refuſe to let him go, behold, I will ſlay thy ſon, even thy firſt-born." Before this threat was put in execution, every attempt was made to ſoften the hardened heart of the obſtinate tyrant. The waters of his ſacred river were turned into blood, and all the fiſhes that it contained ſlain; frogs were brought over all the land to pollute the people; the miniſters of religion were rendered ſo impure by vermin, that they could not diſcharge their wonted offices; the animals moſt revered as gods, or emblems of gods, were cut off by a murrain; the elements, that were everywhere worſhipped as divinities, carried through the land a devaſtation, which was completed by ſwarms of locuſts; the aſhes from the ſacred furnace, which were thought to convey bleſſings whitherſoever they were wafted, were made to communicate incurable diſeaſes; a thick and preternatural darkneſs was ſpread over the kingdom, in defiance of the power of the great Oſiris; and when the hearts of the people and their ſovereign continued ſtill obdurate, the eldeſt ſon in each family was ſlain, becauſe they refuſed to let go Iſrael, God's firſt-born. From this univerſal peſtilence the Iſraelites were preſerved by ſprinkling the door-poſts of their houſes with the blood of one of the animals adored in Egypt; a fact which, as it could not be unknown to Pharaoh or his ſubjects, ought to have convinced that people of the extreme abſurdity of their impious ſuperſtitions. This effect it ſeems not to have had; but the death of the firſt-born produced the deliverance of the Hebrews; for when it was found that there was not a houſe where there was not one dead, "Pharaoh called for Moſes and Aaron by night, and ſaid, Riſe up, and get you forth from among my people, both you and the children of Iſrael; and bleſs me alſo. And the Egyptians were urgent upon the people, that they might ſend them out of the land in haſte; for they ſaid, We be all dead men (Y)." The wonted obſtinacy of the monarch indeed very ſoon returned; and his ſubjects, forgetting the loſs of their children, joined with him in a vain attempt to bring back to bondage the very people whom they had been thus urgent to ſend out of the land; but their attempt was defeated by Jehovah, and all who engaged in it drowned in the Red Sea.

149 Reaſon of detaining the Iſraelites ſo long in the wilderneſs.

The God of Iſrael having thus magnified himſelf over the Egyptians and their gods, and reſcued his people from bondage by ſuch means as muſt not only have ſtruck terror and aſtoniſhment into the whole land, but alſo have ſpread his name through all the countries which had any communication with that far-famed nation, proceeded to inſtruct and exerciſe the Hebrews for many years in the wilderneſs. He inculcated upon them the unity of the Godhead; gave them ſtatutes and judgments more righteous than thoſe of any other nation; and by every method conſiſtent with the freedom of moral agency guarded them againſt the contagion of idolatry and polytheiſm. He ſent his angel before them to keep them in the way, took upon himſelf the office of their ſupreme civil governor, and by his preſence directed them in all their undertakings. He led them with repeated ſigns and wonders through the neighbouring nations, continued to try and diſcipline them till they were tolerably attached to his government and eſtabliſhed in his worſhip, and introduced them into the Promiſed Land when its inhabitants were ripe for deſtruction. At their entrance into it, he gave them a ſummary repetition of their former laws, with more ſuch ordinances, both of a ceremonial and moral kind, as were both ſuited to their temper and circumſtances, as well as to prefigure, and by degrees to prepare them for, a more perfect diſpenſation under the Meſſiah.

150 Great objects of the Jewiſh law.

The Jewiſh law had two great objects in view; of which the firſt was to preſerve among them the knowledge of the true God, a rational worſhip ſpringing from that knowledge, and the regular practice of moral virtue; and the ſecond was to fit them for receiving the accompliſhment of the great promiſe made to their anceſtors, by means analogous to thoſe which a ſchoolmaſter employs to fit his pupils for diſcharging the duties of maturer years. Every thing in that law peculiar to itſelf, its various ceremonies, modes of ſacrificing, the ſanctions by which it was enforced, and the theocratic government by which it was adminiſtered, had a direct tendency to promote one or other of theſe ends; and keeping theſe ends in view, even the minuteſt laws, at which impious ignorance has affected to make itſelf merry, will be diſcovered by thoſe who ſhall ſtudy the whole ſyſtem, and are at the ſame time acquainted with the genius of ancient polytheiſm, to have been enacted with the moſt conſummate wiſdom.

It is not eaſy for us, who have been long bleſſed with the light of revelation, and who have cultivated our minds by the ſtudy of the ſciences, to conceive the propenſity of all nations, in that early age of the world, to the worſhip of falſe gods, of which they were daily adding to the number. It is indeed probable, from many paſſages of Scripture, as well as from profane authors of the greateſt antiquity, that one ſupreme *numen* was everywhere acknowledged; but he was conſidered as an extramundane being, too highly exalted to concern himſelf with the affairs of this world, the government of which, it was believed, he had delegated to various orders of ſubordinate deities. Of thoſe deities, ſome were ſuppoſed to have the charge of one nation and ſome of another. Hence it is, that we read of the gods of Egypt, the gods of the Amorites, and the gods of the different nations round about Paleſtine. None of thoſe nations denied the exiſtence of their neighbour's gods; but all agreed, that while the Egyptians were the peculiar care of Oſiris and Iſis, the Amorites might be the favourites of Moloch, the Phœnicians of Cronus, and the Philiſtines of Dagon; and they

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(Y) For this account of the plagues of Egypt, we are indebted to the very valuable *Obſervations* on the ſubject lately publiſhed by *Mr. Bryant*. We have not quoted the authorities by which the learned and pious author ſupports his opinions; becauſe it is to be hoped, that for a fuller account of theſe important tranſactions the reader will have recourſe to his work, of which we have given only a very brief abſtract. For much of the preceding parts of this ſection, we acknowledge our obligations to the late Biſhop Law's admirable diſcourſe on the *Several Diſpenſations of Revealed Religion*.

they had no objection occaſionally to join with each other in the worſhip of their reſpective tutelary deities. Nay, it was thought impiety in foreigners, while they ſojourned in a ſtrange country, not to ſacrifice to the gods of the place. Thus Sophocles makes Antigone ſay to her father, that a ſtranger ſhould both venerate and abhor thoſe things which are venerated and abhorred in the city where he reſides; and another author*, who, though comparatively late, drew much of his information from ancient writings, which are now loſt, aſſures us, that this complaiſance proceeded from the belief that the "ſeveral parts of the world were from the beginning diſtributed to ſeveral powers, of which each had his peculiar allotment and reſidence."

151 Purpoſe of their ſeparation from other people.

From this notion of local divinities, whoſe power or partial fondneſs was confined to one people, the Iſraelites, at their exodus from Egypt, appear not to have been free (z). Hence it is, that when the true God firſt tells them, by their leader Moſes*, that if they would obey his voice indeed and keep his covenant, then they ſhould be a PECULIAR TREASURE to him above all people: to prevent them from ſuppoſing that he ſhared the earth with the idols of the heathen, and had from partial fondneſs choſen them for his *portion*, he immediately adds, for ALL THE EARTH IS MINE. By this addition he gave them plainly to underſtand that they were choſen to be his peculiar treaſure for ſome purpoſe of general importance; and the very firſt article of the covenant which they were to keep was, that they ſhould have no other gods but him. So inveterate, however, was the principle which led to an intercommunity of the objects of worſhip, that they could not have kept this article of the covenant but in a ſtate of ſeparation from the reſt of mankind†; and that ſeparation could neither have been effected nor continued without the viſible providence of the Almighty watching over them as his peculiar treaſure. This we learn from Moſes himſelf, who, when interceding for the people after their idolatrous worſhip of the golden calf, and intreating that the preſence of God would ſtill accompany them, adds theſe words §: "For wherein ſhall it be known here that I and thy people have found grace in thy ſight? Is it not in that THOU GOEST WITH US? So ſhall we be SEPARATED, I and thy people, from all the people that are upon the face of the earth." Upon this ſeparation every thing depended; and therefore to render it the more ſecure, Jehovah, who in compliance with their prejudices had already aſſumed the appellation of their tutelary God, was graciouſly pleaſed to become likewiſe their ſupreme Magiſtrate, making them a "kingdom of prieſts and a holy nation," and delivering to them a digeſt as well of their civil as of their religious laws.

152 Of their theocratic government.

The Almighty thus becoming their King, the government of the Iſraelites was properly a THEOCRACY, in which the two ſocieties, civil and religious, were of courſe incorporated. They had indeed after their ſettlement in the Promiſed Land, at firſt, temporary *judges* occaſionally raiſed up; and afterwards permanent magiſtrates called *kings*, to lead their armies in war, and to give vigour to the adminiſtration of juſtice in peace: but neither thoſe judges nor thoſe kings could abrogate a ſingle law of the original code, or make the ſmalleſt addition to it but by the ſpirit of prophecy. They cannot therefore be conſidered as ſupreme magiſtrates, by whatever title they may have been known; for they were to go out and come in at the word of the prieſts, who were to aſk counſel for them of the Lord, and with whom they were even aſſociated in all judicial proceedings, as well of a civil as of a ſpiritual nature*. Under any other than a theocratic government the Hebrews could not have been kept ſeparate from the nations around them; or if they could, that ſeparation would not have anſwered the great purpoſe for which it was eſtabliſhed. "The people, on their leaving Egypt, were ſunk into the loweſt practices of idolatry. To recover them by the diſcipline of a ſeparation, it was neceſſary that the idea of God and his attributes ſhould be impreſſed upon them in the moſt *ſenſible* manner. But this could not be commodiouſly done under his character of God of the univerſe: under his character of King of Iſrael, it well might. Hence it is, that we find him in the Old Teſtament ſo frequently repreſented with affections analogous to human paſſions. The civil relation in which he ſtood to the Iſraelites made ſuch a repreſentation natural; the groſſneſs of their conceptions made the repreſentation neceſſary; and the guarded manner in which it was always qualified prevented it from being miſchievous*." Hence too it is, that under the Moſaic diſpenſation, idolatry was a crime of ſtate, puniſhable by the civil magiſtrate. It was indeed high treaſon, againſt which laws were enacted upon the juſteſt principles, and carried into effect without danger of error. Nothing leſs indeed than penal laws of the ſevereſt kind could have reſtrained the violent propenſity of that headſtrong people to worſhip, together with their own God, the gods of the Heathen. But penal laws enacted by human authority for errors in religion are manifeſtly unjuſt; and therefore a theocratic government ſeems to have been abſolutely neceſſary to obtain the end for which the Iſraelites were ſeparated from the ſurrounding nations.

153 And of the ritual law.

It was for the ſame purpoſe of guarding them againſt idolatry, and preventing all undue communications with their Heathen neighbours, that the ritual law was given, after their preſumptuous rebellions in the wilderneſs. Before the buſineſs of the golden calf, and their frequent attempts to return into Egypt, it ſeems not to have been the Divine intention to lay upon them a yoke of ordinances; but to make his covenant depend entirely upon their duly practiſing the rite of circumciſion: obſerving the feſtivals inſtituted in commemoration of their deliverance from bondage, and other ſignal ſervices vouchſafed them; and keeping inviolate all the precepts of the decalogue (A), which, if they had done, they ſhould have even lived in them*. But, after their repeated apoſtacies, and impious wiſhes to mix with the ſurrounding nations, it was neceſſary to ſubject them

* Celſus apud Aug.

* Exod. xix. 5.

† 1 Sam. xxvi. 19.

§ Exod. xxxiii. 16.

* Num. xxvii. 21 and Deut. xvii. 8, 13.

* Warburton's Div. Leg. b. v. ſec. 2.

* Divine Leg. b. iv. ſec. 6.

(z) It is not indeed evident that they had got entirely quit of this abſurd opinion at a much later period. Jephtha, one of their judges, who, though half paganized (as Warburton obſerves) by a bad education, had probably as correct notions of religion as an ordinary Iſraelite, certainly talked to the king of Ammon as if he had believed the different nations of the earth to be under the immediate protection of different deities: "Wilt not thou (ſays he) poſſeſs that which Chemoſh THY GOD giveth thee to poſſeſs? So whomſoever the Lord OUR GOD ſhall drive out from before us, them will we poſſeſs." Judges xi. 24.

(A) Of theſe precepts we think it not neceſſary, in an abſtract ſo ſhort as this, to waſte the reader's time with a formal and laboured defence. To the decalogue no objection can be made by any man who admits the obligations of natural religion; for, except the obſervation of the Sabbath-day, it enjoins not a ſingle duty which does not by the confeſſion of all men reſult from our relations to God, ourſelves, and our fellow-creatures.

them to a multifarious ritual, of which the ceremonial parts were ſolemn and ſplendid, fitted to engage and fix the attention of a people whoſe hearts were groſs; to inſpire them with awful reverence, and to withdraw their affections from the pomp and pageantry of thoſe idle ſuperſtitions which they had ſo long witneſſed in the land of Egypt. To keep them warmly attached to their public worſhip, that worſhip was loaded with operoſe and magnificent rites, and ſo completely incorporated with their civil polity as to make the ſame things at once duties of religion and acts of ſtate. The ſervice of God was indeed ſo ordered as to be the conſtant buſineſs as well as entertainment of their lives, ſupplying the place of all other entertainments; and the ſacrifices which they were commanded to offer on the moſt ſolemn occaſions, were of ſuch animals as the Egyptians and other Heathens deemed ſacred.

154 Inſtanced in their ſacrifices.

Thus a heifer without blemiſh was in Egypt held ſacred to the goddeſs Iſis, and actually worſhipped as the repreſentative of that divinity; but the ſame kind of heifer was by the ritual law of the Hebrews commanded to be burnt without the camp, as the vileſt animal, and the water of ſeparation to be prepared from her aſhes†. The goat was by the Egyptians held in great veneration as emblematical of their ancient god Pan, and ſacrifices of the moſt abominable kind were offered to the impure animal (ſee PAN); but God, by his ſervant Moſes, enjoined the Iſraelites to offer goats themſelves as ſacrifices for ſin, and on one occaſion to diſmiſs the live animal loaded with maledictions into the wilderneſs*. The Egyptians, with ſingular zeal, worſhipped a calf without blemiſh as the ſymbol of Apis, or the god of fertility; and it appears from the book of Exodus, that the Iſraelites themſelves had been infected with that ſuperſtition. They were, however, ſo far from being permitted by their Divine lawgiver to conſider that animal as in any reſpect ſacred, that their prieſts were commanded to offer for themſelves a young calf as a ſin offering ||. No animal was in Egypt held in greater veneration than the ram, the ſymbol of their god Ammon, one of the heavenly conſtellations. It was therefore with wiſdom truly divine, that Jehovah, at the inſtitution of the paſſover, ordered his people to kill and eat a young ram on the very day that the Egyptians began their annual ſolemnities § in honour of that animal as one of their greateſt gods; and that he enjoined the blood of this divinity to be ſprinkled as a ſign upon the two ſide-poſts and upper door-poſt of the houſe in which he was eaten. Surely it is not in the power of imagination to conceive a ritual better calculated to cure the Iſraelites of their propenſity to idol worſhip, or to keep them ſeparate from the people who had firſt given them that propenſity, than one which enjoined them to offer in ſacrifice the very creatures which their ſuperſtitious maſters had worſhipped as gods. "Shall we (ſaid Moſes) ſacrifice the abominations of the Egyptians before their eyes, and will they not ſtone us?"

But it was not againſt Egyptian idolatry only that the ritual law was framed: the nations of Syria, in the midſt of whom the Iſraelites were to dwell, were addicted to many cruel and abſurd ſuperſtitions, againſt which it was as neceſſary to guard the people of God as againſt the brute-worſhip of Egypt. We need not inform any reader of the books of Moſes that thoſe nations worſhipped the ſun and moon and all the hoſt of heaven; or that it was part of their religion to propitiate their offended gods by occaſionally ſacrificing their ſons and their daughters. From ſuch worſhip and ſuch ſacrifices the Iſraelites were prohibited under the ſevereſt penalties; but we cannot conſider that prohibition as making part of the *ritual* law, ſince it relates to practices impious and immoral in themſelves, and therefore declared to be abominations to the Lord. The Phœnicians, however, and the Canaanites, entertained an opinion that every child came into the world with a *polluted nature*, and that this pollution could be removed only by a *luſtral fire*. Hence they took their new born infants, and with particular ceremonies made them paſs through the flame of a pile ſacred to Baal or Moloch, the ſymbols of their great god the ſun. Sometimes this purgation was delayed till the children had arrived at their tenth or twelfth year, when they were made either to leap through the flame, or run ſeveral times backwards and forwards between two contiguous ſacred fires; and this luſtration was ſuppoſed to free them from every natural pollution, and to make them through life the peculiar care of the deity in whoſe honour it was performed*. The true God, however, who would have no fellowſhip with idols, forbade all ſuch purgations among his people, whether done by fires conſecrated to himſelf or to the bloody deities of the Syrian nations. "There ſhall not be found (ſays he) among you any one that maketh his ſon or his daughter to paſs through the fire †."

155 And in the laws reſpecting eating, drinking, and agriculture.

There are, in the Jewiſh law, few precepts more frequently repeated than that which prohibits the ſeething of a kid in its mother's milk ||; and there being no moral fitneſs in this precept when conſidered abſolutely and without regard to the circumſtances under which it was given, infidel ignorance has frequently thought fit to make it the ſubject of profane ridicule. But the ridicule will be forborne by thoſe who know that, among the nations round Judea, the feaſting upon a kid boiled in its mother's milk was an eſſential part of the impious and magical ceremonies celebrated in honour of one of their gods, who was ſuppoſed to have been ſuckled by a ſhe-goat. Hence, in the Samaritan Pentateuch, the text runs thus; "Thou ſhalt not ſeeth a kid in its mother's milk; for whoever does ſo, is as one who ſacrifices an abominable thing, which offends the God of Jacob §." Another precept, apparently of very little importance, is given in theſe words: "Ye ſhall not round the corners of your heads, neither ſhalt thou mar the corners of thy beard*." But its wiſdom is ſeen at once, when we know that at funerals it was the practice of many of the heathens, in that early period, to round the corners of their heads, and mar their beards, that by throwing the hairs they had cut off upon the dead body, or the funeral pile, they might propitiate the ſhade of the departed hero; and that in other nations, particularly in Phœnicia, it was cuſtomary to cut off all the hair of their heads except what grew upon the crown, which, with great ſolemnity, was conſecrated either to the ſun or to Saturn†. The unlearned Chriſtian, if he be a man of reflection, muſt read with ſome degree of wonder ſuch laws as theſe. "Thou ſhalt not ſow thy vineyard with divers ſeeds, leſt the fruit of thy ſeed which thou haſt ſown, and the fruits of thy vineyard be defiled. Thou ſhalt not plow with an ox and an aſs together. Thou ſhalt not wear a garment of divers ſorts, or of woollen and linen together‡." But his wonder will ceaſe when he knows that all theſe were practices from which the Sabian idolaters of the eaſt expected the greateſt advantages. Their belief in magic and judicial aſtrology led them to imagine, that by ſowing different kinds of corn among their vines they ſhould propitiate the gods which were afterwards known in Rome by the names of Bacchus and Ceres; that, by yoking animals ſo heterogeneous as the ox and the aſs in the ſame plough, they ſhould by a charm ſecure the favour of the deities who preſided over the affairs of huſbandry; and that a garment compoſed of linen and woollen worn under certain conjunctions of the ſtars, would protect its owner, his flocks, his herds, and his field, from all malign influences, and render him in the higheſt degree

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† Num. xix.

* Levit. xvi.

|| Lev. ix.

§ Spencer de Legibus Heb. Rit. lib. ii. cap. 4.

* Spencer, lib. ii. cap. 13.

† Deut. xvii. 10. xii. 26, and Levit. xx. 2, &c.

|| Exod. xiii. 19. xxxiv. 26. Deut. xiv. 21.

§ Spencer, lib. ii. cap. 9.

* Levit. xix. 27.

† Spencer, lib. ii. cap. 18.

‡ Deut. xxii. 9. 10, 11.

degree proſperous through the whole courſe of his life §. But magical ceremonies, of which the very eſſence ſeems to have conſiſted in uniting in one group or jumble things never brought together by nature, were always performed in order to render propitious good or evil demons (ſee Magic); and therefore ſuch ceremonies, however unimportant in themſelves, were in that age moſt wiſely prohibited in the Moſaic law, as they naturally led thoſe who were addicted to them to the worſhip of idols and impure ſpirits.

If the whole ritual of the Jewiſh economy be examined in this manner, every precept in it will be found to be directed againſt ſome idolatrous practice of the age in which it was given. It was therefore admirably calculated to keep the Iſraelites a ſeparate people, and to prevent too cloſe an intercourſe between them and their Gentile neighbours. And their civil inſtitutes, even thoſe which appear the moſt trifling, were all contrived with the moſt conſummate wiſdom to promote the ſame end. The diſtinction made by their law between clean and unclean animals (ſee Slavery, n° 33.) rendered it impoſſible for them, without a breach of that law, to eat and drink with their idolatrous neighbours; their ſacred and civil ceremonies being directly levelled againſt the Egyptian, Zabian, and Canaanitiſh ſuperſtitions, had a tendency to generate in their minds a keen contempt of thoſe ſuperſtitions; and that contempt muſt have been greatly increaſed by their yearly, monthly, and daily ſacrifices, of the very animals which their Egyptian maſters had worſhipped as gods.

156
The Moſaic laws enforced by temporal ſanctions.

That theſe laws might have the fuller effect upon minds groſs and carnal, they were all enforced by temporal ſanctions. This was indeed the natural and even neceſſary conſequence of the theocratic government eſtabliſhed in Iſrael; for when God condeſcended to become their ſupreme civil magiſtrate, he of courſe engaged to execute, either immediately by himſelf, or by the medium of his vicegerents the judges and the kings, all the offices included in ſuch magiſtracy. Hence it is that Moſes aſſured them, that if they would hearken to God's judgments, and keep them, and do them, they ſhould be bleſſed above all people; threatening them at the ſame time with utter deſtruction if they ſhould at all walk after other gods, and ſerve them, and worſhip them‡. Nor were theſe temporal rewards and puniſhments held out only to the nation as a collective body; they were promiſed and threatened to every individual in his private capacity as the certain conſequences of his obedience or diſobedience. Every particular Hebrew was commanded to honour his father and mother, that it might go well with him, and that his days might be prolonged; whilſt he who curſed his father or his mother was ſurely to be put to death. Againſt every idolater, and even againſt the wilful tranſgreſſor of the ceremonial law, God repeatedly declared that he would ſet his face, and would cut off that man from among his people: and that individuals, as well as the nation, were in this life actually rewarded and puniſhed according to their deſerts, has been proved by biſhop Warburton with a force of evidence § which muſt carry conviction to every mind which his lordſhip's rude railings at ſome favourite ſyſtem have not filled with prejudices againſt all his works. Indeed the Moſaic law, taken in its literal ſenſe holds out no other proſpects to the Iſraelites than temporal happineſs; ſuch as, health, long life, peace, plenty, and dominion, if they ſhould keep the covenant; and temporal miſery, *viz.* diſeaſes, immature death, war, famine, want, ſubjection, and captivity, if they ſhould break it. "See (ſays Moſes), I have ſet before thee this day life and good, death and evil; in that I command thee this day to love the Lord thy God, to walk in his ways, and to keep his commandments, and his ſtatutes, and his judgments, that thou mayeſt live and multiply; and the Lord thy God ſhall bleſs thee in the land whither thou goeſt to poſſeſs it. But if thine heart turn away, ſo that thou wilt not hear, but ſhalt be drawn away, and worſhip other gods, and ſerve them; I denounce unto you this day, that ye ſhall ſurely periſh, and that ye ſhall not prolong your days upon the land whither thou paſſeſt over Jordan to poſſeſs it." And elſewhere, having informed them that, upon their apoſtacy, their land ſhould be rendered like Sodom and Gomorrah, he adds, that all men ſhould know the reaſon of ſuch barrenneſs being brought upon it, and ſhould ſay, "Becauſe they have forſaken the covenant of the Lord God of their fathers, which he made with them when he brought them forth out of the land of Egypt, the anger of the Lord was kindled againſt this land, to bring upon it all the curſes that are written in this book ‡."

157
Whence it has been raſhly inferred that the ancient Hebrews had no hope beyond the grave.

From this notorious fact, which hardly any man of letters will now dare to deny, ſome divines have concluded, we think raſhly, that the ancient Iſraelites had no hope whatever beyond the grave; and that in the whole Old Teſtament there is not a ſingle intimation of a future ſtate. That many of the loweſt vulgar, who could neither read nor write, were in this ſtate of darkneſs, may be true; but it is impoſſible that ſuch of them as underſtood the book of Geneſis could be ignorant that death came into the world by the tranſgreſſion of their firſt parents, and that God had repeatedly promiſed to redeem mankind from every conſequence of that tranſgreſſion. They muſt likewiſe have known that, before the deluge, Enoch was tranſlated into heaven without taſting death; that afterwards Elijah had the ſame exemption from the common lot of humanity; and that, as God is no reſpecter of perſons, every one who ſerved him with the zeal and fidelity of theſe two prophets would, by ſome means or other, be made capable of enjoying the ſame rewards. The God of Abraham, Iſaac, and Jacob, was not the God of the dead but of the living.

In the earlieſt periods of their commonwealth, the Iſraelites could, indeed, only *infer*, from different paſſages of their ſacred books, that there would be a general reſurrection of the dead, and a future ſtate of rewards and puniſhments; but from the writings of the prophets it appears, that before the Babyloniſh captivity that doctrine muſt have been very generally received. We ſhall not, in ſupport of our opinion, quote the famous paſſage in the book of Job §, becauſe it is not determined at what period that beautiful and ſublime poem was admitted into the Jewiſh canon; but in the Pſalms, and in the prophecies of Iſaiah, Daniel, and Ezekiel, there are ſeveral texts which ſeem to us to prove, incontrovertibly, that, at the time when theſe inſpired books were written, every Iſraelite who could read the ſcriptures muſt have had ſome hopes of a reſurrection from the dead. We ſhall conſider two of theſe texts, becauſe they have been quoted by a very learned and valuable writer in ſupport of an opinion the reverſe of ours.

158
This opinion confuted.

In a ſublime ſong, compoſed with a view to incite the people to confidence in God, the prophet Iſaiah has theſe remarkable words; "Thy dead men ſhall live; together with my dead body ſhall they ariſe. Awake and ſing, ye that dwell in the duſt; for thy dew is as the dew of herbs, and the earth ſhall caſt out the dead‡." We agree with biſhop Warburton that theſe words are figurative, and that they were uttered to give the Iſraelites conſolation in very diſaſtrous times. The purpoſe of the prophet was to aſſure them, that though their community ſhould, in Babylon, be as completely diſſolved as a dead body reduced to duſt, yet God would reſtore them to their own land, and raiſe that community again to life. This was indeed a prophecy only of a temporal deliverance; but as it is expreſſed in terms relating to the death and reſurrection of man, the doctrine of a reſurrection muſt then have been well known, and generally received, or ſuch language would have been altogether unintelligible. No (ſays the biſhop); that the language might be intelligible, it was only neceſſary that the Iſraelites ſhould have diſtinct *ideas* of a reſurrection from the dead, without knowing that the natural body is indeed to riſe again; and as he thinks that ſuch metaphorical expreſſions as this would have the greateſt force where the doctrine of the reſurrection was unknown, he concludes that it muſt have been unknown among the Iſraelites in the days of Iſaiah[*].

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§ Spenſer, lib. ii. cap. 30, 31, 33.

‡ Deut. paſſim

§ Div. Leg. book v. ſect. 4.

‡ Deut. xxx. 15—19. xxix. 25.

§ Chap. xix. verſe 25, &c.

‡ Chap. xxvi. 19.

Had there been no ſacred books among the Iſraelites before this prophecy was uttered, his lordſhip's reaſoning would have been at leaſt plauſible, if not concluſive; but that a people who knew how death had entered into the world, who believed that they were by ſome means or other to be freed from its ſting, who, it is natural to ſuppoſe, often meditated upon the bruiſing of the ſerpent's head, and the nature of the bleſſing which all nations were to derive from the ſeed of Abraham, ſhould form diſtinct *ideas* of a reſurrection, and read this prophecy without believing that the natural body is *indeed to riſe again*, we cannot poſſibly conceive. The very ſuppoſition is one of his lordſhip's moſt irreconcileable paradoxes; and it is a paradox which his ſyſtem did not require him to ſupport.

The prophet Ezekiel, when the ſtate of things was moſt deſperate, is carried by the Spirit into a valley full of dry bones, and aſked this queſtion; "Son of man, can theſe bones live?" To which he anſwers; "O Lord God, thou knoweſt [†];" an anſwer which the ſame learned prelate thinks the prophet could not have made, had he been brought up in the knowledge and belief of a reſurrection from the dead. Our opinion is directly the reverſe of that of his lordſhip, who ſeems to have miſtaken the nature of this ſcenical repreſentation. The prophet was not aſked if *all* the dead would riſe at the laſt day; but only if the particular bones *then* preſented to him could live at *that time*, and while other bones were mouldering in corruption: and to ſuch a queſtion we cannot conceive any anſwer that a man brought up in the belief of a general reſurrection could have given, but—"O Lord God, thou knoweſt." Had Ezekiel been a ſtranger to the doctrine of a general reſurrection, or had he not believed that doctrine, he would doubtleſs have anſwered the queſtion that was put to him in the negative; but convinced that *all* men are at *ſome* period to riſe from the dead, "that every one may receive the things done in his body, according to that he hath done, whether it be good or bad," he very naturally ſaid, that God alone knew whether the bones then exhibited to him in the valley would riſe before the general reſurrection.

159 The hope of the Hebrews, however, not from their own law.

But though the more intelligent and righteous Iſraelites certainly "all died in faith, and not having received the promiſes, but having ſeen them afar off, were perſuaded of them and embraced them, confeſſing that they were ſtrangers and pilgrims on earth, who deſired a better country, that is, a heavenly one [†]," we are not to ſuppoſe that this heavenly deſire aroſe from any thing taught in the law of Moſes. That law, when taken by itſelf, as unconnected with prior and ſubſequent revelations, makes no mention whatever of a heavenly inheritance, which St Paul aſſures us [‡] was given 430 years before to Abraham by a promiſe which may be traced back to the firſt ray of comfort vouchſafed to fallen man in the ſentence paſſed on the original deceiver. "Wherefore then ſerved the law? It was added (ſays the apoſtle), becauſe of tranſgreſſions, till the ſeed ſhould come to whom the promiſe was made." The tranſgreſſions here alluded to were polytheiſm and idolatry, which, with their never-failing train of cruel and deteſtable vices, had overſpread the whole world; and the primary intention of the law was to ſtem the torrent of theſe corruptions, for which we have ſeen it was admirably calculated; and, like a ſchoolmaſter, to inſtruct the Iſraelites in the unity and worſhip of Jehovah, and thus by degrees bring them to Chriſt.

But though it is apparent that a future ſtate of rewards and puniſhments made no part of the Moſaic diſpenſation, yet the law had certainly a ſpiritual meaning to be underſtood when the fulneſs of time ſhould come. Every Chriſtian ſees a ſtriking reſemblance between the ſacrifice of the paſchal lamb, which delivered the Iſraelites from the deſtroying angel in Egypt, and the ſacrifice of the lamb of God, which taketh away the ſin of the world. Indeed the whole ritual of ſacrifice muſt have led the more intelligent of them to faith in a future ſacrifice; by which, while the heel of the ſeed of the woman ſhould be bruiſed, the head of the ſerpent ſhould be completely cruſhed (ſee SACRIFICE); and as prophets were raiſed up from time to time, to prepare them for the coming of the Meſſiah, and to foretel the nature of his kingdom, there can be no doubt but that thoſe inſpired teachers would lay open to them, as far as was expedient, the temporary duration of the Moſaic law, and convince them that it was only the ſhadow of better things to come. From the nature of their ritual, and the different prophecies vouchſafed them, which became more and more explicit as the time approached for their accompliſhment, they muſt ſurely have been led to expect redemption from the curſe of the fall by the ſufferings of their Meſſiah; but that any one of them knew preciſely the *manner* in which they were to be redeemed, and the nature of that religion which was to ſuperſede their own, is wholly incredible (B). Such knowledge would have

160 Why the law was typical.

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[*] Div. Leg. book vi. ſect. 2.

[†] Chap. xxxvii. 3.

[†] Heb. xi. 13, &c.

[‡] Gal. iii. 16—19.

(B) This doctrine is ſtated in ſo clear a light by biſhop Bull, whom, as a divine, we think the glory of the church of England, and who has had few ſuperiors in any church, that the learned reader will be pleaſed to have his opinions in his own words. "An igitur, inquies, fuerunt ſub lege, qui vitam æternam ſperarent? Reſp. Qui meliores erant et perſpicaciores in populo Judaico, veroſimile eſt eos ſeu generalium promiſſionum vi, ſeu temporalium bonorum levi æſtimatione, ſeu divinæ bonitatis intuitu, ſeu animæ ſuæ, melioris quam caduci boni appetentis, conſideratione, ſeu Enochi exemplo (cui ſequiori ævo acceſſit Eliæ raptus) ſeu Patriarcharum traditione, (quibus Deus multis indiciis ſpem futurorum bonorum fecerat, in quorum indiciorum genere non minimum erat et illud, quod multi eximie boni terreſtris felicitatis expertes vixerint, quod argumentum late exequitur Scriptor ad Hebræos cap. 11.) ſeu aliis rationibus adductos credidiſſe, Deum, præter ſpecialia iſta bona ad hanc vitam pertinentia, et legibus Moſaicis comprehenſa, etiam alia poſt mortem cultoribus ſuis fidis largiri velle. Imo ſtatuendum illud omnino eſt, ne viros ſanctos eximioſque in populo Dei ſuum inſtar tum vixiſſe, tum devixiſſe credatur. Nec refert, quod hujus fidei vix ac ne vix quidem ulla in Canonicis V. T. Scripturis mentio fiat. Nam certum eſt, Abrahamum filium promiſſionis, mactare juſſum non recuſaſſe, hac ratiocinatione ſuſtentatum, Deum potentia tanta præditum eſſe, ut filium jam mortuum in vitam revocare, eumque ei redivivum reſtituere poſſet. Certum, inquam, illud eſt, quia divinus Autor Epiſtolæ ad Hebræos id diſerte teſtatur, cap.

Theology from the fall of Adam to the coming of Christ.

have made them impatient under the yoke of ordinances to which they were ſubjected; for after the Chriſtian faith came into full ſplendour, mankind could be no longer under the tuition of ſuch a ſchoolmaſter as the law, which "had only a *ſhadow* of good things; and ſo far from their reality, not even the very *image* of them †." Through theſe ſhadows, however, the Jews, aided by the clearer light of prophecy, though it too ſhone in a dark place, might have ſeen enough of God's plan of redemption to make them acknowledge Jeſus of Nazareth, when he came among them working miracles of mercy, for the Meſſiah ſo long promiſed to their forefathers, and in whom it was repeatedly ſaid, that all the nations of the earth ſhould be bleſſed.

161 Means uſed to prepare the world for the coming of Chriſt.

While ſuch care was taken to prepare the deſcendants of Abraham for the coming of the Prince of Peace, we muſt not ſuppoſe that God was a reſpecter of perſons, and that the reſt of the world was totally neglected. The diſperſion of the ten tribes certainly contributed to ſpread the knowledge of the true God among the eaſtern nations. The ſubſequent captivity of the tribes of Judah and Benjamin muſt have confirmed that knowledge in the great empires of Babylon and Perſia; and that particular providence of God which afterwards led Ptolemy Philadelphus to have the Jewiſh ſcriptures tranſlated into the Greek language, laid the divine oracles open to the ſtudy of every accompliſhed ſcholar. At laſt, when the arms of Rome had conquered the civilized world, and rendered Judea a province of the empire; when Auguſtus had given peace to that empire, and men were at leiſure to cultivate the arts and ſciences; when the different ſects of philoſophers had by their diſputations whetted each others underſtandings ſo that none of them was diſpoſed to ſubmit to an impoſture; and when the police of the Roman government was ſuch that intelligence of every thing important was quickly tranſmitted from the moſt diſtant provinces to the capital of the empire; "when that fulneſs of time was come, God ſent forth his Son made of a woman, made under the law, to redeem them that were under the law, that we might receive the adoption of ſons," and be reſtored to that inheritance of which the forfeiture introduced the ſeveral diſpenſations of revealed religion into the world.

SECT. V. *View of Theology, more peculiarly Chriſtian.*

Theology more peculiarly Chriſtian.

MANKIND being trained by various diſpenſations of providence for the reception of that ſeed of Abraham, in whom all the nations of the earth were to be bleſſed, and the time fixed by the Jewiſh prophets for his coming being arrived, "a meſſenger was ſent before his face to prepare his way before him by preaching the baptiſm of repentance for the remiſſion of ſins." This meſſenger was John the Baptiſt, a very extraordinary man, and the greateſt of all the prophets. His birth was miraculous, the ſcene of his miniſtry the wilderneſs, his manners auſtere, and his preaching upright, without reſpect of perſons. He frankly told his audience that he was not the Meſſiah, that the Meſſiah would ſoon appear among them, that "he was mightier than himſelf, and that he would baptiſe them with the Holy Ghoſt and with fire."

162 Chriſt the divine word incarnate.

Mightier indeed he was; for though born of a woman the Meſſiah was not the ſon of a human father; and though living for the firſt thirty years of his life in obſcurity and poverty, he was the lineal deſcendant of David, and heir to the throne of Iſrael. But the dignity of his human deſcent, great as it was, vaniſhes from conſideration when compared with the glory which he had with his father before the world was. The Jewiſh diſpenſation was given by the miniſtry of Moſes, and illuſtrated by ſubſequent revelations vouchſafed to the prophets; the immediate author of the Chriſtian religion is the λογος or ſecond perſon of the bleſſed Trinity, of whom St John declares, that "he was in the beginning with God, and was God; that all things were made by him; and that without him was not any thing made that was made." We have already proved that in the one Godhead there is a Trinity of perſons; and that the λογος is one of the three, is apparent from theſe words of the apoſtle, and from many other paſſages of ſacred ſcripture. Thus he is called *the Lord of hoſts himſelf; the firſt and the laſt, beſides whom there is no God; the moſt high God; God bleſſed for ever; the mighty God, the everlaſting Father, Jehovah our righteouſneſs;* and *the only wiſe God our Saviour* (c). This great Being, as the ſame apoſtle aſſures us, was made fleſh, and dwelt among men; not that the divine nature was or could be changed into humanity, for God is immutable, the ſame Almighty and incomprehenſible Spirit yeſterday, to-day, and forever; but the word or ſecond perſon in the godhead, aſſuming a human ſoul and body into a perſonal union with himſelf, dwelt upon earth as a man, veiling his divinity under mortal fleſh. Hence he is ſaid elſewhere to have been "manifeſted in the fleſh," and "to have taken upon him the nature of man;" phraſes of the ſame import with that which aſſerts "the WORD to have been made fleſh."

163 Objections to the incarnation of the word.

This incarnation of the Son of God is perhaps the greateſt myſtery of the Chriſtian faith, and that to which ancient and modern heretics have urged the moſt plauſible objections. The doctrine of the Trinity is indeed equally incomprehenſible; but the nature of God and the mode of his ſubſiſtence, as revealed in ſcripture, no man, who thinks, can be ſurpriſed that he does not comprehend; for a revelation which ſhould teach nothing myſterious on ſuch a ſubject would be as incredible and as uſeleſs as another which

† Heb. x. 1.

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cap. 11. 19. Hujus tamen vere admirandæ fidei, atque Evangelicæ ſupparis, in hiſtoria Abrahami nec volam, nec veſtigium reperias. Præterea floruerunt ſingulis ſæculis in populo Judaico Viri Dei ac Prophetæ cælitus edocti, quos, inter tot arcana ipſis patefacta, myſticum hunc legis ſenſum penitus ignoraſſe, nihilque de futura vita intellexiſſe, nemo prudens ſuſpicabitur. Cum autem nefas ſit vel cogitaſſe, Viros optimos ſapientiam, qua ipſi pollebant, aliis invidiſſe, credendum omnino eſt, eos, *ſicubi idoneos invenerint Auditores*, evolviſſe iis obtecta in lege myſteria, ſingulisque tantum aperuiſſe, quantum captus ipſorum et utilitatis ratio ferebat. In publicis autem concionibus Prophetæ ac Sapientes ita loquebantur, ut nec in contemptum adducerent arcana ſanctioris diſciplinæ, et tamen Auditorem attentum ad inveſtigandi ſollicitudinem excitarent. Atque hinc natum arbitratur maximus Grotius diſcrimen antiquitus inter Judæos celebratum, ſcriptæ legis, et legis oralis, quam et קבלה i. e. παράδοσιν ſeu *Traditionem* vocant; utramque dicentes a Moſe profectam: non quod res aliæ fuerint in traditione quam in lege ſcripta; ſed quod ea quæ in lege ſcripta occultius continebantur, ſtudioſis indagatoribus enodaret accuratior interpretatio. *Harmonia Apoſtolica*, Diſſert. poſt. cap. 10.

(c) Iſaiah viii. 13, 14. compared with 1 Peter ii. 7, 8; Iſaiah vi. 5. compared with John xii. 41; Iſaiah xliv. 6. compared with Revelation xxii. 13; Pſalm lxxvii. 56. compared with 1 Corinthians x. 9. Romans ix. 5. Iſaiah ix. 6. Jeremiah xxiii. 6. Jude.

contained nothing but *myſtery*. The difficulty reſpecting the incarnation, which forces itſelf upon the mind, is not how two natures ſo different as the divine and human can be ſo intimately united as to become one perſon; for this union in itſelf is not more inconceivable than that of the ſoul and body in one man: but that which at firſt is apt to ſtagger the faith of the reflecting Chriſtian is the infinite diſtance between the two natures in Chriſt, and the comparatively ſmall importance of the object, for the attainment of which the eternal Son of God is ſaid to have taken upon him our nature.

164 Obviated.

Upon mature reflection, however, much of this difficulty will vaniſh to him who conſiders the ways of Providence, and attends to the meaning of the words in which this myſtery is taught. The importance of the object for which the WORD condeſcended to be made fleſh, we cannot adequately know. The oracles of truth indeed inform us, that Chriſt Jeſus came into the world to ſave ſinners; but there are paſſages ſcattered through the New Teſtament [*] which indicate, not obſcurely that the influence of his ſufferings extends to other worlds beſides this: and if ſo, who can take upon him to ſay, that the quantity of good which they may have produced was not of ſufficient importance to move even to this condeſcenſion a Being who is emphatically ſtyled LOVE?

But let us ſuppoſe that every thing which he did and taught and ſuffered was intended only for the benefit of man, we ſhall, in the daily adminiſtration of providence, find other inſtances of the divine condeſcenſion; which, though they cannot be compared with the incarnation of the ſecond perſon in the bleſſed Trinity, are yet ſufficient to reconcile our underſtandings to that myſtery when revealed to us by the Spirit of God. That in Chriſt there ſhould have dwelt on earth "all the fulneſs of the Godhead bodily [‖]," is indeed a truth by which the devout mind is overwhelmed with aſtoniſhment; but it is little leſs aſtoniſhing that the omnipotent Creator ſhould be intimately preſent at every inſtant of time to the meaneſt of his creatures, "upholding all things, the vileſt reptile as well as the moſt glorious angel, by the word of his power[‡]." Yet it is a truth ſelf-evident, that without this conſtant preſence of the Creator, nothing which had a beginning could continue one moment in being; that the viſible univerſe would not only crumble into chaos, but vaniſh into nothing; and that the ſouls of men, and even the moſt exalted ſpirits of creation, would inſtantly loſe that exiſtence, which, as it was not of itſelf, and is not neceſſary, muſt depend wholly on the will of him from whom it was originally derived. See METAPHYSICS, n° 272—276, and PROVIDENCE, n° 3.

In what particular way God is preſent to his works, we cannot know. He is not diffuſed through the univerſe like the *anima mundi* of the ancient Platoniſts, or that modern idol termed the *ſubſtratum of ſpace* (METAPHYSICS, n° 309, 310.); but that he is in power as intimately preſent now to every atom of matter as when he firſt brought it into exiſtence, is equally the dictate of ſound philoſophy and of divine revelation; for "in him we live and move and have our being;" and power without ſubſtance is inconceivable. If then the divine nature be not debaſed, if it cannot be debaſed by being conſtantly preſent with the vileſt reptile on which we tread, why ſhould our minds recoil from the idea of a ſtill cloſer union between the ſecond perſon of the ever bleſſed trinity and the body and ſoul of Jeſus Chriſt? The one union is indeed different from the other, but we are in truth equally ignorant of the nature of both. Reaſon and revelation aſſure us that God muſt be preſent to his works to preſerve them in exiſtence; and revelation informs us farther, that one of the perſons in the Godhead aſſumed human nature into a perſonal union with himſelf, to redeem myriads of rational creatures from the miſerable conſequences of their own folly and wickedneſs. The importance of this object is ſuch, that, for the attainment of it, we may eaſily conceive that he who condeſcends to be potentially preſent with the worms of the earth and the graſs of the field, would condeſcend ſtill farther to be perſonally preſent with the ſpotleſs ſoul and body of a man. Jeſus Chriſt lived indeed a life of poverty and ſuffering upon earth, but his divine nature was not affected by his ſufferings. At the very time when, as a man he had not a place where to lay his head; as God, he was in heaven as well as upon earth[*], dwelling in light inacceſſible; and while, as a man, he was increaſing in wiſdom and ſtature, his divinity was the fulneſs of him who filleth all in all, and from whom nothing can be hid.

Perhaps the very improper appellation of *mother of God*, which at an early period of the church was given to the Virgin Mary, may have been one cauſe of the reluctance with which the incarnation has been admitted; for as we have elſewhere obſerved (ſee NESTORIUS), ſuch language, in the proper ſenſe of the words, implies what thoſe, by whom it is uſed, cannot poſſibly believe to be true; but it is not the language of ſcripture. We are there taught, that "Chriſt being in the form of God, thought it no robbery to be equal with God; but made himſelf of no reputation, and took upon him the form of a ſervant, and was made in the likeneſs of man[†];" that "God ſent forth his Son made of a woman, made under the law, to redeem them that were under the law, that we might receive the adoption of ſons[‖];" and that "the WORD who was in the beginning with God, and was God, by whom all things were made, was made fleſh, and dwelt among men (who beheld his glory, the glory as of the only begotten of the father), full of grace and truth[‡]:" but we are nowhere taught that as God, he had a mother! It was indeed the doctrine of the primitive church[‖], that the very principle of perſonality and individual exiſtence in Mary's ſon, was union with the uncreated WORD; and this doctrine is thought to imply the miraculous conception, which is recorded in the plaineſt terms by two of the evangeliſts; for he was conceived by the Holy Ghoſt and born of a virgin[§]; but, as God, he had been begotten from all eternity of the Father, and in order of nature was prior to the Holy Ghoſt.

165 His divine nature begotten of the Father.

This is evident from the appellation of ὁ λογος given to him by St John; for the term being uſed in that age, both by the Jewiſh Rabbies and the heathen philoſophers, to denote the ſecond divine ſubſiſtence, which they conſidered as an eternal and neceſſary emanation from the firſt, ſometimes called τ'αγαθον and ſometimes το ἑν; and the apoſtle giving no intimation of his uſing the word in any uncommon ſenſe, we muſt neceſſarily conclude, that he meant to inform us that the divinity of Chriſt is of eternal generation. That the term λογος was uſed in this ſenſe by the later Platoniſts, and in all probability by Plato himſelf, we have ſufficiently ſhewn in another place (ſee PLATONISM); and that a ſimilar mode of expreſſion prevailed among the Jews in the time of St John, is apparent from the Chaldee paraphraſe; which, in the 110th Pſalm, inſtead of the words "the Lord ſaid unto my Lord," has, "the Lord ſaid unto his WORD." Again, where we are told in the Hebrew that Jehovah ſaid to Abraham[§], "I am thy ſhield and thy exceeding great reward," we read in the Chaldee, "my WORD is thy ſhield, and thy exceeding great reward." Where it is ſaid, "your new moons and your appointed feaſts my ſoul hateth[*]." the paraphraſt hath it, "my WORD hateth;" and where it is ſaid, that "Iſrael ſhall be ſaved in the Lord with an everlaſting ſalvation[†]," in the ſame paraphraſe it is, "Iſrael raël ſhall be ſaved by the WORD of the Lord with everlaſting ſalvation." But there is a paſſage in the Jeruſalem Targum which puts it beyond a doubt, that by the λογος the Jews underſtood a divine perſon begotten of his Father before all worlds; for commenting on Geneſis iii. 22. the authors of that work thus expreſs themſelves: "The WORD of the Lord ſaid, behold Adam, whom I created, is the only begotten upon earth, as I AM THE ONLY BEGOTTEN IN HEAVEN;" in conformity with which, Philo introduces ‡ the Logos ſpeaking thus of himſelf; Και γαρ ουτε αγεννητος ως θεος ων, ουτε γεννητος ως ημεις, *I am neither unbegotten, as God, nor begotten after the ſame manner as you are.*

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[*] Eph. i. 10. Col. i. 19, 20

[‖] Col. ii.

[‡] Heb. i. 3.

[*] John iii. 13.

[†] Philip. ii. 6, 7.

[‖] Galatians iv. 4, 5.

[‡] John i.

[‖] Horſley's Sermon on the incarnation.

[§] St Matt. i. 18, &c. Luke i. 27, &c.

[§] Gen. xv. 1.

[*] Iſaiah i. 14.

[†] Iſaiah xlv. 17.

166 Orthodoxy of the Nicene creed.

From theſe quotations we may juſtly conclude, that the Nicene fathers expreſſed themſelves properly when they declared that the only begotten Son of God was begotten of his Father before all worlds, and is God of God; for if St John had believed the λογος or WORD to be unbegotten, contrary to the belief of all who made uſe of the phraſe at the time when he wrote, he would ſurely have expreſſed his diſſent from the generally received opinion. This however, he is ſo far from doing, that he gives the ampleſt confirmation of that opinion, by declaring, that "he beheld the glory of the WORD incarnate as the glory of the only begotten of the Father;" for this declaration is true only of the divinity of Chriſt, his human nature not being begotten of the Father, but conceived by the Holy Ghoſt of the Virgin Mary. Hence our bleſſed Lord aſſures us, that "as the Father HATH life in HIMSELF, ſo hath he GIVEN the Son to have life in himſelf;" that "the Son can do nothing of *himſelf*, but what he ſeeth the Father do ‖;" and that "he knew the Father becauſe he was from him and ſent by him †." We muſt therefore agree with biſhop Pearſon (D), that "though the Father and Son are both truly God, and therefore equal in reſpect of nature, yet the one is greater than the other, as being the fountain of the Godhead. The Father is God, but *not of God*; Light, but *not of Light*. Chriſt is God, but *of* God; Light, but *of* Light. There is no difference or inequality in the nature or eſſence, becauſe the ſame in both; but the Father of our Lord Jeſus Chriſt hath that eſſence of himſelf, from none; Chriſt hath the ſame eſſence, not of himſelf, but from him."

167 Purpoſe for which Chriſt was ſent into the world.

The great purpoſe for which this divine perſon was ſent into the world, and born of a woman, was to bruiſe the head of the ſerpent, and reſtore mankind to the inheritance which had been forfeited by Adam's tranſgreſſion. Every diſpenſation of Providence from the fall had been preparatory to this reſtoration. Prophets had been raiſed from time to time to preſerve in the early ages of the world the knowledge and worſhip of the true God: the children of Abraham, as we have ſeen, had been ſeparated from the ſurrounding nations for the ſame purpoſe; and by the diſperſion of the ten tribes, the captivity of the other two in Babylon, and the tranſlation of the Hebrew ſcriptures into the Greek language, much of the knowledge which had been revealed to the Iſraelites was gradually diffuſed over the eaſtern world.

168 Corruption of the Jews at the time of his coming.

But while the Jews were thus rendered the inſtruments of enlightening the heathen nations of antiquity, their intercourſe with thoſe nations made them almoſt unavoidably acquainted with the philoſophy which was cultivated among the Chaldeans, the Perſians, and the Egyptian Greeks; and ingrafting many of the opinions derived from thoſe ſchools upon the doctrines of Moſes and the prophets, they corrupted their own religion while they improved that of their neighbours. Hence, by the time that Chriſt came among them, they had made the word of God of none effect through a number of idle fancies which they inculcated on the people as the traditions of the elders; and as they had attached themſelves to different maſters in philoſophy, their unauthoriſed opinions were of courſe different according to the different ſources whence they were drawn. The peculiar tenets of the ESSENES ſeem to have been a ſpecies of myſtic Platoniſm. The PHARISEES are thought to have derived their origin from a Jewiſh philoſopher of the Peripatetic ſchool; and the reſemblance between the doctrines of the SADDUCEES and the philoſophy of Epicurus has eſcaped no man's obſervation.

Though theſe ſects maintained mutual communion in public worſhip, they abhorred each other's diſtinguiſhing tenets; and their eternal wranglings had well nigh baniſhed from them every ſentiment of true religion. They agreed, however, in the general expectation of the Meſſiah promiſed to their fathers; but, unhappily for themſelves, expected him as a great and temporal prince. To this miſtake ſeveral circumſtances contributed: ſome of their prophets had foretold his coming in lofty terms, borrowed from the ritual law, and the ſplendour of earthly monarchs. The neceſſity of caſting this veil over thoſe living oracles we have ſhewn in another place (ſee PROPHECY, nº 17.). At the time when the predictions were made, the Moſaic ſyſtem had not run out half its courſe, and was therefore not to be expoſed to popular contempt by an information that it was only the harſh rudiment of one more eaſy and perfect. To prevent, however, all miſtakes in the candid and impartial, when the Meſſiah ſhould arrive with the credentials of miraculous powers, other prophets had deſcribed him in the cleareſt terms as having no form nor comelineſs, as a ſheep dumb before his ſhearers, and as a lamb brought to the ſlaughter; but the Jews had ſuffered ſo much from the Chaldeans, the Greeks, and other nations by whom they had been conquered, and were then ſuffering ſo much from their maſters the Romans, that their carnal minds could think of no deliverance greater than that which ſhould reſcue their nation from every foreign yoke.

What men earneſtly wiſh to be true, they very readily believe.

‡ De Agricult. lib. ii.

‖ St John v. 26. 19.

† John vii. 29.

(D) We beg leave to recommend to our readers this author's excellent expoſition of the apoſtle's creed, as a work which will render them great aſſiſtance in acquiring juſt notions of the fundamental articles of the Chriſtian faith. They will find it, we think, a complete antidote againſt the poiſon of modern Unitarians and modern Tritheiſts; of whom the former teach that Jeſus Chriſt was a mere man, the ſon of Joſeph as well as of Mary; while the latter, running to the other extreme, maintain, that, with reſpect to his divinity, he is in no ſenſe ſubordinate to the Father, but might have been the Father, the Son, or the Holy Ghoſt, according to the good pleaſure of the eternal three. We have been at ſome pains to prove his divinity, and likewiſe his eternal generation; but in ſuch a ſhort compend as we muſt give, it ſeems not to be worth while to prove his miraculous conception. That miracle is plainly aſſerted in the New Teſtament in words void of all ambiguity; and as it is ſurely as eaſy for God to make a man of the ſubſtance of a woman as of the duſt of the earth, we cannot conceive what ſhould have induced any perſon profeſſing Chriſtianity to call it in queſtion. The natural generation of Chriſt is a groundleſs fancy, which can ſerve no purpoſe whatever, even to the Unitarians.

believe. Hence that people, loſing ſight of the yoke under which they and the whole human race were brought by the fall of Adam, miſtaking the ſenſe of the bleſſing promiſed to all nations through the ſeed of Abraham, and devoting their whole attention to the moſt magnificent deſcriptions of the Meſſiah's kingdom, expected in him a prince who ſhould conquer the Romans, and eſtabliſh on earth a univerſal monarchy, of which Jeruſalem was to be the metropolis.

169
The objects of his preaching.

As our Saviour came for a very different purpoſe, the firſt object of his miſſion was to rectify the notions of his erring countrymen, in order to fit them for the deliverance which they were to obtain through him. Accordingly, when he entered upon his office as a preacher of righteouſneſs, he embraced every opportunity of inveighing with becoming firmneſs againſt the falſe doctrines taught as traditions of the elders; and by his knowledge of the ſecrets of all hearts, he expoſed the vile hypocriſy of thoſe who made a gain of godlineſs. The Jews had been led, by their ſeparation from the reſt of the world, to conſider themſelves as the peculiar favourites of Jehovah; and the conſequence was, that, contrary to the ſpirit of their own law, and the explicit doctrines of ſome of their prophets, they looked upon all other nations with abhorrence, as upon people phyſically impure. Theſe prejudices the bleſſed Jeſus laboured to eradicate. Having deſired a lawyer, by whom he was tempted, to read that part of the law of Moſes which commanded the Iſraelites to love their neighbours as themſelves, he compelled him, by means of a parabolical account of a compaſſionate Samaritan, to acknowledge, that under the denomination of neighbour the divine lawgiver had comprehended all mankind as the objects of love ||. The importance in which Moſes held the ritual law, and to which, as the means of preſerving its votaries from the contagion of idolatry, it was juſtly intitled, had led the Jews to conſider every ceremony of it as of intrinſic value and perpetual obligation: but Jeſus brought to their recollection God's declared preference of mercy to ſacrifice; ſhewed them that the weightier matters of the law, judgment, mercy, and faith, claimed their regard in the firſt place, and its ceremonial obſervances only in the ſecond; and taught them, in conformity with the predictions of their own prophets †, that the hour was about to come when the worſhip of God ſhould not be confined to Jeruſalem, but that "true worſhippers ſhould every where worſhip the Father in ſpirit and in truth. ‡"

It being the deſign of Chriſt's coming into the world to break down the middle wall of partition between the Jews and Gentiles, and to introduce a new diſpenſation of religion which ſhould unite all mankind as brethren in the worſhip of the true God, and fit them for the enjoyment of heaven; he did not content himſelf with merely reſtoring the moral part of the Moſaic law to its primitive purity, diſencumbered of the corrupt gloſſes of the Scribes and Phariſees, but added to it many refined and ſpiritual precepts, which, till they were taught by him, had never occurred either to Jew or Gentile. The Hebrew lawgiver had prohibited murder under the penalty of death; but Chriſt extended the prohibition to cauſeleſs anger, and to contemptuous treatment of our brethren, commanding his followers, as they valued their everlaſting ſalvation, to forgive their enemies, and to love all mankind. Adultery was forbidden by the law of Moſes as a crime of the deepeſt dye; but Jeſus ſaid to his diſciples, "that whoſoever looketh on a woman to luſt after her, hath committed adultery with her already in his heart," and is of courſe liable to the divine vengeance. The *lex talionis* was in force among the Jews, ſo that the man who had deprived his neighbour of an eye or a tooth, was to ſuffer the loſs of an eye or a tooth himſelf; but this mode of puniſhment, which inflicted *blemiſh* for *blemiſh*, though ſuited to the hardneſs of Jewiſh hearts, being inconſiſtent with the mild ſpirit of Chriſtianity, was aboliſhed by our bleſſed Lord, who ſeverely prohibited the indulgence of revenge, and commanded his followers to love even their enemies. Perjury has in every civilized nation been juſtly conſidered as a crime of the higheſt atrocity, and the Moſaic law doomed the falſe witneſs to bear the puniſhment, whatever it might be, which he intended by ſwearing falſely to bring upon his brother; but the Author of the Chriſtian religion forbade not only falſe ſwearing, but ſwearing at all, except on ſolemn occaſions, and when an oath ſhould be required by legal authority. See OATH.

170
In which he executed the office of a prophet.

By thus reſtoring the law to its original purity, and in many caſes extending its ſenſe, the bleſſed Jeſus executed the office of a PROPHET to the loſt ſheep of the houſe of Iſrael; but had he not been more than an ordinary prophet, he could not have abrogated the moſt trivial ceremony of it, nor even extended the ſenſe of any of its moral precepts; for their great lawgiver had told them, that "the Lord their God would raiſe up unto them but one Prophet, like unto him, to whom they ſhould hearken ‡." That Prophet was by themſelves underſtood to be the Meſſiah, whom they expected to tell them all things. It was neceſſary therefore that Jeſus, as he taught ſome new doctrines, and plainly indicated that greater changes would ſoon be introduced, ſhould vindicate his claim to that exalted character which alone could authoriſe him to propoſe innovations. This he did in the ampleſt manner, by fulfilling prophecies and working miracles (ſee MIRACLE and PROPHECY); ſo that the unprejudiced part of the people readily acknowledged him to be of a truth "that prophet which ſhould come into the world—the Son of God, and the King of Iſrael."

171
His strict obedience to the law.

He did not, however, make any change in the national worſhip, or aſſume to himſelf the ſmalleſt civil authority. He had ſubmitted to the rite of circumciſion, and ſtrictly performed every duty, ceremonial as well as moral, which that covenant made incumbent upon other Jews; thus fulfilling all righteouſneſs. Though the religion which he came to propagate was in many reſpects contrary to the ritual law, it could not be eſtabliſhed, or that law abrogated, but in conſequence of his death, which the ſyſtem of ſacrifices was appointed to prefigure; and as his kingdom, which was not of this world, could not commence till after his reſurrection, he yielded during the whole courſe of his life a cheerful obedience to the civil magiſtrate, and wrought a miracle to obtain money to pay the tribute that was exacted of him. Being thus circumſtanced, he choſe from the loweſt and leaſt corrupted of the people certain followers, whom he treated with the moſt endearing familiarity for three years, and commiſſioned at his departure to promulgate ſuch doctrines as, conſiſtently with the order of the divine diſpenſations, he could not perſonally preach himſelf. With theſe men, during the courſe of his miniſtry on earth, he went about continually doing good, healing the ſick, caſting out devils, raiſing the dead, reproving vice, preaching righteouſneſs, and inſtructing his countrymen, by the moſt perfect example which was ever exhibited in the world, of whatſoever things are true, or honeſt, or juſt, or pure, or lovely, or of good report. The Scribes and Phariſees, however, finding him not that conqueror whom they vainly expected, becoming envious of his reputation among the people, and being filled with rancour aginſt him for detecting their hypocritical arts, delivered him up to the Roman governor, who, though convinced of his innocence, yielded to the popular clamour, and crucified him between two thieves, as an enemy to Cæſar.

|| St Luke x. 25—38.

† Jeremiah xxxi. 31, &c.

‡ John iv. 25—27.

‡ Deut. xviii. 15.

172 He voluntarily died for us.

Juſt before he expired, he ſaid, It is finiſhed, intimating that the purpoſe was now fulfilled for which he had come into the world, and which, as he had formerly told his diſciples, "was not to be miniſtered unto but to miniſter, and to give his life a ranſom fot many ||." For his blood, as he aſſured them at the inſtitution of the Euchariſt, "was to be ſhed for the remiſſion of ſins." That Chriſt died voluntarily for us, the juſt for the unjuſt, and that "there is none other name under heaven given among men whereby we muſt be ſaved;" is the uniform doctrine of the prophets who foretold his coming, of John the Baptiſt who was his immediate harbinger, and of the apoſtles and evangeliſts who preached the goſpel after his aſcenſion into heaven. Thus Iſaiah ſays of the Meſſiah †, that "he was wounded for our tranſgreſſions, and bruiſed for our iniquities; that the chaſtiſement of our peace was upon him, and that with his ſtripes we are healed; that we had all like ſheep gone aſtray, turning every one to his own way, and that the Lord laid on him the iniquity of us all; that he was cut off out of the land of the living, and ſtricken for the tranſgreſſion of God's people; that his ſoul or life was made an offering for ſin; and that he bore the ſin of many, and made interceſſion for the tranſgreſſors." The Baptiſt, "when he ſaw Jeſus coming unto him, ſaid to the people, Behold the Lamb of God, which taketh away the ſin of the world;" plainly intimating that his death was to be a ſacrifice, ſince it was only as a ſacrifice that the Jews could form any conception of a lamb taking away ſin. The epiſtles of St Paul are ſo full of the doctrine of Chriſt's ſatisfaction, that it is needleſs from his writings to quote particular texts in proof of it. He tells the Romans, that Jeſus Chriſt was ſet forth to be a propitiation through faith in his blood; that he was delivered for our offences, and "raiſed again for our juſtification; that he died for the ungodly; and that God commendeth his love towards us, in that while we were yet ſinners Chriſt died for us." He aſſures the Corinthians that Chriſt died for all; that they who live ſhould not henceforth live unto themſelves, but to him who died for them and roſe again; and that God made him to be ſin for us who knew no ſin, that we might be made the righteouſneſs of God in him." He informs the Galatians, that Chriſt "gave himſelf for our ſins, that he might deliver us from this preſent evil world, according to the will of God and our Father; and that he redeemed us from the curſe of the law, being made a curſe for us." St Peter and St John talk the very ſame language; the former teaching us, that "Chriſt ſuffered for us, and bare our ſins in his own body on the tree †; the latter, that the blood of Jeſus Chriſt cleanſeth us from all ſin, and that he is the propitiation for our ſins; and not for our's only, but alſo for the ſins of the whole world ‡." That he came into the world for the purpoſe of ſuffering, appears from his own words: for "no man (ſaid he§) taketh my life from me, but I lay it down of myſelf: I have power to lay it down, and I have power to take it again. This commandment have I received from my Father." And that he voluntarily laid it down for mankind, is evident from his calling himſelf the Good Shepherd, and adding, that "the Good Shepherd giveth his life for the ſheep*."

173 Different opinions reſpecting the nature and extent of the benefit reaped from his death.

That Chriſt died for the benefit of the human race, is a truth ſo apparent from theſe texts, and from many others which might be quoted, that no man profeſſing Chriſtianity has hitherto called it in queſtion. Very different opinions have been formed indeed concerning the nature and extent of that benefit, and the means by which it is applied; but that the paſſion and death of the bleſſed Jeſus were eſſential parts of his miniſtry on earth, has never been controverted, unleſs perhaps by thoſe modern Unitarians who have corrected the errors of the apoſtles and evangeliſts, and with whoſe writings we acknowledge ourſelves to be very little acquainted. That on the croſs he made ſatisfaction to his Father for the ſins of the world, is the general belief of Chriſtians; but preſumptuous men, aiming at being wiſe beyond what is written, have ſtarted a thouſand idle queſtions concerning the neceſſity of ſuch ſatisfaction, and the manner in which it was made. Some limiting the power and mercy of the Omnipotent, have dared to affirm that God *could not* have pardoned man without receiving full ſatisfaction for his offences; that nothing but the ſhedding of the blood of Chriſt could make that ſatisfaction; that his death was indeed ſufficient to atone for a thouſand worlds; that, however, he did not die for all mankind, but only for a choſen few, ordained to eternal life by a ſecret decree before the foundation of the world; and that the reſt of the race are paſſed by, and doomed to eternal perdition, for the glory of God's juſtice. Others, convinced by every thing around them that the Creator and Governor of the univerſe is a being of infinite benevolence, whoſe only end in giving life muſt have been to communicate happineſs, have contended, that no atonement whatever could be neceſſary to obtain from him the forgiveneſs of ſin upon ſincere repentance; that it is contrary to all our notions of juſtice to puniſh the innocent for the guilty; and that therefore the death of Chriſt, though an eſſential part of his miniſtry, could not be neceſſary, but at the moſt expedient.

We enter not into theſe impious debates. The Scriptures have nowhere ſaid what God could or could not do; and on this ſubject we can know nothing but what they have taught us. That "we are reconciled to God by the death of his Son," is the principal doctrine of the New Teſtament; and without preſuming to limit the power, the mercy, or the wiſdom, of him who created and ſuſtains the univerſe, we ſhall endeavour to ſhow that it is a doctrine worthy of all acceptation. In doing this, we ſhall ſtate impartially the opinions which men really pious have held reſpecting the form or manner in which Chriſt by his death made ſatisfaction to God for the ſins of the world; and we hope that our readers, diſregarding what may be prejudices in us, will embrace that opinion which ſhall appear to them moſt conſonant to the general ſenſe of ſacred Scripture.

174 Opinions of the Calviniſts

The ſtricteſt adherents to the theological ſyſtem of Calvin, interpreting literally ſuch texts of Scripture as ſpeak of his being *made ſin* for us, of his *bearing our ſins in his own body on the tree*, and of the Lord's *laying on him the iniquity of us all*, contend, that the ſins of the elect were lifted off from them and laid upon Chriſt by *imputation*, much in the ſame way as they think the ſin of Adam is imputed to his poſterity. "By bearing the ſins of his people (ſays Dr Gill*), he took them off from them, and took them upon himſelf, bearing or carrying them as a man bears or carries a burden on his ſhoulders. There was no ſin *in* him inherently, for if there had, he would not have been a fit perſon to make ſatisfaction for it; but ſin was *put* upon him by his Divine Father, as the ſins of the Iſraelites were put upon the ſcape-goat by Aaron. No creature (continues he) could have done this; but the LORD hath laid on him, or made to meet on him, the iniquity of us all, not a ſingle iniquity, but a whole maſs and lump of ſins collected together, and laid as a common burden upon him; even the ſins of all the elect of God. This phraſe of laying ſin on Chriſt is expreſſive of the *imputation* of it to him; for it was the will of God not to impute the tranſgreſſions of his elect to themſelves, but to Chriſt, which was done by an act of his own; for he hath made him to be ſin for us; that is, by *imputation*, in which way we are made the righteouſneſs of God in him;

|| St Matth. xx. 28.

† Chap. liii.

† 1 Peter ii. 21. and 24.

‡ 1 John i 7 ii. 2.

§ St John x. 18.

* Ibid. ver. 11.

* Body of Divinity, vol. ii book iii. chap. v. § 4.

that being imputed to us by him as our ſins were to Chriſt. The ſenſe (ſays our author) is, a charge of ſin was brought againſt him as the ſurety of his people. He was numbered with the tranſgreſſors; for bearing the ſins of many, he was reckoned as if he had been a ſinner himſelf, ſin being *imputed* to him; and was dealt with as ſuch. Sin being found upon him by *imputation*, a demand of ſatisfaction for ſin was made, and he anſwered it to the full. All this was with his own conſent. He *agreed* to have ſin laid upon him, and *imputed* to him, and a charge of it brought againſt him, to which he engaged to be reſponſible; yea, he himſelf took the ſins of his people upon him; ſo the evangeliſt Matthew has it. 'Himſelf took our infirmities, and bore our ſickneſſes †.' As he took the nature of men, ſo he took their ſins, which made his fleſh to have *the likeneſs of ſinful fleſh*, though it really was not ſinful. What Chriſt bore being laid upon him, and imputed to him, were *ſins* of all ſorts, original and actual; ſins of every kind, open and ſecret, of heart, lip, and life; all acts of ſin committed by his people, for he has redeemed them from all their iniquities; and God, for Chriſt's ſake, forgives all treſpaſſes, his blood cleanſes from all ſin, and his righteouſneſs juſtifies from all; all being imputed to him as that is to them. Bearing ſin ſuppoſes it to be a burden; and indeed it is a burden too heavy to bear by a ſenſible ſinner (E). When ſin is charged home upon the conſcience, and a ſaint groans, being burdened with it, what muſt that burden be, and how heavy the load which Chriſt bore, conſiſting of all the ſins of all the elect from the beginning of the world to the end of it? and yet he ſunk not, but ſtood up under it; failed not, nor was he diſcouraged, being the mighty God, and the Man of God's right-hand, made ſtrong for himſelf."

175 Objected to

To the Arminians or Remonſtrants, this doctrine of the imputation of the ſins of men to the Son of God appears as abſurd as the ſimilar doctrine of the imputation of the ſin of Adam to his unborn poſterity; and it is certainly attended with conſequences which have alarmed ſerious Chriſtians of other denominations.

Were it poſſible in the nature of things, ſays the Arminian, to transfer the guilt of one perſon to another, and to lay it upon him as a burden, it could not be done without violating thoſe laws of equity which are eſtabliſhed in the ſcripture and engraven on the human heart. But this is not poſſible. To talk of lifting lumps of ſin or transferring them like burdens from the guilty to the innocent, is to utter jargon, ſays he, which has no meaning; and we might with as much propriety ſpeak of lifting a ſcarlet colour from a piece of cloth and laying it on the ſound of a trumpet, as of literally lifting the ſins of the elect from them and laying them on Chriſt. Guilt is ſeated in the mind; and no man can become a ſinner but by an act of volition. If Chriſt therefore *really* took upon him the ſins of his people, he muſt have deliberately formed a wiſh to have actually *committed* all thoſe ſins; but ſuch a wiſh, though it would have made him inherently guilty, and therefore incapable of ſatisfying for ſin, could not have cancelled deeds that were done before he was born, or have made thoſe innocent who had really been ſinners. A deed once done cannot be undone; a volition which has been formed cannot be annihilated. By ſincere repentance, the habitual diſpoſitions are indeed changed, and thoſe who have been ſinners become objects of mercy; but no power can recal the hours that are paſt, or make thoſe actions which have been performed to have been not performed. To remove guilt from the ſinner and lay it upon the innocent may therefore be ſafely pronounced impoſſible even for Omnipotence itſelf, for it implies that a thing may be and not be at the ſame inſtant of time; and the doctrine which teaches that this removal was made from the elect to Chriſt, is an imagination of yeſterday, which has no countenance from ſcripture, and is contrary to the eſtabliſhed conſtitution of things. Thoſe who imagine that guilt may be propagated from father to ſon, have ſomething like an argument to urge for the imputation of Adam's ſin to his numberleſs poſterity; for all the men and women who have by ordinary generation been introduced into the world, have undoubtedly derived their nature from the primeval pair. But Chriſt did not derive his nature from the *elect*, that their ſins ſhould be communicated to him; nor, as he was miraculouſly conceived by the Holy Ghoſt, can we attribute to him any degree of that *taint* which is ſuppoſed to have been conveyed from Adam to all the other generations of men.

176 Texts on which they are built explained.

Nothing more, therefore, can be meant by "Chriſt's being made ſin for us," and "bearing our ſins in his own body on the tree," or by God's "laying upon him the iniquity of us all," than that by his ſufferings we are freed from the puniſhment of our ſins; it being in ſcripture a common figure of ſpeech, as even Dr Gill has ſomewhere acknowledged, to denote by the word *ſin* the *conſequences* of ſin. That this figure is uſed in thoſe texts from which he infers that Chriſt took the ſins of the elect upon himſelf, is evident from the verſe which he quotes from the goſpel of St Matthew; in which it is ſaid, that "himſelf took our infirmities and bore our ſickneſſes." The ſickneſſes and infirmities there alluded to are the leproſy, the palſy, the fever, and demoniacal poſſeſſions: but when our bleſſed Lord cured theſe diſeaſes, ſurely he did not by his omnipotent word lift them off from the patients and take them on himſelf, ſo as actually to become a leper, a paralytic, and a dæmoniac, or even to be reckoned as ſuch either by the multitude, or by the prieſts whoſe duty it was to take cognizance of every legal uncleanneſs*. And if his inveterate enemies did not *impute* to him the leproſy when he removed that plague from others, why ſhould it be ſuppoſed that his own Father, to whom he was at all times well-pleaſing, *imputed* to him thoſe ſins of which, by his ſufferings, he removed the puniſhment from thoſe who were guilty? To impute to a perſon any action, whether virtuous or vicious, which he did not perform, can proceed only from ignorance, or malice, or partiality; but God is no reſpecter of perſons, and from ignorance and malice he is removed to an infinite diſtance. It is indeed an undoubted truth, that "the Lord Jeſus, by his perfect obedience and ſacrifice of himſelf, which he through the eternal ſpirit once offered up unto God, hath fully ſatisfied the juſtice of his Father; and purchaſed not only reconciliation, but an everlaſting inheritance in the kingdom of heaven for all thoſe whom the Father hath given him †;" but that he actually took upon himſelf the ſins of mankind, or that thoſe ſins were imputed to him by God, who puniſhed him as a perſon whom he conſidered as guilty, is a doctrine equally injurious to the juſtice of the Father and to the immaculate purity of the Son.

177 They have probably contributed to make Socinius deny the doctrine of redemption.

The earneſtneſs with which this doctrine was inculcated by ſome of the earlieſt reformers, and the impoſſibility of admitting it, which every reflecting and unprejudiced mind muſt feel, was probably one of the cauſes which drove Socinius

‡ Chap. viii. 17.

* Levit. xiii.

† Confeſſion of Faith, chap. viii. § 5.

(E) By the phraſe *a ſenſible ſinner*, the learned author means a ſinner who is not paſt feeling, but has a conſcience alive to the ſenſe of remorſe.

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cinus and his followers to the other extreme of denying Chriſt's ſatisfaction altogether, and conſidering his death as nothing more than that of an ordinary martyr, permitted for the purpoſe of atteſting the truth of his doctrine, and paving the way for his reſurrection, to confirm the great promiſe of immortality. According to theſe men, forgiveneſs is freely diſpenſed to thoſe who repent, by the eſſential goodneſs of God, without regard to the merit or ſufferings of any other being; and the goſpel is ſaid to ſave from ſin, becauſe it is the moſt perfect leſſon of righteouſneſs. The great objection of *Crellius* to the doctrine of the ſatisfaction is, that it is a hindrance to piety; for if Chriſt has payed the whole debt, he thinks that we muſt have nothing to do, as nothing more can be required of us. And if it were indeed true that our ſins are imputed to Chriſt, and his righteouſneſs imputed to us, this objection would be inſurmountable; for God could not juſtly exact a double puniſhment for the ſame ſin, or inflict miſery upon thoſe to whom he imputes perfect righteouſneſs. But as to this imaginary transferring of virtues and vices from one perſon to another, the Chriſtian ſcriptures give no countenance; ſo they nowhere call the death of Chriſt a *ſatisfaction* for the ſins of men. The term has indeed been long in uſe among divines, and when properly explained it may be retained without any danger; but in treating of this ſubject, it would perhaps be more prudent to reſtrict ourſelves to the uſe of ſcripture language, as the word *ſatisfaction* carries in it the ideas of a debt paid and accepted; whereas it is ſaid by St Paul, that "eternal life is the *gift* of God through Jeſus Chriſt our Lord; and that we are juſtified *freely by his grace* through the redemption that is in Jeſus Chriſt, whom God hath ſet forth to be a propitiation through faith in his blood."

178 The death of Chriſt reſtored to mankind what they had loſt in Adam.

To clear up this matter, and attain adequate notions of redemption and juſtification, it will be neceſſary to look back to the fall of our firſt parents; for the great purpoſe for which Chriſt was promiſed, and for which he came into the world, was by bruiſing the head of the ſerpent, to reſtore mankind to the inheritance which they had loſt through the tranſgreſſion of Adam. This is apparent not only from the original promiſe made to the woman, but alſo from different paſſages in the epiſtles of St Paul, who expreſsly calls Chriſt the ſecond Adam, and ſays, that, "as by the offence of one, judgment came upon all men to condemnation; even ſo by the righteouſneſs of one, the free-gift came upon all men unto juſtification of life;" that "as by one man's diſobedience many were made ſinners, ſo by the obedience of one ſhall many be made righteous;" and that, "as in Adam all die, even ſo in Chriſt ſhall all be made alive." Hence it was that John the Baptiſt, when he ſaw Jeſus coming to him, ſaid to his diſciples†, "Behold the Lamb of God which taketh away, not the *ſins*, but the *ſin* of the world," evidently alluding to Adam's ſin and its conſequences, ſince no other ſin was ever committed of which the conſequences extend to the whole world.

This being the caſe, it is undeniable, that whatever we loſt in the firſt Adam is reſtored to us by the ſecond; and therefore they who believe that the puniſhment denounced againſt eating the forbidden fruit was death *corporal*, *ſpiritual*, and *eternal*, muſt believe that we are redeemed from all theſe by Chriſt: who having "appeared once in the end of the world to put away ſin by the ſacrifice of himſelf, died for us, that whether we wake or ſleep we ſhould live together with him*." If the image of God in which man was created was loſt by the breach of the firſt covenant, it is more than reſtored to us "by the Mediator of a better covenant, which is eſtabliſhed upon better promiſes;" if by the ſin of Adam we were utterly indiſpoſed, diſabled, and made oppoſite to all that is ſpiritually good, and wholly inclined to all evil, and that continually, we are freed from that dreadful curſe by "our ſaviour Jeſus Chriſt, who gave himſelf for us, that he might redeem us from all iniquity, and purify to himſelf a peculiar people zealous of good works†;" and if for our ſhare in the firſt tranſgreſſion we be juſtly liable to all puniſhments in this world and in that which is to come, the apoſtle aſſures us, that "when we were enemies we were reconciled to God by the death of his Son, becauſe that God was in Chriſt reconciling the world to himſelf, not imputing their treſpaſſes unto them‡." As Jeſus is "the Lamb ſlain in the divine decree from the foundation of the world," theſe beneficial conſequences of his death have been extended by a retroſpective view to all in every age whoſe names are written in the book of life, though it is abſurd to ſuppoſe that he literally took their ſins upon him, and impious to imagine that he ſuffered under the imputation of ſin.

179 Moderate Calviniſts and Remonſtrants of the ſame opinion.

Such is the general doctrine of redemption, as it is taught by the more moderate Calviniſts and more moderate Remonſtrants; for moderate Chriſtians of all denominations, though they expreſs themſelves differently, have nearly the ſame views of the fundamental articles of their common faith. It muſt not, however, be concealed, that many divines of great learning and piety, though removed to an infinite diſtance from the ſchool of Socinus, contend ſtrenuouſly againſt the doctrine of vicarious atonement for actual tranſgreſſions of the moral law. Theſe are the more zealous Arminians, who deny that we inherit any moral taint or intellectual weakneſs from our firſt parents, whom they believe never to have been in a ſtate of greater perfection than many of their poſterity who are called *degenerate*.

180 Doctrine of the more zealous Arminians.

According to them, we loſt nothing by the fall of Adam but our title to eternal life or perpetual exiſtence, together with thoſe graces of the Holy Spirit which were beſtowed under the firſt covenant to train mankind for the ſociety of heaven; and as eternal life and ſupernatural grace conſtituted one free-gift, not due to the nature of man, or indeed of any created being, they might, when forfeited, be reſtored by any means or upon any condition which ſhould ſeem expedient to the all-wiſe Donor. Theſe means, and that condition, human reaſon cannot indeed diſcover; but it ſeems very fit that they ſhould be different from the means by which moral agents under the law of nature can ſecure to themſelves the favour of their Creator, or recover it when occaſionally loſt. The former depends on arbitrary will and pleaſure, or at leaſt upon no other principles diſcoverable by us; while the latter ariſeth out of the eſtabliſhed and well-known conſtitution of things. Thus moral virtue, comprehending piety, was the condition of that favour and protection which the creature man, in his original ſtate, could claim from his Maker; but obedience to a poſitive command was the condition of the free gift of immortality conferred upon Adam on his introduction into paradiſe. The claim ariſing from the relation between the creature and the Creator is indiſſoluble, becauſe that relation cannot be diſſolved; ſo that the man who, by a tranſgreſſion of the moral law, or of any part of that ſyſtem which is called the *religion of nature*, has forfeited the favour of God, may reaſonably hope to recover it by ſincere repentance and a return to his duty: and nothing but ſuch repentance and reformation can recover it; becauſe, in a moral agent, nothing can be agreeable to God but moral diſpoſitions, which cannot be transferred from one perſon to another, and for the want of which nothing can atone. Our virtues are not required nor our vices prohibited, as if the one could profit and the other injure him who created us; "for is it any *pleaſure* to the Almighty that we are righteous? Or is it

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† Ch. i. ver. 3.

* Heb. ix. 6. 1 Theſ. 10.

† Titus ii. 14.

‡ Rom. v. 10. 2 Cor. v. 19.

gain to him that we make our ways perfect? Will he reprove us for *fear* of us?" No! He commands us to be virtuous, and forbids us to be vicious, only becauſe virtue is neceſſary to our own happineſs, and vice productive of everlaſting miſery.

Were an immoral man to be introduced into the ſociety of angels and juſt men made perfect, he would not experience in that ſociety what we are taught to expect from the joys of heaven; becauſe to ſuch joys his acquired diſpoſitions would be wholly repugnant. Nor could the ſufferings of any perſon whatever, or the *imputation* of any extrinſic righteouſneſs, make that mind which had long been immerſed in the groſſeſt ſenſuality reliſh the intellectual and refined enjoyments of heaven; or the man who had been the habitual ſlave of envy, malice, and duplicity, a fit inhabitant of that place where all are actuated by mutual love. On the other hand, ſay the divines whoſe doctrine we are now detailing, it is impoſſible to ſuppoſe that the Father of mercies, who knows whereof we are made, ſhould have doomed to eternal miſery any moral agent who had laboured through life to ſerve him in ſincerity and in truth; or that any atonement could be neceſſary to redeem from the pains of hell the man whoſe pious and virtuous diſpoſitions have through penitence and prayer become ſuited to the ſociety of heaven. Unſinning perfection never was nor ever could be expected in man. He is brought into the world free indeed from vice, but equally deſtitute of virtue; and the great buſineſs of his life is to guard his mind from being polluted by the former, and to acquire diſpoſitions habitually leading to the practice of the latter. Till theſe habits be fairly formed, it ſeems impoſſible that he ſhould not ſometimes deviate from the paths of rectitude, and thereby incur a temporary forfeiture of the divine favour; but the very conſtitution of his mind, and the purpoſe for which he is placed in a ſtate of probation, ſhow that the divine favour thus forfeited can be recovered only by repentance and reformation.

181 That Chriſt died to redeem us from the power of the grave.

Widely different, however, is the caſe with reſpect to the forfeiture and recovery of a free gift, to which man has no natural claim. When the condition is broken on which ſuch a gift was beſtowed, repentance can be of no avail; it muſt be either irrecoverably loſt, or reſtored by the mere good pleaſure of the giver. Immortality or perpetual exiſtence is a gift which upon certain terms was freely beſtowed upon the human race, and forfeited by the tranſgreſſion of their firſt parent violating thoſe terms. It was reſtored by the free grace of God, who was pleaſed to ordain, that "ſince by man came death, by man ſhould alſo come the reſurrection of the dead; for as in Adam all die, even ſo in Chriſt ſhall all be made alive." "Hence the apoſtle, writing to the Romans of the benefits of being the children of God, and joint-heirs with Chriſt, ſummeth up thoſe benefits with the reſurrection from the dead." For the creature, *i. e.* mankind, was made ſubject (ſays he*) to vanity or death, not willingly, but by reaſon of him who has ſubjected the ſame in hope; becauſe the creature itſelf alſo ſhall be delivered from the bondage of corruption into the glorious liberty of the children of God. For we know that the whole creation groaneth, and travaileth in pain together until now: and not only *they* but *ourſelves* alſo, who have the firſt fruits of the ſpirit, even we ourſelves, groan within ourſelves, waiting for the adoption, viz. *the redemption of our body* (F). That this redemption of our body is the conſequence of the ſacrifice of Chriſt, is taught in the moſt explicit terms in the epiſtle to the Hebrews; of which the inſpired author informs us, that foraſmuch as the children are partakers of fleſh and blood, he alſo himſelf likewiſe took part of the ſame; that through *death* he might deſtroy him that had the power of death, that is the devil; and deliver them, who through fear of death were all their life-time ſubject to bondage†." A vicarious atonement made with this view, the divines, whoſe theory we are now conſidering, acknowledge to be perfectly rational and conſiſtent with the ſtricteſt juſtice. "The law of nature (ſay they§) allows not of vicarious atonements; but ordains that the man who tranſgreſſeth ſhall himſelf bear the puniſhment of his iniquity; a puniſhment which no man deſerves for the faults of another, unleſs he be partaker of the guilt by joining in the tranſgreſſion." And in proof of this their opinion, they appeal to the words of God himſelf, declaring to Moſes,—"Whoſoever hath ſinned againſt me, him will I blot out of my book*." But when the free gift of immortality was loſt, it was with great wiſdom, ſay they, that God reſtored it through a Mediator who ſhould make atonement by his blood for the breach of the firſt covenant; ſince ſuch a mediation implies that the gift reſtored is merely of grace, to the attainment of which man could no further co-operate than by his hopes and wiſhes.

* Rom. viii. 20—24.

† Heb. ii. 14, 15.

§ Warburton's Div. Leg. b. ix. and Law's Conſiderations on the Theory of Religion, part iii.

* Exod. xxxii. 31—34.

182 An objection.

To this view of redemption, and indeed to every view of it which we yet have taken, an objection forces itſelf upon the mind. Throughout the New Teſtament LIFE AND IMMORTALITY are conſidered as a *free gift*, and called ſo in expreſs words by St Paul*. To the ſcheme under conſideration it is eſſential to conſider them as ſuch; and yet we know that a large price was paid for them, as St Paul likewiſe acknowledges, when he twice tells the Corinthians that they were bought with a price§.

* Rom. v. 15.

§ 1 Cor. vi. 20. vii. 23.

183 Obviated.

"To clear up this matter (ſays biſhop Warburton), and to reconcile the apoſtle to himſelf who certainly was not defective either in natural ſenſe or artificial logic, let us once again remind the reader, that life and immortality beſtowed on Adam in paradiſe was a FREE *gift*, as appears from the hiſtory of his creation. As a *free gift*, it was taken back by the Donor when Adam fell; to which reſumption our original natural rights are not ſubject, ſince natural religion teacheth, that ſincere repentance alone will reinſtate us in the poſſeſſion of thoſe rights which our crimes had ſuſpended. So that when this free gift, forfeited by the *firſt* Adam, was recovered by the *ſecond*, its nature continuing the ſame, it muſt ſtill remain a *free gift*—a gift to which man, by and at his creation, had no claim; a gift which natural religion did not beſtow. But if miſled by meaſuring this *revealed myſtery* of human redemption by the ſcant idea of human tranſactions, where a *free gift* and *purchaſed benefit* are commonly oppoſed to one another, yet even here we may be able to ſet ourſelves right, ſince, with regard to man, the character of a *free gift* remains to *immortality reſtored*. For the price paid for forfeited man was not paid by him, but by a Redeemer of divine extraction, who was pleaſed, by participating

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(F) That by the words *creature* and *creation* the apoſtle here means all mankind, and by *vanity* and *corruption*, death, the reader will find proved by Dr Whitby, in his note on the place, with a ſtrength of argument which cannot be ſhaken; and that the whole creation, the Gentiles as well as the Jews, groaned and travailed in pain together under the apprehenſion of death, is apparent from the writings of Cicero, who always ſeems doubtful whether death be a good or an evil; and from the lamentation of Hezekiah, when deſired by the prophet to ſet his houſe in order becauſe he ſhould die and not live.

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ticipating of man's nature, to ſtand in his ſtead. Hence the ſacred writers ſeeing, in this caſe, the perfect agreement between a *FREE GIFT* and a *PURCHASED POSSESSION*, call it ſometimes by the one and ſometimes by the other name*."

184 The death of Chriſt an atonement only indirectly for actual ſin.

A reſtoration to life and immortality from that ſtate of unconſciouſneſs or extinction as living agents, to which all mankind were doomed in conſequence of the fall of Adam, is that great ſalvation which we have obtained through the blood of our Redeemer; and according to the theologians whoſe theory we are now conſidering, it was the only thing in the divine intention when the promiſe was given to the firſt mother that the ſeed of the woman ſhould bruiſe the head of the ſerpent. But though they contend thus earneſtly that the death of Chriſt does not operate *directly* as an atonement for the *actual* ſins of men, they admit that it does ſo *indirectly* and by neceſſary conſequence, ſince it gives opportunities for repentance and newneſs of life, which under the firſt covenant they did not enjoy. Had a man under that covenant tranſgreſſed any moral precept, he would of courſe have forfeited the favour of his God, and either been ſubjected to puniſhment or to a long courſe of repentance; but ſuppoſing the efficacy of repentance under the law of nature to be what they ſuppoſe it to be, he might before it was perfected have loſt his exiſtence by the eating of the forbidden-fruit; and thus his penitence or puniſhment have ended in everlaſting death. This can never be the iſſue of things under the new covenant, which, by the death of Chriſt, ſecures immortality to man, and gives to him opportunities, as long as he ſhall be in a ſtate of probation, of recovering the divine favour when forfeited, whether by a moral tranſgreſſion or a temporary violation of the peculiar condition of the covenant. Hence they admit the truth of the apoſtle's doctrine, that we are gainers by the fall of Adam and the redemption wrought by Chriſt; which will appear when we come to conſider their notions of Chriſtian juſtification. In the mean time it may be proper to obſerve, that they conſider it as no ſmall confirmation of their opinion, that it tends to put an end to the long agitated diſputes concerning the *extent* of redemption, and to reconcile paſſages of ſcripture which, on the commonly received theories both of Calviniſts and Arminians, ſeem to be at variance with each other.

185 According to the Calviniſts Chriſt died only for the elect.

It is well known to be one of the fundamental doctrines of the Calviniſtic ſchool, that "none are *redeemed* by Chriſt, effectually called, juſtified, adopted, ſanctified, and ſaved, but the elect only†; and if the notions of redemption, which, in the end of the laſt century, were very generally embraced, be admitted as juſt, it will not be eaſy to overturn the arguments by which that doctrine is ſupported. Such of them as are connected with the great queſtion of election and reprobation, and enter into the deciſion of it, we have ſtated in another place (ſee PREDESTINATION, n° 14); but it is farther argued ‡, that the doctrine of *univerſal* redemption reflects on the wiſdom, the juſtice, and the power of God, and robs him of his glory.

The ſcriptures aſſure us that all men ſhall not be ſaved; but how can this be, if Chriſt died for all, and the ſcheme of ſalvation by his death was formed by infinite wiſdom? The Arminians indeed ſay, that thoſe who fail of ſalvation, fail through their own fault in not performing the conditions required of them; but God either *knew* or knew *not* that ſuch men would not perform thoſe conditions. If he knew it not, his knowledge is limited; if he did know it, where was his wiſdom in providing a ſcheme of redemption for men to whom he was aware that it would be of no benefit? "God, we are told, is righteous in all his ways and holy in all his works;" but there is no righteouſneſs in making Chriſt bear the ſins of *all* men, and ſuffer the puniſhment due to them, if any one of thoſe men ſhall be afterwards puniſhed everlaſtingly. If Chriſt has already paid the debts of the whole world, it cannot be juſt to caſt a ſingle inhabitant of the world into the priſon of hell, there to be detained till he ſhall again have paid the uttermoſt farthing. "The Lord's hand is not ſhortened that it cannot ſave;" for he is and always will be the ſame Almighty power that he was from eternity; but if by the divine decree Chriſt died for all men, and yet all men ſhall not be ſaved, it would appear that man is mightier than his Maker! The ultimate end of God in the redemption of man is admitted to have been his own glory; but if any individual of the human race, who was redeemed by Chriſt, ſhall not be ſaved, God will ſo far loſe his end, and be deprived of his glory. For, if this were the caſe, where would be the glory of God the Father in forming a ſcheme which, with reſpect to multitudes, does not ſucceed? and where would be the glory of the Son of God, the Redeemer, in working out the redemption of men who are yet not to be ſaved by him? and where would be the glory of the ſpirit of God, if redemption were not by him effectually applied to every individual for whom it was wrought? By ſuch arguments as theſe do the Calviniſts oppoſe the ſcheme of univerſal redemption, and contend that Chriſt died only for the *elect*, or ſuch as ſhall be placed on his right hand at the day of judgment. This notion of a limited redemption, as they think it more worthy of the ſovereignty of God, they believe to be taught by our Saviour himſelf, when he ſaith *, "All that the Father *giveth* me ſhall come to me; and him that cometh to me, I will in nowiſe caſt out. For I came down from heaven, not to do mine own will, but the will of him that ſent me. And this is the Father's will who hath ſent me, that of all which he hath *given* me I ſhould loſe nothing, but ſhould raiſe it up again at the laſt day."

186 According to the Arminians he died for all men.

The Arminians, on the other hand, contend, that it is impious to limit the effects of Chriſt's death to a choſen few, ſince it appears from ſcripture, that by the decree and intention of his Father he taſted death for every man, that all, without exception, might through him obtain remiſſion of their ſins. Thus our Lord himſelf told Nicodemus †, that "as Moſes lifted up the ſerpent in the wilderneſs, even ſo muſt the Son of Man be lifted up; that *whoſoever* believeth in him, ſhould not periſh, but have everlaſting life. For God ſo loved the *world*, that he gave his only begotten Son, that whoſoever believeth in him ſhould not periſh, but have everlaſting life. For God ſent not his Son into the world to condemn the world, but that the *world* through him might be ſaved." In perfect conformity with the doctrine of his divine Maſter, St Paul teaches ‡, that "Chriſt died for *all*; that God was in Chriſt reconciling the *world* to himſelf, not imputing their treſpaſſes unto them;" that "he will have *all* men to be ſaved, and to come unto the knowledge of the truth;" that "Chriſt gave himſelf a ranſom for *all*;" and that "Jeſus was made a little lower than the angels, that by the grace of God he ſhould taſte death for *every man*." The very ſame thing is taught by St Peter and St John, when the former ſays §, that "the Lord is not willing that *any* ſhould periſh, but that *all* ſhould come to repentance;" and the latter ‖, that "Jeſus Chriſt the righteous is the propitiation for our ſins; and not for our's only, but for *the whole world*."

Upon theſe texts, without any commentary, the Arminians are willing to reſt their doctrine of univerſal redemption; though they think that a very ſtrong additional argument for its truth ariſes from the numberleſs abſurdities which flow from the contrary opinion. Thus, ſay they *, the apoſtles were commanded by our Saviour † to "go into *all* the world and preach the goſpel to *every creature*," and

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* Div. Leg. book 9. ch. 2.

† Confeſſion of Faith of the Church of Scotland, ch. iii. § 6.

‡ Gill's Body of Divinity, vol. ii book 3. ch. 3.

* John vi. 37—40.

† John iii. 14—18.

‡ 2 Cor. v 14—20. 1 Tim. ii. 4—7. Heb. ii. 9.

§ 2 Peter iii. 9.

‖ 1 John ii. 2.

* Limborch's Theologia Chriſtiana, Eng. Tranſ. book 4. ch. 3.

† St Mark xvi. 15, 16.

and all who hear it preached are required to believe it: but no man, as the Calviniſts themſelves confeſs, can believe the goſpel as a Chriſtian, without believing that Chriſt *died for him;* and therefore, if it be true that Chriſt died only for the *elect*, a great part of mankind are required to believe a lie, and a falſity is made the object of divine faith! Again, if Chriſt did not die for *all*, then no man can be ſure that he is bound to believe in Chriſt when preached to him; nor can any man be juſtly condemned for infidelity: which is not only abſurd in itſelf, but directly contrary to what we are taught by our bleſſed Lord, who aſſures us*, that unbelief is the cauſe of condemnation. Laſtly, if Chriſt died not for *all*, then is it certain that he cannot claim dominion *over all* in *conſequence* of his *death* and *reſurrection;* but St Paul ſays expreſsly †, that "to *this end* Chriſt both *died*, and *roſe*, and *revived*, that he might be the Lord both of the *dead* and *living*." The Arminians acknowledge, that though Chriſt died for all, there are many who will not be ſaved; for, ſay they ‡, the death of Chriſt did not literally pay the debts incurred by ſinners, but only obtained for them the gracious covenant of the goſpel, by which all who believe in him, and ſincerely endeavour to work out their own ſalvation with fear and trembling, are entitled to forgiveneſs of ſins and eternal life.

187
Difficulties removed by the modern Arminians.

Such is the ſtate of this controverſy as it was agitated between the Calviniſts and Arminians of the laſt century; but the preſent leaders of this latter ſchool are of opinion, that it never could have been ſtarted, had not both parties miſtaken the purpoſe for which Chriſt died. It is not conceivable, ſay they, that any thing for which the eternal Son of God took upon him human nature, and in that nature ſuffered a cruel and ignominious death, ſhall not be fully accompliſhed; and therefore, if in the divine intention he died to make atonement for the ſins of man actual as well as original, we muſt of neceſſity conclude that thoſe for whom he died ſhall certainly be ſaved. Yet we learn from ſcripture that many ſhall go away into everlaſting puniſhment, though the ſame ſcripture repeatedly aſſures us that Chriſt gave his life a ranſom for *all*, and that he is the propitiation for *the whole world.* To reconcile theſe different paſſages of ſcripture is impoſſible, if we ſuppoſe that he laid down his life to atone for the *actual* tranſgreſſions of men; but if the direct purpoſe of the Godhead in forming this ſtupendous plan of redemption was, that the death of Chriſt ſhould be the ranſom of all from the grave or utter extinction, every difficulty is removed; for we know that all, the wicked as well as the righteous, ſhall through him be raiſed to life at the laſt day. That this was the purpoſe for which he died, they think apparent from the very words quoted by the Calviniſts to prove that redemption was not univerſal; for he declares that it was his Father's will, "that of all which had been given him he ſhould loſe nothing," *not* that he ſhould ſave it all from *future puniſhment*, but only that he "ſhould raiſe it up at the laſt day." When St John calls him a propitiation for our ſins, which, as we have ſeen, the divines whoſe doctrine we are now ſtating hold him to be indirectly, he does not add, as in our tranſlation, for the *ſins* of the whole world, but περι ὁλου του κοσμου, for the whole world, which, by his death, he redeemed from that vanity and corruption under which, according to St Paul, it had groaned from the fall till the preaching of the goſpel. Hence it is that our bleſſed Lord calls himſelf "the reſurrection and the life," and always promiſes to thoſe who ſhould believe in him that though they were dead, yet ſhould they live, and that he would raiſe them up at the laſt day.

Among theſe various opinions reſpecting the deſtination of the death of Chriſt, it belongs not to us to decide. The ſerious reader, diveſting himſelf of prejudice in favour of the ſyſtem in which he has been educated, will ſearch the ſcriptures, and adopt the theory which he ſhall find moſt explicitly taught in that ſacred volume; but as in every ſyſtem it is admitted, that *one purpoſe* for which Chriſt died was to redeem mankind from the everlaſting power of the grave, and bring to light life and immortality, it is of the utmoſt importance to know whether that purpoſe has been fully attained. Death we ſee ſtill triumphing over all the generations of men; and as the ſcriptures give us no hopes of being reſcued from its dominion but through the medium of a reſurrection, ſome ſenſible evidence ſeems neceſſary to evince that a general reſurrection ſhall actually take place. This we are promiſed as one great benefit purchaſed for us by the ſufferings of Chriſt ſacrificed on the croſs. And ſince the price has been *paid*, and paid thus *viſibly*, the nature of the covenant requires that the benefit ſhould be as *viſibly enjoyed* by the perſon whoſe ſufferings obtained it for his brethren. "If the Redeemer himſelf had not been ſeen to enjoy the fruits of the redemption procured, what hopes could have remained for the reſt of mankind? Would not the natural concluſion have been, that the expedient of *redemption*, by the death and ſacrifice of Jeſus, had proved ineffectual?" This is the concluſion which St Paul himſelf draws: "If Chriſt be not riſen (ſays he*), then is our preaching vain, and your faith is alſo vain; ye are yet in your ſins. Then they alſo, who are fallen aſleep in Chriſt, are periſhed—απωλοντο—are loſt, as if they had never exiſted. But now (adds he) is Chriſt riſen from the dead, and become the firſt fruits of them that *ſlept*. For ſince by man came *death*, by man came alſo the *reſurrection* of the dead: For as in Adam *all die*, even ſo in Chriſt ſhall *all be made alive*."—So neceſſarily connected, in the opinion of the apoſtle, is the reſurrection of Chriſt with the very eſſence of Chriſtianity †.

188
One purpoſe for which Chriſt died was to bring to light life and immortality.

Though we have in another place (ſee Resurrection, n° 50.) ſtated ſuch arguments for the truth of this fundamental article of our common faith, as muſt carry conviction to every mind capable of eſtimating the force of evidence; yet as attempts are daily made, ſometimes openly and ſometimes with the moſt inſidious art, to propagate in this nation the French doctrine concerning the eternal ſleep of death (G), we truſt that we ſhall not treſpaſs on the ſerious reader's patience if we here reſume the ſubject, and endeavour to ſhow that it was abſolutely impoſſible for the apoſtles to perſuade the world, or to think of perſuading the world, that their Maſter roſe from the dead, if his reſurrection was not real.

In the article Miracle*, we have ſaid, that "the very *reſolution* of the apoſtles to propagate the belief of falſe miracles in ſupport of ſuch a religion as that which is taught in

* St John iii. 18, 19, and 36.

† Rom. xiv. 9.

‡ Wells's Div. Laws and Covenants, part 2. ch. 3.

* 1 Cor. xv. 15—23.

† Warburton's Sermon on the Reſurrection.

* Vol. XII. p. 173.

(G) Once we intended (ſee Vol. XVI. page 140. note A) to notice in this place ſome of the moſt recent of thoſe attempts, and to expoſe them to that indignation with which, we truſt, the good ſenſe of our countrymen ſhall alway treat ſuch ſophiſtical reaſonings as have no other object than to diminiſh the ſum of human happineſs. On maturer reflection, however, it ſeems more expedient to ſtate one deciſive argument for the reſurrection of Chriſt, which may be ſafely oppoſed to any new ſophiſms of our minute philoſophers, when thoſe which are at preſent in faſhion ſhall have ſunk through their own weakneſs into oblivion, or quietly retired with their authors to that place "Where Tindal dictates and Silenus ſnores." *Dunciad*.

in the New Teſtament, is itſelf as great a miracle as human imagination can eaſily conceive." We ſhall illuſtrate this poſition by the reſurrection of Jeſus, which we are to ſuppoſe the apoſtles reſolving to publiſh as an unqueſtionable fact, whilſt they were conſcious that they themſelves ſtole the body from the ſepulchre, and ſaw it in their cuſtody under the dominion of death. On ſuch an enterpriſe they could not enter without much deliberation; and we may conceive him, to whom the thought of propagating this fable firſt occurred, addreſſing his companions in ſome ſuch terms as the following:—

189 The truth of his reſurrection demonſtrated.

"The Maſter whom we ſerved is now no more, and the magnificent hopes which we had formed with reſpect to him and to ourſelves are blaſted by his death. The time which he fixed for his reſurrection is paſſed; and it is folly to cheriſh any expectation of that event, as we ſee his body which we ſtole a prey to corruption. We muſt therefore either ſeparate and return to our former profeſſions, the obſcurity of which will ſcreen us from the diſgrace of having been deceived; or, remaining united, take the generous reſolution of ſupporting our glory, by ſaying to every body that our Maſter is riſen from the dead, and is the true Meſſiah expected by our nation, and foretold by the prophets. To return to our profeſſions would be cowardly and mean; to propagate the ſtory of the reſurrection will be attended with infinite difficulty and danger; but to deſpiſe danger and to conquer difficulties, is worthy of great ſouls ſuch as ours; and therefore I take it for granted that this is the part which you have all reſolved to act.

"To ſucceed in our glorious enterpriſe, it will be abſolutely neceſſary to admit into our moſt ſecret counſels, not only the ſeventy diſciples whom our Lord ſent before him, in pairs, into every city and place which he viſited *, but alſo that crowd of women‡ who followed him from Galilee, were preſent at his crucifixion, and viſited his ſepulchre; for all theſe perſons are ſo intimately acquainted with every circumſtance of his life and death, that they have it in their power completely to defeat our project in ſpite of our utmoſt art; and that power, it cannot be doubted, they will exert, unleſs admitted to ſhare with us the glory of deceiving the world. The taſk which they and we have to perform is no ordinary one; for we muſt all ſpeak the ſame things, and things which each of us knows to be falſe. Yet we muſt advance them with an air ſo intrepid as to remove ſuſpicion, and be able to bury in profound ſecrecy the reſolutions which in concert we take to-day.

"No truth can be ſo deeply impreſſed upon our minds as that our Maſter continues under the dominion of death; and we all know that truth ſtands ſo ready at the door of the lips, that the greateſt liar among us has hitherto uttered a thouſand truths for one falſehood (H); but henceforth, on this moſt intereſting ſubject, we muſt never let a ſingle truth eſcape us either in our moſt unguarded moments or when put to the torture; for all will be loſt, if any one perſon in whom we may place confidence ſhall reveal to our enemies what ſhould be known to ourſelves alone. It is therefore neceſſary to foreſee all that is capable of extorting ſecrets from ſuch perſons as are not like us proof againſt every thing. We ſhall be expoſed to much bad treatment, to priſons, to ſevere examinations, to death itſelf, and even to the moſt cruel and lingering kinds of death, ſufficient to ſhake any but the moſt invincible reſolutions. All this ſhould be foreſeen, and muſt be deſpiſed by every perſon among us, man and woman!

"But I muſt forewarn you, that under the greateſt tortures we are not to hope for the ſmalleſt ſupport from the teſtimony of a good conſcience and the proſpect of a future reward; for the very cruelleſt of our ſufferings will ariſe from the remorſe of conſcience, unleſs we fortify ourſelves againſt it by the moſt determined reſolution. Others have indeed been wonderfully ſupported under violent and tedious ſufferings, by the internal perſuaſion that they ſuffered for truth and righteouſneſs ſake; but as we are called upon to give new proofs of courage by ſuffering for what we know to be an impious falſehood, every reflection which tended to ſupport them will torment us, and tempt us, in the moſt forcible manner, to betray our cauſe. From him, for whom we are to ſuffer and be ſacrificed, we have nothing to expect; for ſince he could neither reſcue himſelf from the violence of his enemies, nor fulfil his promiſe of riſing from the dead, it would be madneſs to ſuppoſe that he will deliver us from our perſecutors, or afford us the ſmalleſt conſolation when ſinking under the cruelleſt tortures which malicious ingenuity can invent. He was a deceiver, and has deceived us. He promiſed, a few hours before he was taken, that he would riſe from the dead and go before us into Galilee; but God has ordered things otherwiſe; and as he is ſupreme Lord, we are not to ſound his judgments, or even to *think* too much of them.

"You ſeem aſtoniſhed at this counſel! It is new indeed, but neceſſary; and neceſſary to ſuch a degree, that all our deſigns will prove abortive if we ſuffer the fear of God to get poſſeſſion of our minds, and make us timid and puſillanimous in the teſtimony which we are determined to give againſt him, by maintaining that he raiſed from the dead a man whom he has without doubt condemned as an uſurper of the glory which was not his due. Such aſſertions in favour of falſehood will no doubt coſt us ſomething in the beginning; but we muſt endeavour to make ourſelves as eaſy as we can, by imprinting ſtrongly on our minds how glorious and diſintereſted it will be to ſuffer without hope either from God or man, and even with the certainty of being puniſhed both by God and man, not only in this life, but eternally in the next, if there be another. For let me not attempt to conceal from you, that preſent and future miſery muſt be our inevitable portion; and that we muſt therefore become inacceſſible to fear, even to ſuch fear as religion itſelf ought to inſpire, or return ignobly to our nets and boats; there is abſolutely no other alternative. He whom we lament has not only aſſumed openly the character of the Meſſiah, but has dared even to call himſelf the Son of God; and though we have ſeen him ready to be ſtoned for theſe pretenſions, and cannot doubt but that God was highly provoked at them, we muſt, in defiance of the divine vengeance, undertake to make them good, or at leaſt cauſe him to be worſhipped as the Son of God; whom to our own knowledge God has expreſsly diſavowed. This might frighten timid and vulgar ſouls; but we muſt have none ſuch among us. All the men and women of our company muſt be capable of braving Omnipotence, and of deriving new vigour and reſolution from the proſpect of uninterrupted miſery.

"Let us now conſider how this great deſign is to be carried into execution; for it would be the exceſs of folly to enter upon it without preparing the means of ſucceſs. Firſt of all, we will draw up together a hiſtory of the pretended apparitions of our common Maſter. Thoſe who have the beſt inventions ſhall be employed in it; the reſt of us ſhall reviſe and correct the work; and all muſt ſtrongly imprint on their memories the pretended facts and diſcoveries which ſhall be agreed upon; becauſe we muſt never think of retracting, and the leaſt contradiction in our evidence would be of fatal conſequence (1). To this labour we muſt join another, which requires more knowledge of the Scriptures than we poſſeſs; but we will ſupply our deficiencies by ſtudy. Our rulers, and indeed our countrymen in general, expect that the Meſſiah ſhall be a great and invincible hero; that he ſhall deliver his country from the dominion of the Romans; that he ſhall conquer all nations, and eſtabliſh on earth an univerſal monarchy, of which Jeruſalem is to be the capital. As ſuch (they ſay) he is foretold by the prophets; but the perſon whom we mean to impoſe on them as the Meſſiah, expreſsly diſclaimed all wordly greatneſs, and made the ſufferings of himſelf and his followers one teſt of the truth of his pretenſions to the character which he aſſumed. Some of the moſt ſubtile among us therefore muſt carefully examine the books of Moſes, the Pſalms, and the Prophets, and wreſt all the prophecies of the true Meſſiah in favour of him whom we know to be an impoſtor. The enterpriſe, as it is directly oppoſed, not only by truth, but alſo by all the prejudices and hopes of the nation, is indeed bold: but what is the whole of our deſign but the exceſs of boldneſs?

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* St Luke x. 1—18.

‡ St Matth. xxvii. 55, 56. St Luke xxiii. 55, 56. xxiv. 1—12.

(H) To the moſt illiterate fiſherman of Galilee this muſt have been known as a *fact*; for no man can ſpeak an intelligible ſentence without uttering a truth or a falſehood, and ſurely every man ſpeaks a thouſand ſentences for one in which he either utters or intends to utter a falſehood. How he muſt neceſſarily do ſo, we have ſhown in another place. See METAPHYSICS, n° 135, &c.

"We have hitherto believed that the religion of our forefathers is true, and was given by God to Moſes. It is certainly the moſt ancient, the moſt authorized, the pureſt religion in the world; and the only one founded on divine revelation, or that boaſts of ſuch a foundation. But if we are to preach to the whole world, that our Maſter, whom we know to be an impoſtor, is the true and only Meſſiah; and if we are to apply to him prophecies which have another object, we muſt neceſſarily deſpiſe this moſt ancient religion, which our fathers and we have hitherto deemed divine and incontrovertible; and this is the ultimate point to which it has been my aim to bring you. I deſire not that you ſhould conſent immediately, for to abandon one's religion is a thing which ſhould not be done without maturely weighing the conſequences; but what I deſire is, that you will diligently compare all the parts of the plan which I have ſuggeſted to you, examine their ſtrict and neceſſary union, and ſatisfy yourſelves completely, that we muſt *adopt* the whole or *reject* the whole; for it is obvious that modifications and exceptions are here abſolutely impoſſible.

"I hope you will not deliberate long on my propoſal; for we ſhall have much to do after your reſolution is formed, and the time in which I propoſe to concert and finiſh the whole ſcheme is very ſhort. We have but the interval betwixt the preſent moment and the feaſt of Pentecoſt in which to prepare the order of falſe apparitions, and fix it in the memories of our numerous coadjutors, male and female; to ſtudy in the Scripture all that relates to the Meſſiah; to form the plan and adjuſt the parts of a new religion;

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(1) Deiſtical writers have laboured ſtrenuouſly, though in vain, to find ſuch contradictions in the different accounts of the circumſtances attending the reſurrection as may diſcredit the evidence of the evangeliſts to the principal fact.—This gave occaſion to Mr Weſt's admirable *Obſervations on the Reſurrection;* and were there any candour or modeſty among our minute philoſophers, the appearance of that book would have ſilenced them for ever. This, however, it has not done. The old cavils have, without the leaſt notice of Mr Weſt, been again brought forward by Thomas Paine, and again obviated by the Biſhop of Landaff in his maſterly *Apology for the Bible.* "If the writers of the Goſpels (ſays Paine) had gone into any court of juſtice to prove an *alibi* (for it is of the nature of an alibi that is here attempted to be proved, namely, the abſence of a dead body by ſupernatural means), and had given their evidence in the ſame contradictory manner as it is here given, they would have been in danger of having their ears cropt for perjury, and would have juſtly deſerved it." In reply to this impious ſarcaſm, the right reverend apologiſt thus addreſſes its author: "As we cannot have this *viva voce* examination of all the witneſſes, let us call up and queſtion the evangeliſts as witneſſes to a ſupernatural alibi.—Did you find the ſepulchre of Jeſus empty? One of us actually ſaw it empty, and the reſt heard from eye witneſſes that it was empty.—Did you, or any of the followers of Jeſus, take away the dead body from the ſepulchre? All anſwer, No.—Did the ſoldiers, or the Jews, take away the body? No.—How are you certain of that? Becauſe we ſaw the body when it was dead, and we ſaw it afterwards when it was alive.—How do you know that what you ſaw was the body of Jeſus? We had been long and intimately acquainted with Jeſus, and knew his perſon perfectly.—Were you not affrighted, and miſtook a ſpirit for a body? No; the body had fleſh and bones; we are ſure that it was the very body which hung upon the croſs, for we ſaw the wound in the ſide, and the print of the nails in the hands and feet.—And all this you are ready to ſwear? We are; and we are ready to die alſo, ſooner than we will deny any part of it.—This is the teſtimony which all the evangeliſts would give, in whatever court of juſtice they were examined; and this, I apprehend, would ſufficiently eſtabliſh the alibi of the dead body from the ſepulchre by ſupernatural means."

"The book of Matthew (ſays Paine) continues its account, that at the end of the Sabbath, as it began to *dawn*, towards the firſt day of the week, came *Mary Magdalene* and the other *Mary* to ſee the ſepulchre. Mark ſays it was ſun-riſing, and John ſays it was dark. Luke ſays it was Mary Magdalene, and Joanna, and *Mary the mother of James*, and *other women*, that came to the ſepulchre. And John ſays that Mary Magdalene came alone. So well do they agree about their firſt evidence! they all appear, however, to have known moſt about Mary Magdalene; ſhe was a woman of a large acquaintance; and it was not an ill conjecture that ſhe might be upon the ſtroll."

"This (replies the Biſhop) is a long paragraph, and I will anſwer it diſtinctly: Firſt, There is no diſagreement of evidence with reſpect to the time when the women went to the ſepulchre; all the evangeliſts agree as to the day on which they went; and as to the time of the day, it was early in the morning: what court of juſtice in the world would ſet aſide this evidence as inſufficient to ſubſtantiate the fact of the women's having gone to the ſepulchre, becauſe the witneſſes differed as to the degree of twilight which lighted them on their way? Secondly, There is no diſagreement of evidence with reſpect to the perſons who went to the ſepulchre. John ſtates that Mary Magdalene went to the ſepulchre; but he does not ſtate, *as you make him ſtate*, that Mary Magdalene went alone; ſhe might, for any thing you have proved or can prove to the contrary, have been accompanied by all the women mentioned by Luke. Is it an unuſual thing to diſtinguiſh by name a principal perſon going on a viſit or an embaſſy, without mentioning his ſubordinate attendants?

gion; to efface in our mind all traces and ideas of the ancient one; and to fortify ourſelves againſt our prejudices, our fears, and our worldly intereſts: for we muſt get quit of all theſe, ſince we are going moſt generouſly to renounce all the goods of this life, and all the hopes of the next.—What makes me chooſe the feaſt of Pentecoſt for our firſt public appearance in our new capacity, is the great concourſe of people from all nations which will be then at Jeruſalem; for it will be a favourable opportunity to preach to them the reſurrection of him whom our rulers have crucified, and by their means to ſpread the news quickly over the whole world. We are ignorant indeed of foreign tongues, and we are without interpreters; but our preſence will ſuffice. Some will comprehend by ſigns what we would ſay to them, and others, who hear and underſtand our language, will aſſiſt them. We cannot, it is true, work a miracle; but was there ever ſuch a miracle thought of as our daring to reſiſt all that is mighty and reſpectable in our nation? There would perhaps be more prudence in not appearing all together; and as we have nothing extraordinary or divine to command reſpect, nor any protection to hope from God or man, in not expoſing ourſelves in a *body* on the firſt day of our enterprize; but in a deſign like ours, ſingular in its whole nature, and contrary to common rules, of what uſe would prudence be? I am ſure that with our Galilean pronunciation, and with the goodly appearance that we ſhall make in our fiſhermens garments, we ſhall perſuade a multitude of people. Nay, ſo confident am I of our ſucceſs, that I include in my deſign not only Judea but all the nations upon earth. Nor ſhall I be diſcouraged by the diverſity of religions, manners, and tongues, which prevail in the world; be affrighted by the hoſtile power of all mankind; or have my zeal in the leaſt abated for him who hath deceived us, by the improbability of being able to make the Gentiles who know nothing of the Scriptures or the Meſſiah, adore as the Son of God the man whom the Jews have crucified as an impoſtor.

"In the mean time, it will be proper to accuſtom ourſelves to the moſt inhuman ſpectacles, in order to arrive by degrees at ſuch a hardneſs of heart as nothing can be ſuppoſed to move. You may depend upon it, that we ſhall ſee multitudes of people, ſeduced by our diſcourſes, proſcribed, baniſhed, thrown into dark priſons, torn in pieces by engines of torture, condemned to wild beaſts, to the fire, and to the moſt ſhameful and inſupportable puniſhments, for preaching with us the reſurrection of Jeſus. Now, as we are all by nature inclined to compaſſion, we might be tempted to relieve them from ſuch exquiſite miſery, ſince we could effectually do it by a ſingle word; but this word, which would diſcover the whole myſtery, muſt never ſlip from our mouths. There muſt not be ſo much as one ſigh or one groan to betray us. Inſtead of unſeaſonably reproaching ourſelves with our impoſture by which we deceived them, we muſt applaud ourſelves for their ſeduction; we muſt place our own joy in their wretchedneſs; and we muſt not be afraid to honour and cauſe them to be honoured, as illuſtrious witneſſes of the truth, though we know them to be only martyrs to our hypocriſy, and to their own facility in believing falſehood*."

This is a faithful view of the outlines of that plan which *muſt have been formed* by the apoſtles, if they intended to deceive the world with reſpect to the reſurrection of their Maſter. It is of no conſequence to the argument whether it grew gradually out of the joint deliberations of the whole body, or was completely digeſted, as we have ſuppoſed, by one of the number, and implicitly adopted by the reſt: it is enough that every circumſtance which we have mentioned muſt have occurred to them, and that every reſolution muſt have been unanimouſly adopted which we have made to flow from the mouth of this daring orator. But ſurely the bare recital of ſuch an oration is ſufficient to ſhow the impoſſibility of carrying into effect ſo abſurd, ſo horrible, and ſo impious a meaſure—a meaſure diametrically oppoſite to all the principles and motives of human actions.

Archbiſhop King has ſuppoſed*, that the human will is a faculty diſtinct from the underſtanding and the appetites; that activity is eſſential to it; and that previous to an election formed, it is equally indifferent to all objects. He thence infers that a man may chooſe, and even take delight in, what is not naturally agreeable to any of his appetites; becauſe

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dants? Thirdly, In oppoſition to your inſinuation, that Mary Magdalene was a common woman, I wiſh it to be conſidered whether there is any ſcriptural authority for that imputation; and whether there be or not, I muſt contend, that a repentant and reformed woman ought not to be eſteemed an improper witneſs of a fact. The conjecture which you adopt concerning her is nothing leſs than an illiberal, indecent, unfounded calumny, not excuſable in the mouth of a libertine, and intolerable in yours.

"The book of Matthew (continues Paine) goes on to ſay: 'And behold there was an earthquake, for the angel of the Lord deſcended from heaven, and came and rolled back the ſtone from the door, and *ſat upon it*;—but the other books ſay nothing about any earthquake.'—What then? does their ſilence prove that there was none?—'Nor about the angel rolling back the ſtone and ſitting upon it.'—What then? does their ſilence prove that the ſtone was not rolled back by an angel, and that he did not ſit upon it?—'And according to their accounts there was no angel ſitting there.'—This concluſion (ſays his Lordſhip) I muſt deny; their accounts do not ſay there was no angel ſitting there at the time that Matthew ſays he ſat upon the ſtone. They do not deny the fact, they ſimply omit the mention of it; and they all take notice that the women, when they arrived at the ſepulchre, found the ſtone rolled away: hence it is evident that the ſtone was rolled away *before* the women arrived at the ſepulchre; and the other evangeliſts, giving an account of what happened to the women *when* they reached the ſepulchre, have merely omitted giving an account of a tranſaction previous to their arrival. Where is the contradiction? What ſpace of time intervened between the rolling away the ſtone and the arrival of the women at the ſepulchre, is nowhere mentioned; but it certainly was long enough for the angel to have changed his poſition; from ſitting on the outſide he might have entered into the ſepulchre; and another angel might have made his appearance, or from the firſt, there might have been two, one on the outſide rolling away the ſtone, and the other within. Luke, you tell us, 'ſays there were two, and they were both ſtanding; and John ſays there were two, and both ſitting.'—It is impoſſible, I grant, even for an angel to be ſitting and ſtanding at the ſame inſtant of time: but Luke and John do not ſpeak of the ſame inſtant, nor of the ſame appearance.—Luke ſpeaks of the appearance to all the women; and John of the appearance to Mary Magdalene alone, who tarried weeping at the ſepulchre after Peter and John had left it. But I forbear making any more minute remarks on ſtill minuter objections, all of which are grounded on this miſtake—that the angels were ſeen at one particular time, in one particular place, and by the ſame individuals."

* See the Principles of the Chriſtian Religion tranſlated by Mr Lally.

* Origin of Evil, 4th edit. ch. 5. ſect. 1, ſubſect. 3, and 4.

cauſe when the choice is made, a relation is formed between the will and the object of choice, which, from being originally indifferent, now becomes a favourite object. But neither his Grace, nor any other aſſerter of human liberty, has ever affirmed or ſuppoſed, that any man or body of men could deliberately chooſe *evil* for its *own ſake*, or enter zealouſly upon a tedious and difficult enterpriſe, from which *no good* could *poſſibly ariſe*, and from which *unmixed miſery* was *clearly foreſeen* as the *neceſſary reſult of every ſtep of the progreſs*. Such however, muſt have been the choice and the conduct of the apoſtles, when they reſolved to preach a new religion founded on the reſurrection of Jeſus, if they did not certainly know that Jeſus had riſen from the dead. And this conduct muſt have been adopted, and in oppoſition to every motive which can influence the human mind; have been perſevered in by a great number of men and women, without the ſmalleſt contradiction having ever appeared in the various teſtimonies, which at different times, and under the cruelleſt tortures, they all gave to a variety of circumſtances, of which not one had its foundation in truth. He who can admit this ſuppoſition, will not ſurely object to the incredibility of miracles. The reſurrection of a man from the dead is an event ſo different indeed from the common courſe of things, that nothing but the moſt complete evidence can make it an object of rational belief; but as the reſurrection of Jeſus has always been ſaid to have had God for its Author, it is an effect which does not exceed the power of the cauſe aſſigned, and is therefore an event poſſible in itſelf and capable of proof. It is a deviation from the laws of nature, but it is not contradictory to any one of thoſe laws.

That a great number of men and women ſhould deliberately form a plan of ruin and miſery to themſelves, without a proſpect of the ſmalleſt advantage either in this world or in the next, is as different from the common courſe of things as the reſurrection from the dead: and therefore in itſelf at leaſt as great a miracle: but that they ſhould perſiſt in proſecuting this plan in the midſt of torments; that they ſhould ſpread themſelves over the whole world, and everywhere publiſh a number of falſehoods, without any one of them contradicting the reſt; that truth ſhould never eſcape them either in an unguarded moment, or when lingering on the rack, and yet that all their lies ſhould be in perfect agreement with each other; that they ſhould every one of them court ſufferings for a perſon whom they knew to be an impoſtor; that not one of the number—not even a ſingle woman—ſhould have ſo much compaſſion for a fellow-creature, as to reſcue him from the flames by confeſſing a truth which could injure nobody—not even the ſuffering deceivers themſelves—all this is not only different from the common courſe of things, but directly contrary to the moſt known laws of nature, and is therefore not miraculous, but may be pronounced impoſſible. Yet this impoſſibility we muſt admit, or acknowledge, that as "Chriſt died for our ſins, according to the Scriptures, and was buried; ſo he roſe again the third day according to the Scriptures; that he was ſeen of Cephas, then of the twelve; after that of above five hundred brethren at once; after that of James; then of all the apoſtles; and that he was laſt of all ſeen of St Paul*," who was converted by the viſion to preach the faith which till then he had perſecuted.

190 Hence we are aſſured of our own reſurrection.

Thus are we aſſured, that thoſe who have fallen aſleep in Chriſt are not loſt, ſince he is riſen from the dead, and become the firſt fruits of them that ſlept. For ſince by man came death, by man came alſo the reſurrection of the dead. For as in Adam all die, even ſo in Chriſt ſhall all be made alive. But every man in his own order: Chriſt the firſt-fruits, afterwards they that are Chriſt's at his coming; for all that are in the graves ſhall hear his voice, and ſhall come forth; they that have done good unto the reſurrection of life, and they that have done evil to the reſurrection of damnation*."

Our bleſſed Lord having converſed familiarly with the eleven apoſtles for forty days after his reſurrection, inſtructing them in the things pertaining to the kingdom of God; having extended their authority as his miniſters, by giving them a commiſſion to teach all nations, and make them his diſciples, by baptizing them in the name of the Father, and of the Son, and of the Holy Ghoſt; and having promiſed them power from on high to enable them to diſcharge the duties of ſo laborious an office—led them out as far as Bethany, that they might be witneſſes of his aſcenſion into heaven. "When they therefore were come together, they aſked of him, ſaying, Lord, wilt thou at this time reſtore again the kingdom to Iſrael? And he ſaid, it is not for you to know the times and the ſeaſons, which the Father hath put in his own power. But ye ſhall receive power after that the Holy Ghoſt is come upon you; and ye ſhall be witneſſes unto me, both in Jeruſalem, and in all Judea, and in Samaria, and unto the uttermoſt parts of the earth. But tarry ye in the city of Jeruſalem, until ye be endued with power from on high; and he lift up his hands and bleſſed them; and it came to paſs while he bleſſed them, he was parted from them, and a cloud received him out of their ſight. And while they looked ſtedfaſtly towards heaven, as he went up, behold, two men ſtood by them in white apparel; who alſo ſaid, ye men of Galilee, why ſtand ye gazing up into heaven? This ſame Jeſus, who is taken up from you into heaven, ſhall ſo come, in like manner as ye have ſeen him go into heaven. And they worſhipped him, and returned to Jeruſalem with great joy‡."

181 Proofs of Chriſt's aſcenſion.

That our bleſſed Lord aſcended into heaven, will hardly be denied in the preſent age by any one who admits that he roſe from the dead. The aſcenſion was indeed the natural conſequence of the reſurrection; for we cannot ſuppoſe that a man would be called back from the grave to live for ever in a world where all other men fall in ſucceſſion a prey to death. The purpoſe for which he died was to recover for the deſcendants of Adam every privilege which they had forfeited through his tranſgreſſion; and if, as has been generally believed, mankind were by the terms of the firſt covenant to enjoy eternal life in heaven, ſome proof was neceſſary that Chriſt by his death and reſurrection had opened the kingdom of heaven to all faithful obſervers of the terms of the ſecond. Hence it was propheſied § of the Meſſiah, in whom all the nations of the earth were to be bleſſed, that "he ſhould aſcend on high, lead captivity captive, and ſit on the right hand of God until his enemies ſhould be made his footſtool." It was therefore of the greateſt importance to the apoſtles to have ſufficient proof of their Maſter's exaltation to the right hand of the Majeſty on high; for otherwiſe they could neither have looked for an entrance into heaven themſelves, by a new and living way, as the author of the epiſtle to the Hebrews expreſſes it, nor have preached Jeſus as the Meſſiah promiſed to their fathers, ſince they could not have known that in him theſe prophecies were fulfilled. But the proof vouchſafed them was the moſt complete that the nature of the thing would bear. The ſpectators of the aſcenſion were many; for according to the hiſtory of St Luke*, thoſe who returned from the Mount of Olives to Jeruſalem, and prepared themſelves for the coming of the Holy Ghoſt, were in number about ſix ſcore; and to ſuch a cloud of witneſſes the evangeliſt would not have appealed, had not the fact he was recording been very generally known. Yet theſe were perhaps but part of the witneſſes; for ſince Chriſt had told to his diſciples that he was to aſcend to his Father and their Father, to his God and their God, and that he was going to prepare a place for them, that where he is there they might be likewiſe; we can hardly doubt but that all who believed in him as the Redeemer of the world would take care to be preſent, not only to view their Maſter's triumph over all his enemies, but alſo to have a ſight of that glory which awaited themſelves. It was on this occaſion probably that he was ſeen after his reſurrection by above five hundred brethren at once, of whom the greater part were alive at the writing of St Paul's firſt epiſtle to the Corinthians.

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* 1 Cor. xv. 3—9.

* 1 Cor. xv.20—24. and St John v. 28. 29.

§ St Luke xxiv. 49—53. and Acts i. 6—12.

§ Pſ. lxviii. 12. cx. 1. Micah ii. 13.

* Acts i. 12—16.

192
In heaven our Saviour executes the office of a prieſt.

But though ſuch multitudes of people ſaw Jeſus lifted up from the mount, and gradually vaniſh out of their ſight, ſome other evidence ſeemed neceſſary to certify them of the place to which he had gone. Two angels therefore appear, and atteſt what human eyes could not ſee, but what was indeed the conſequence of what they had ſeen. They atteſt that Chriſt had aſcended to heaven, not to deſcend again till the laſt day; and ſurely, with reſpect to this point, the citizens of heaven were the moſt unexceptionable witneſſes. We muſt therefore acknowledge and confeſs, againſt all the wild hereſies of old (K), that Jeſus Chriſt the Son of God, who died and roſe again, did with the ſame body and ſoul with which he had lived upon earth aſcend up "into heaven, there to appear in the preſence of God for us*." Having in the outward tabernacle of this world once offered up himſelf a pure and perfect ſacrifice for the expiation of our ſins, he entered within the veil into the moſt holy place, there to preſent his blood before God himſelf, in order to obtain mercy for us, and reſtore us to the Divine favour. So that, "if any man ſin, we have an advocate with the Father, Jeſus Chriſt the righteous, who is the propitiation for our ſins, and not for ours only, but alſo for the ſins of the whole world; and he is able to ſave to the uttermoſt thoſe that come to God by him, ſeeing he ever liveth to make interceſſion for us." "Seeing then that we have a great high-prieſt, who is paſſed into the heavens, Jeſus the Son of God, we may through him come boldly unto the throne of grace, that we may obtain mercy, and find grace to help in time of need."

193
And a king.

But it is not the office of a prieſt only that our Lord diſcharges in heaven; he is repreſented as ſitting on the right hand of God, to denote that regal authority with which he is now veſted; "angels, and authorities, and powers, being made ſubject to him ‡." Hence it is, that after his reſurrection, he ſaid of himſelf †, "all power is given unto me in heaven and in earth;" for, as St Paul informs us ‡, "becauſe he humbled himſelf and became obedient unto death, even the death of the croſs, therefore God hath highly exalted him, and given him a name which is above every name; that at the name of Jeſus every knee ſhould bow, of things in heaven, and things in earth, and things under the earth." And this ſubmiſſion is due to him, becauſe "God raiſed him from the dead, and ſet him at his own right hand in the heavenly places, far above all principalities and powers, and might, and dominion, and every name that is named, not only in this world, but alſo in that which is to come; and hath put all things under his feet, and gave him to be head over all things to the church*." As God, Chriſt poſſeſſed a kingdom, which, as it had not a beginning, can never have an end: but the dominion, of which the apoſtle is here treating, was conferred upon him as the mediator of the new covenant, and will no longer continue than till his enemies ſhall be ſubdued; for we are told, that "he muſt reign till he hath put all enemies under his feet; and that the laſt enemy which ſhall be deſtroyed is death." "He will ranſom his ſubjects from the power of the grave; he will redeem them from death. O death, he will be thy plague; O grave, he will be thy deſtruction ‡." The trumpet ſhall ſound, the graves ſhall be opened, all the ſons and daughters of Adam ſhall return to life, and death ſhall be ſwallowed up in victory. "Then cometh the end, when the office of mediator ceaſing, he ſhall have delivered up the kingdom to God, even the Father, when he ſhall have put down all rule and all authority and power. For when all things ſhall be ſubdued unto him, then ſhall the Son alſo himſelf be ſubject unto him that put all things under him, that God may be all in all ||."

194
Deſcent of the Holy Ghoſt on the apoſtles.

The firſt conſpicuous proof which our bleſſed Lord gave of being veſted with ſupreme power, and made head over all things to the church, was on the day of Pentecoſt. He had told the apoſtles that he would pray the Father to give them another comforter, who ſhould abide with them for ever, even the Spirit of truth, which ſhould teach them all things, and bring all things to their remembrance which he had ſaid unto them. He had aſſured them, that it was expedient for them that he himſelf ſhould go away; "for if I go not away (ſaid he ‡), the Comforter will not come unto you; but if I depart, I will ſend him unto you." At his laſt interview with them, juſt before his aſcenſion, he had deſired them to tarry at Jeruſalem till they ſhould be endued with power from on high, before they entered upon their great work of converting the nations. Theſe promiſes were amply fulfilled; for "when the day of Pentecoſt was fully come, they were all with one accord in one place. And ſuddenly there came a ſound from heaven as of a ruſhing mighty wind, and it filled all the houſe where they were ſitting. And there appeared unto them cloven tongues, like as of fire, and it ſat upon each of them. And they were all filled with the Holy Ghoſt, and began to ſpeak with other tongues, as the Spirit gave them utterance. And there were dwelling at Jeruſalem Jews, devout men, out of every nation under heaven. Now when this was noiſed abroad, the multitude came together, and were confounded, becauſe that every man heard them ſpeak in his own language. And they were all amazed, and marvelled, ſaying one to another, Behold, are not all theſe who ſpeak Galileans? And how hear we every man in our own tongue, wherein we are born? Parthians, and Medes, and Elamites, and the dwellers in Meſopotamia, and in Judea, and Cappadocia, in Pontus and Aſia, Phrygia and Pamphylia, in Egypt and in the parts of Libya about Cyrene, and ſtrangers of Rome, Jews and proſelytes, Cretes and Arabians—we do hear them ſpeak in our tongues the wonderful works of God. And they were all amazed, and were in doubt, ſaying one to another, What meaneth this*?"

That thoſe who heard the apoſtles ſpeak ſo many different

* Heb. ix. 24.

‡ 1 Peter iii. 22.

† St Matth. xxviii. 18.

‡ Phil. ii. 8, 9, 10.

* Eph. i. 20, &c.

‡ Hoſea xiii. 14.

|| 1 Cor. xv. 24—28.

‡ John xvi. 7.

* Acts ii. 1—13.

(K) There was one Apelles in the primitive church, who was condemned as a heretic for teaching that Chriſt's body was diſſolved in the air, and that he aſcended to heaven without it. The opinions of this man and his followers are ſtated at large and confuted by Tertullian, Gregory Nazianzen, and Epiphanius; and the reader who thinks ſuch ridiculous notions worthy of his notice, will find enough ſaid of them in the Notes to the ſixth article of Pearſon's Expoſition of the Creed. Perhaps it may be from a hint communicated in theſe Notes, that our great modern corrector of the evangeliſts has diſcovered, if it be indeed true that he pretends to have diſcovered, that Jeſus Chriſt is ſtill upon earth.

ferent languages were amazed, is what we ſhould naturally ſuppoſe; but that a ſingle individual among them remained unconvinced, is aſtoniſhing: for the gift of tongues on the day of Pentecoſt is one of the moſt palpable miracles that was ever wrought.

195 Certainty of that miracle.

It is likewiſe one of the beſt authenticated miracles; for the book entitled *the Acts of the Apoſtles* was written not more than 30 years after the event took place (ſee Scripture, n° 168.); and it is not conceivable that, within ſo ſhort a period, St Luke, or any man of common ſenſe, would have appealed for the truth of what he recorded to ſo many inveterate enemies of the Chriſtian name, had he not been aware that the miraculous gift of tongues was a fact incontrovertible. We all know how deſirous the Jewiſh rulers were to ſtop the progreſs of the faith, by whatever means, whether of fraud or force; but if this miracle was not really performed, they had now an opportunity of doing it effectually by means to which truth and honour would give their approbation. Thouſands muſt have been alive in the city of Jeruſalem who were men and women at the time when the apoſtles were ſaid to have been thus ſuddenly inſpired with the tongues of the Parthians, Medes, and Elamites, &c.; and as theſe foreigners were themſelves either Jews by deſcent, or at leaſt proſelytes to the Jewiſh religion, ſurely the chief-prieſt would have found multitudes ready, both at home and abroad, to contradict this confident appeal of St Luke's, if contradiction had been poſſible. We read however of no objection whatever being made to this miracle. Some of the audience, indeed, when the apoſtles addreſſed people of ſo many nations in all their reſpective languages, not underſtanding what was ſaid, and taking it for jargon which had no meaning, concluded, not unnaturally, that the ſpeakers were full of new wine, and mocked them for being drunk ſo early in the day; but this is a circumſtance which, ſo far from rendering the miracle doubtful, adds much to the credit of the hiſtorian, as it would hardly have occurred to the writer of a narrative wholly falſe, and would certainly not have been mentioned, had he known that the apoſtles really attempted to impoſe upon the multitude unmeaning ſounds for foreign languages.

196 The gift of tongues permanent with the apoſtles.

As it is thus certain that the apoſtles were miraculouſly furniſhed with the gift of tongues, ſo the elegance and propriety of that miracle to atteſt the real deſcent of the Spirit of truth, who was to teach them all things, and endue them with power from on high to convert the nations; can never be enough admired by the pious Chriſtian; for words being the vehicle of knowledge, an ability to ſpeak the different languages of the earth was abſolutely neceſſary to enable thoſe who had been originally fiſhermen to go into all the world and preach the goſpel to every creature. Yet there have been writers‡, who, though unable to call in queſtion the reality of the gift of tongues on the day of Pentecoſt, have contended, that it was a gift "not laſting, but inſtantaneous and tranſitory; not beſtowed upon them for the conſtant work of the miniſtry, but as an occaſional ſign only, that the perſon endowed with it was a choſen miniſter of the goſpel; which ſign, according to them, ceaſed and totally vaniſhed as ſoon as it had ſerved that particular purpoſe." The chief argument upon which this opinion is attempted to be built, is drawn from the ſcripture Greek, which is ſaid to be "utterly rude and barbarous, and abounding with every fault which can poſſibly deform a language; whereas we ſhould naturally expect to find an inſpired language pure, clear, noble, and affecting, even beyond the force of common ſpeech, ſince nothing can come from God but what is perfect in its kind. In ſhort, we ſhould expect, ſays the objector, the purity of Plato and the eloquence of Cicero*."

197 Objections

198 Anſwered.

In reply to this objection, it has been well obſerved†, that it ſuppoſes what is called the purity, elegance, and ſublimity, of language, to be ſomething natural and eſſential to human ſpeech, and inherent in the conſtitution of things. "But the matter is far otherwiſe. Theſe qualities are accidental and arbitrary, and depend on cuſtom and faſhion; modes of humanity as various as the differing climes of the earth; and as inconſtant as the tempers, genius, and circumſtances, of its inhabitants. For what is *purity*, but the uſe of ſuch terms and their combinations as the caprice of a writer or ſpeaker of authority hath preferred to their equals? what is *elegance*, but ſuch a turn of idiom as a faſhionable fancy hath brought into credit? and what is *ſublimity*, but the application of ſuch images as arbitrary and caſual connections, rather than their own native grandeur, have dignified and ennobled? The conſequence of this is, that the mode of compoſition which is a model of perfection to one nation or people, has always appeared either extravagant or mean to another. Aſiatic and Indian eloquence was eſteemed hyperbolical and unnatural by the Greeks and Romans, and is ſo eſteemed by us; whilſt the Greek and Roman eloquence in its turn appeared cold and inſipid to the warm inhabitants of the eaſt; and ours would appear perhaps ſtill colder. But the New Teſtament was deſigned for the rule of life to all mankind. Such a rule required inſpiration; and inſpiration, ſay the objecters, implies the moſt perfect eloquence. What human model then was the Holy Ghoſt to follow? for a human model it muſt have been becauſe there was no other; and if there had, no other would have anſwered the purpoſe, which was to make a due impreſſion on the mind and affections. Should the eaſtern eloquence have been employed? But it would have been too ſwelling and animated for the weſt. Should the weſtern? This would have been too ſtill and inactive for the eaſt. Or ſuppoſe us only ſolicitous for what we beſt underſtand; which ſpecies of this latter genus ſhould the ſacred writers have preferred? The diſſolute ſoftneſs of the Aſiatic Greeks, or the dry conciſeneſs of the Spartans? The flowing exuberances of Attic eloquence, or the grave ſeverity of the Roman?

"But are there not ſome general principles of eloquence in common to all the ſpecies? There are. Why then ſhould not theſe have been employed to credit the apoſtolic inſpiration? Becauſe the end even of theſe (replies our author) is to miſlead reaſon, and inflame the paſſions; which being abhorrent to the truth and purity of our holy religion, were very fitly rejected by the inſpired penman. Beſides, it might eaſily be known to have been the purpoſe of Providence, though ſuch purpoſe had not been expreſsly declared, that the goſpel ſhould bear all poſſible marks of its divine original, as well in the courſe of its progreſs as in the circumſtances of its promulgation. To this end, the human inſtruments of its conveyance were mean and illiterate, and choſen from among the loweſt of the people, that when the world ſaw itſelf converted by the *fooliſhneſs of preaching*, as the only learned apoſtle thinks fit to call it, unbelievers might have no pretence to aſcribe its ſucceſs to the parts, or ſtations, or authority, of the preachers. Now had the language inſpired into theſe illiterate men been the eloquence of Plato or Tully, Providence would have appeared to counteract its own meaſures, and to defeat the purpoſe beſt calculated to advance its glory. But God is wiſe, though man is a fool. The courſe of Providence was uniform and conſtant: It not only choſe the weakeſt inſtruments, but carefully kept out of their hands that powerful weapon, of words which their adverſaries might ſo eaſily have wreſted to the diſhonour of the goſpel. Common ſenſe tells us, that the ſtyle of an univerſal law ſhould retain what is common to all languages, and neglect what is peculiar to each. It ſhould retain nothing but CLEARNESS and PRECISION, by which the mind and ſentiments of the writer are intelligibly conveyed to the reader. This quality is eſſential, invariably the ſame, and independent of cuſtom and faſhion. It is the conſequence of ſyntax, the very thing in language which is leaſt poſitive, as being formed on the principles of philoſophy and logic: whereas all beſides, from the very power of the elements and ſignification of the terms to the tropes and figures in compoſition, are arbitrary; and, as deviating from theſe principles, frequently vicious. But this quality of clearneſs and preciſion eminently diſtinguiſhes the writings of the New Teſtament; inſomuch that it may be eaſily ſhown, that whatever difficulties occur in the ſacred books do not ariſe from any imperfect information cauſed by this local or nominal barbarity of ſtyle; but either from the ſublime or obſcure nature of the things treated of, or from the intentional conciſeneſs of the writers; who, in the caſual mention of any thing not eſſential to the diſpenſation, always obſerve a ſtudied brevity."

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† Dr Middleton and Lord Shafteſbury.

* Middleton's Eſſay on the Gift of Tongues

† Warburton's Doctrine of Grace.

After much ingenious and ſound reaſoning on the nature of language in general, our author concludes, that the STYLE of the New Teſtament, even on the ſuppoſition of the truth of what has been ſaid to its diſcredit, is ſo far from proving the language not to be divinely inſpired, that it bears one certain mark of that original. "Every language conſiſts of two diſtinct parts, the ſingle terms, and the phraſes and idioms. Suppoſe now a foreign language to be inſtantaneouſly introduced into the minds of illiterate men like the apoſtles; the impreſſion muſt be made either by fixing in the memory the terms and ſingle words only with their ſignification, as, for inſtance, Greek words correſponding to ſuch or ſuch Syriac or Hebrew words; or elſe, together with that ſimple impreſſion, by enriching the mind with all the phraſes and idioms of the language ſo inſpired. But to enrich the mind with the peculiar phraſes and idioms of a foreign language, would require a previous impreſſion to be made of the manners, notions, faſhions, and opinions, of the people to whom that language is native; becauſe the idioms and phraſes ariſe from and are dependent on theſe manners. But this would be a waſte of miracles without ſufficient cauſe or occaſion; for the Syriac or Hebrew idiom, to which the Jews were of themſelves enabled to adapt the Greek or any other words, abundantly ſerved the uſeful purpoſes of the gift of tongues, which all centered in thoſe tongues, being ſo ſpoken and written as to be CLEARLY UNDERSTOOD. Hence it follows, that if the ſtyle of the New Teſtament were indeed derived from that language which was miraculouſly impreſſed upon the apoſtles on the day of Pentecoſt, it muſt be juſt ſuch a one as in reality we find it to be; that is, it muſt conſiſt of Greek words in the Syriac or Hebrew idiom."

199 Divinity of the Holy Ghoſt.

The immediate author of this gift, ſo neceſſary to the propagation of the goſpel, was the Spirit of truth, or the Comforter, who is the Holy Ghoſt and the third perſon in the bleſſed Trinity. That there are three perſons in the one Godhead, has been ſhewn at large in a former ſection of this article; and that the Holy Ghoſt is one of theſe three, might be ſafely concluded from the form of baptiſm inſtituted by Chriſt himſelf. But as more plauſible objections have been urged againſt his divinity than any that we have met with againſt the divinity of Chriſt, it may not be improper to conſider theſe before we proceed to give an account of the graces which he imparted to the infant church, and of the apoſtles preaching under his influence. By the Arians the Holy Ghoſt is conſidered as a creature; by the Socinians and modern Unitarians, as they call themſelves, the words *Holy Ghoſt* are ſuppoſed to expreſs, not a perſon or ſpiritual ſubſiſtance, but merely an energy or operation, a quality or power, of the Father, whom alone they acknowledge to be God. If this doctrine can be confuted, the Arian hypotheſis will fall to the ground of itſelf; for it is not conceivable that any inſpired teacher ſhould command his followers to be baptized in the name of the ſelf-exiſtent God and two creatures.

200 Objections.

It is admitted by the Socinians themſelves, that in the ſcriptures many things are ſpoken of the Holy Ghoſt which can be properly predicated only of a perſon; but the inference drawn from this conceſſion they endeavour to invalidate by obſerving, that in ſcripture there are likewiſe expreſſions in which things are predicated of abſtract virtues, which can be literally true only of ſuch perſons as practiſe theſe virtues. Thus when St Paul ſays[*], that "charity ſuffereth long and is kind, charity envieth not, charity vaunteth not itſelf, is not puffed up, &c." we cannot ſuppoſe his meaning to be, that theſe actions are performed by charity in the abſtract, but that every charitable perſon, in conſequence of that one Chriſtian grace, ſuffereth long and is kind, envieth not, vaunteth not himſelf, and is not puffed up, &c. In like manner, ſay they, perſonal actions are attributed to the Holy Ghoſt, which itſelf is no perſon, but only the virtue, power, or efficacy, of God the Father; becauſe God the Father, who is a perſon, performs ſuch actions by that power, virtue, or efficacy, in himſelf, which is denominated the Holy Ghoſt. Thus when we read[‡] that "the Spirit ſaid unto Peter, Behold three men ſeek thee; ariſe therefore and get thee down, and go with them, doubting nothing, for I have ſent them;" we muſt underſtand that God the Father was the perſon who ſpoke theſe words and ſent the three men; but becauſe he did ſo by that virtue in him which is called the *Spirit*, therefore the *Spirit* is ſaid to have ſpoken the words and ſent the men. Again, when "the Holy Ghoſt ſaid[||] to thoſe at Antioch, Separate me Barnabas and Saul for the work whereunto I have called them;" we are to conceive that it was God the Father who commanded the two apoſtles to be ſeparated for the work to which he had called them; but becauſe he had done all this by that power within him which is called the Holy Ghoſt, therefore his words and actions are attributed to the Holy Ghoſt, juſt as long-ſuffering in men is attributed to charity.

201 Anſwered.

This reaſoning has a plauſible appearance, and would be of much force, were *all* the actions which in ſcripture are attributed to the Holy Ghoſt of ſuch a nature as that they could be ſuppoſed to have proceeded from the perſon of God the Father, in conſequence of any particular power or virtue in him; but this is far from being the caſe. Thus "the Spirit is ſaid[†] to make interceſſion for us;" but with whom can we ſuppoſe God the Father, the fountain of divinity, to intercede? Our Saviour aſſured[‡] his diſciples, that the Father would, in his name, ſend to them the Holy Ghoſt, who is the Comforter; that he would himſelf ſend the Comforter unto them from the Father; that the Comforter ſhould not ſpeak of himſelf, but ſpeak only what he ſhould hear; and that he ſhould receive of Chriſt's, and ſhew it unto them. But we cannot, without blaſphemy and abſurdity, ſuppoſe that the Father would, in the name of Chriſt, ſend himſelf; that the Son would ſend the Father from the Father; that the Father would not ſpeak of himſelf, but ſpeak only what he heard; or that either the Father in perſon, or a quality of the Father, ſhould receive any thing of Chriſt to ſhew unto the apoſtles.

The ſagacity of Socinus perceived the force of ſuch objections as theſe to his notion of the Holy Ghoſt, being nothing more than the power of the Father perſonified; and therefore he invented another *proſopopeia* to ſerve his purpoſe in the interpretation of thoſe texts to which this one cannot be applied. "The Spirit of God (ſays he §) may be conſidered either as a property or power in God, or as the things on which that power is working. When taken in the former ſenſe, the Spirit, where any perſonal attribute is given to it, means God the Father; when taken in the latter ſenſe, it means the man on whom the power of the Father is working; who, as long as he is affected by that power, is therefore called the Spirit of God;" and he quotes, we think moſt abſurdly, the tenth verſe of the ſecond chapter of the firſt epiſtle to the Corinthians, as a text in which by the Spirit is meant an inſpired man who could ſearch all things, yea, even THE DEEP THINGS OF GOD.

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[*] 1 Cor. xiii. 4—8.

[‡] Acts x. 19, 20.

[||] Acts xiii. 2.

[†] Rom. viii. 26, 27.

[‡] St John xiv. 26. xv. 26. xvi. 13, 14, 15.

§ Fauſt. Socinus in Reſp. ad Wickham, cap. 10.

How his modern followers, who deny the plenary inſpiration even of Chriſt, will reliſh ſuch a degree of inſpiration as this, which raiſes mere man to a temporary equality with God, we know not; but leaving them to ſettle the diſpute with their maſter as they beſt can, we ſhall produce one or two paſſages in which perſonal attributes are given to the Spirit of God, when it is impoſſible to conceive that Spirit either as a power inherent in the Divine Father, or as the perſon on whom that power is operating. We need not bring new texts into view, as ſome of thoſe already quoted will ſerve our purpoſe. When our Saviour promiſes that the *Holy Ghoſt, the Comforter, the Spirit of truth*, ſhould be ſent by the Father and the Son to the apoſtles, we have ſeen, that by this Spirit he could not mean the Father or a property of the Father; neither could he poſſibly mean the apoſtles themſelves, unleſs we are to ſuppoſe that the Father and the Son ſent St Peter to St Peter, and that St Peter, ſo ſent, came to St Peter! Again, when Chriſt ſaith of the Holy Ghoſt, "he ſhall receive of mine, and ſhall ſhew it unto you," he could not, for the reaſon already aſſigned, mean by the Holy Ghoſt the Father or the power of the Father; and ſurely his meaning was not, that the apoſtles, under the influence of the power of the Father, ſhould receive ſomething and ſhew it each to himſelf! The Holy Ghoſt therefore is unqueſtionably a perſon; for tho' there are many paſſages of ſcripture in which the *gifts* of the Holy Ghoſt are called the *Holy Ghoſt*, they are ſo called by a very common figure of ſpeech, in which the effect receives the name of its cauſe: and ſince this perſon is joined with the Father and the Son in the formula of Chriſtian baptiſm; ſince they who lied to the Holy Ghoſt are ſaid † to have lied unto God; ſince blaſphemy againſt him is a more heinous offence than the ſame ſin againſt even the Father or the Son ‡; and ſince it was by the operation of the Holy Ghoſt that Jeſus Chriſt was conceived of the Virgin Mary, and even on that account † called the Son of God—it follows undeniably, that the Holy Ghoſt is God, of the ſame ſubſtance with the Father and Son.

† Acts v. 4.

‡ Mark iii. 28, 29.

† Luke i. 35.

202 The apoſtles miraculouſly inſtructed in the principles of religion.

It was this divine Spirit which, on the day of Pentecoſt, inſpired the apoſtles with the knowledge of different languages; and as theſe were given only to enable them to preach the goſpel to every creature, it can admit of no doubt but that he, who ſo amply provided the means of preaching, would take care that the goſpel ſhould be preached in purity. Our Saviour had told his apoſtles that the Comforter would guide them into all the truth (εις πασαν την αληθειαν), and bring all things to their remembrance, whatſoever he had ſaid unto them; but if they had not comprehended the meaning of what he ſaid, the bare remembrance of his ſayings would have been of little importance. That before this miraculous ſhedding abroad of the Spirit they had but a very imperfect knowledge of his doctrines, and of the purpoſe for which he had come into the world, is apparent from that unſeaſonable queſtion which they put to him when aſſembled to witneſs his glorious aſcenſion; "Lord, wilt thou at this time reſtore again the kingdom to Iſrael?"

203 Their great need of ſuch inſtruction.

Their minds ſtill cheriſhed with fondneſs the vain proſpect of temporal power; but after the day of Pentecoſt they were directed to nobler objects. From the ſame Spirit they received diverſities of gifts beſides that of language; for we are aſſured by St Paul*, when ſpeaking of the early converts to Chriſtianity in general, that "to one was given by the Spirit the word of WISDOM; to another the word of KNOWLEDGE by the ſame Spirit; to another FAITH by the ſame Spirit; to another the gifts of HEALING by the ſame Spirit; to another the working of MIRACLES; to another PROPHECY; to another DISCERNING OF SPIRITS; to another DIVERS KINDS OF TONGUES; to another the INTERPRETATION of tongues:" and theſe gifts, which were ſeverally divided either among private Chriſtians or among the inferior orders of miniſters in the church, we have reaſon to believe were all beſtowed in a greater or leſs degree upon each of the apoſtles.

* 1 Cor. xii. 8—12.

Men thus endowed were well qualified to declare unto the world all the council of God. By the word of *wiſdom* they communicated to the Gentile nations a pure ſyſtem of what is called *natural religion;* turning them from the vanity of idols to the worſhip of the living God: by the word of *knowledge*, they preached the great doctrines of revelation both to Jews and Gentiles, ſhewing them that there is none other name under heaven given unto men whereby they may be ſaved than the name of Jeſus Chriſt (L); and by their gifts of *healing* and of *miracles*, &c. they were enabled to prove unanſwerably that their doctrines were divine. They taught everywhere the unity of God, the creation of the world, the fall of man, the neceſſity of redemption, the divinity of the Redeemer, his ſacrifice on the croſs to reſtore mankind to their forfeited immortality, and the terms of the new covenant into which they had through him been graciouſly admitted by God.

Such a view as our limits would admit of we have given of all theſe doctrines, except that which reſpects the terms of the goſpel covenant; but theſe being explicitly ſtated only by St Paul and St James, we could not till now inveſtigate them, without violating the hiſtorical order into which, for the ſake of perſpicuity, we have digeſted the ſeveral parts of this ſhort ſyſtem. Our Saviour himſelf has indeed taught with great plainneſs the neceſſity of faith and baptiſm

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(L) It is not perhaps eaſy to determine what is here meant by the word of WISDOM and the word of KNOWLEDGE, as diſtinguiſhed from each other. By the former (λογος σοφιας), biſhop Warburton underſtands all the great principles of natural religion. "The ancients (ſays he) uſed the word σοφια in this peculiar ſenſe; it is uſed in the ſame ſenſe by St. Paul in Col. iv. 5; and we can hardly give it any other in the place before us, where we ſee the word of wiſdom diſtinguiſhed from the word of knowledge (λογος γνωσεως), which evidently means all the great principles of revelation; the term γνωσις being as peculiarly applied by Chriſtian writers to revealed religion as σοφια is by the Gentiles to the natural. St Paul uſes the word in this ſenſe in 2 Cor. xi. 6. where he ſays, Ει δε και ιδιωτης τῳ λογῳ αλλ ου τῃ γνωσει; and St Peter in his firſt epiſtle, chap. iii. verſe 7. Hence thoſe early heretics, who ſo much deformed the ſimplicity and purity of the Chriſtian faith by viſionary pretences to ſuperior knowledge of revelation, took from this word the name of Gnoſtics." See *Warburton's Sermon on the Office and Operation of the Holy Ghoſt.*

baptiſm to the ſalvation of thoſe who have an opportunity of hearing the goſpel preached with power (ſee BAPTISM); and in his ſermon on the mount, which is ſuch a lecture of ethics founded on religion as the Son of God only could have delivered, we learn, that "unleſs our righteouſneſs ſhall exceed the righteouſneſs of the Scribes and Phariſees, we ſhall in no caſe enter into the kingdom of heaven; that not every one who ſaith unto Chriſt, Lord, Lord, ſhall enter into the kingdom of heaven, but he who doth the will of his Father who is in heaven; and that many will ſay to him at the day of judgment, Lord, Lord, have we not propheſied in thy name? and in thy name done many wonderful works?" which could not be done without faith; "to whom he will, notwithſtanding, ſay, Depart from me, ye that work iniquity ‡." St Paul, however, ſeems to attribute our juſtification to the bare act of believing; for he repeatedly aſſures us, "that a man is juſtified by faith without the deeds of the law;" while St James, on the other hand, affirms, "that by works a man is juſtified, and not by faith only."

This apparent difference in the language of the two apoſtles, for we hope to ſhow that it is only apparent, has produced among divines opinions really different reſpecting the juſtification of Chriſtians; and the principal of theſe opinions it is our duty to ſtate. But previous to this, it will be neceſſary to aſcertain the meaning of the word *juſtification;* for we are ſorry to ſay, that for want of accurate definitions, many theological controverſies are nothing better than empty logomachies; and perhaps againſt no controverſy can this charge be brought with greater truth than againſt that which, in the end of the laſt century and in the beginning of the preſent, was ſo violently agitated concerning the *cauſes*, the *inſtruments*, and the *conditions*, of juſtification.

204
Meaning of juſtification.

Between *pardon* of ſin and *juſtification* there is ſo cloſe a connection, that many writers ſeem to conſider the terms as ſynonymous, and to infer, that he who is pardoned is *ipſo facto* juſtified. That every Chriſtian, who ſhall be pardoned at the judgment of the great day, will likewiſe be juſtified, is indeed true; but in propriety of ſpeech, *juſtification* is a word of very different import from *pardon*, and will entitle the Chriſtian to what mere pardon could not lead him to expect. An innocent perſon, when falſely accuſed and acquitted, is *juſtified* but not *pardoned;* and a criminal may be *pardoned*, though he cannot be *juſtified* or declared innocent. A man whoſe ſins are pardoned is free from puniſhment; but the juſtified Chriſtian is entitled to everlaſting life, happineſs, and glory. If we were only pardoned through Chriſt, we ſhould indeed eſcape the pains of hell, but could have no claim to the enjoyments of heaven; for theſe, being more than the moſt perfect human virtue can merit, muſt be, what in the Scriptures they are always ſaid to be, "the gift of God through Jeſus Chriſt our Lord." Hence it is that St Paul, diſtinguiſhing, as we have done upon his authority, between mere remiſſion of ſins and juſtification of life, declares ‡, that "Jeſus our Lord was *delivered* for our *offences*, and *raiſed* again for our *juſtification*."

The word juſtification, as uſed both by St Paul and St James, has been very generally conſidered as a forenſic term expreſſing the ſentence of a judge. The moſt eminent reformed divines of all denominations*, and even many of the Romaniſts themſelves, have ſtrenuouſly contended, that this is its genuine ſenſe, when it is diſtinguiſhed from mere remiſſion of ſins, regeneration, and ſanctification; and if ſo, it will ſignify God's pronouncing a perſon *juſt*, either as being perfectly blameleſs, or as having fulfilled certain conditions required of him in the Chriſtian covenant. But that "there is not a juſt man upon earth, who doth good and ſinneth not," is made known to us by the moſt complete evidence poſſible, the joint dictates of our own conſciences and of divine revelation; and therefore whoſoever is pronounced juſt by the Judge of all the earth, muſt be ſo, either becauſe, though not abſolutely blameleſs, he has performed the conditions required of him in the covenant of grace, or becauſe Chriſt has fulfilled all righteouſneſs in his ſtead.

105
It is a forenſic term.

If this be the Scripture notion of juſtification, it muſt be wholly the act of God, and cannot be the effect either of our faith or of our virtue. Accordingly, we are ſaid by the apoſtle to be juſtified freely by his grace through the redemption that is in Jeſus Chriſt; whom *God hath ſet forth* to be a propitiation through faith in his blood †. The act of juſtification therefore proceeds from the divine philanthropy, and cannot be performed by the inſtrumentality of faith; for it is not God, but man, who believes; and man is not the juſtifier of himſelf. To talk of any kind of *inſtrument* of juſtification beſides the propitiation ſet forth by God, is indeed to make uſe of very improper language: "Omnis cauſa inſtrumentalis (ſays Biſhop Bull ‡), ſuo modo in effectum influit, eique effecti productio propriè attribui poteſt. Jam vero, cum juſtificatio nihil aliud ſit quam gratioſus Dei actus, quo peccata noſtra nobis condonet, ac nos ad ſalutem acceptet, valde abſurdum eſſet dicere, vel fidem, vel opera noſtra, vel quidvis aliud noſtri aut remittere peccata noſtra, aut perſonas noſtras acceptare: quod tamen, ſi inſtrumentalis cauſa juſtificationis fides ſit, plane dicendum eſſet."

In this ſentiment of the illuſtrious Biſhop of St David's, ſome of the moſt eminent divines both among the Calviniſts and Arminians agree; and indeed it is not eaſy to be conceived how any man can entertain a different ſentiment, when conſidering juſtification in its proper ſenſe. Many, however, have choſen to treat of juſtification not only in the active ſenſe, as it is the act of God, for all admit that it is he who juſtifies; but likewiſe in a paſſive ſenſe, as it means our *privilege* or *poſſeſſion* holden of him, when we are ſaid to be juſtified by his grace. In this view of the ſubject they may talk, with ſufficient propriety, of an inſtrument of juſtification, not as the mean by which it is conveyed, but as the medium through which it is received by the true Chriſtian. And hence it follows, that the Doctors Waterland and Warburton, of whom the former was not a thorough Calviniſt, and the latter was a profeſſed Arminian, ſtrenuouſly maintain the doctrine of the Weſtminſter Confeſſion, that "faith receiving and reſting on Chriſt is the alone inſtrument of juſtification; though it cannot be alone in the perſon juſtified, but muſt ever be accompanied with all other ſaving graces, and be a faith which worketh by love."

But notwithſtanding this agreement between the leaders of the rival ſects, they have found abundant matter of controverſy reſpecting faith and works, in deciding the great queſtion, "Whether, when God juſtifies man, he conſiders him as abſolutely righteous on account of Chriſt's righteouſneſs performed in his ſtead; or only as juſt, becauſe he has fulfilled the conditions of the covenant of grace, which does not require of him perfect righteouſneſs?" The former is the doctrine of the more rigid Calviniſts, the latter that of the Arminians or Remonſtrants.

"A notion (ſays Dr Gill ‡) obtained ſome years ago, that a relaxation of the law and the ſeverities of it has been obtained by Chriſt; and a new law, a remedial law, a law of milder terms, been introduced by him, which is the goſpel; the terms of which are, faith, repentance, and new obedience; and though theſe be imperfect, yet, being ſincere, they are accepted by God in the room of a perfect righteouſneſs. But every article of this ſcheme (continues he) is wrong; for

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‡ St Matth. v. 20. vii. 21,—24.

‡ Romans iv. 25.

* Limborch, Bull, Waterland Warburton Beveridge, Vitringa, Gill, &c.

2 Rom. iii. 24, 25.

† Harmonia Apoſtolica, cap. ii. § 9.

‡ Body of Divinity, vol. ii. book iii. chap. 8. § 5.

206 Doctrine of the Calviniſts reſpecting it.

for the law is not relaxed, nor any of its ſeverities abated; Chriſt came not to deſtroy, but to fulfil it; and therefore it requires the ſame holy, juſt, and good things, as ever. Nor is the goſpel a new law. There is nothing in it (he ſays) which looks like a law; for it has no commands in it, but all promiſes, being a pure declaration of grace and ſalvation by Chriſt; nor are faith, repentance, and new obedience, required by it as conditions of man's acceptance with God. Faith and repentance are goſpel doctrines, and parts of the goſpel miniſtry; they are graces, and not terms required to be performed by men of themſelves. Faith is the gift of God, and repentance is a grant from him. It is not true (continues our author) that God will accept of an imperfect righteouſneſs in the room of a perfect one; nor can any thing more highly reflect upon the juſtice and truth of God, who is the judge of all the earth, than to ſuppoſe that he can ever account that as a righteouſneſs which is not one."

Having thus proved by arguments which were almoſt in the ſame words ſtated long before by Biſhop Beveridge [||], that the goſpel is no relaxation of the law, he proceeds to lay down his own notions of juſtification, of which (he ſays) "the ſole matter, or that for the ſake of which a ſinner is juſtified before God, is the righteouſneſs of Chriſt—that which he did and ſuffered on earth, in our nature, in our ſtead, and as our repreſentative. This is commonly called his active and paſſive obedience; and when the purity and holineſs of his own nature was added to it, the whole made up the *δικαιωμα του νομου, the righteouſneſs of the law*, which was fulfilled by him as the head and repreſentative of his people [*]; for whatever the law required is neceſſary to a ſinner's juſtification before God, and it required of ſinners more than it did of man in innocence. Man was created with a pure and holy nature, conformable to the pure and holy law of God; and it was incumbent on him to continue ſo, and to yield in it perfect and ſinleſs obedience; in the failure whereof he was threatened with death. Man did fail; by which his nature was vitiated and corrupted, and his obedience became faulty and imperfect. He therefore became liable to the penalty of the law, and ſtill perfect obedience was required of him. To the juſtification of a ſinner therefore is required the moſt complete obedience, active and paſſive; or, in other words, purity of nature, perfect obedience, and the ſufferings of death; all which meet in Chriſt, the repreſentative of his people, in whom they are juſtified. There are indeed ſome divines (continues our author) who exclude the active obedience of Chriſt from being any part of the righteouſneſs by which men are juſtified. They allow it to have been a condition requiſite in him as a Mediator, qualifying him for his office; but deny that it is the matter of juſtification, or reckoned for righteouſneſs to man. But without the active obedience of Chriſt the law would not be ſatisfied; the language of which is, *Do and live*; and unleſs its precepts be obeyed, as well as its penalty endured, it cannot be ſatisfied; and unleſs it be ſatisfied, there can be no juſtification. If therefore men are juſtified by the righteouſneſs of Chriſt, it muſt be by his active obedience imputed and made over to them, ſo as to become their's, *even as David deſcribeth the bleſſedneſs of the man unto whom God imputeth righteouſneſs without works* [*]. That this is really the way in which men are juſtified, our author thinks evident, becauſe they muſt be juſtified either by an inherent or by an imputed righteouſneſs; but they cannot be juſtified by their own inherent righteouſneſs, for that is imperfect, and thereſore not juſtifying. Hence the apoſtle 'counts all things but dung, that he may win Chriſt and be found in him; not having his own righteouſneſs, which is of the law, but that which is *through the faith of Chriſt*, the righteouſneſs which is of *God by Faith* [§].' But by ſuch a righteouſneſs as this a man cannot be juſtified in any other way than by an imputation of it to him. Whence it follows, that "*as by one man's diſobedience many were made ſinners* by imputation, ſo *by the obedience of one ſhall many be made* righteous, by having that obedience placed to their account."

As this author properly conſiders juſtification as the act of God, he does not approve of the language in which faith is called the inſtrument either of conferring or receiving it. "Faith (ſays he [*]) is merely the evidence of juſtification to the perſon juſtified; for 'faith is the evidence of things not ſeen.' The righteouſneſs of God, of the God man and Mediator Jeſus Chriſt, is revealed from faith to faith in the everlaſting goſpel [‡]; and therefore muſt be before it is revealed, and before the faith to which it is revealed. Faith is that grace whereby a ſoul, having ſeen its guilt and its want of righteouſneſs, beholds in the light of the Divine Spirit, a complete righteouſneſs in Chriſt, renounces its own, lays hold on that, puts it on as a garment, rejoices in it, and glories of it; the Spirit of God witneſſing to his ſpirit that he is a juſtified perſon: and ſo he is evidently and declaratively 'juſtified in the name of the Lord Jeſus, and by the Spirit of our God [†]'. Faith adds nothing to the *eſſe*, only to the *bene eſſe* of juſtification; which is a complete act in the eternal mind of God, without the being or conſideration of faith, or any foreſight of it. In the account of God, a man is as much juſtified before his faith as after it; and after he does believe, his juſtification depends not on his acts of faith, for though *we believe not, yet God abides faithful* to his covenant-engagements with his Son, by whoſe ſuretyſhip-righteouſneſs the elect are juſtified; but by faith men have a comfortable ſenſe, perception, and apprehenſion, of their juſtification, and enjoy that peace of ſoul which reſults from it. It is by that only, under the teſtimony of the Divine Spirit, that they know their intereſt in it, and can claim it, and ſo have the comfort of it."

Though this language differs from that of the Weſtminſter Confeſſion, the author ſeems not to teach a different doctrine; for if faith be that grace by which a ſoul renounces its own righteouſneſs, and lays hold of Chriſt's, which it puts on as a garment, it muſt be that very thing which the compilers of the Confeſſion meant by their definition of faith receiving and reſting on Chriſt and his righteouſneſs, when they called it "the alone inſtrument of juſtification." Accordingly our author elſewhere [*] teaches, that "true faith in ſenſible ſinners aſſents to Chriſt and embraces him, not merely as a Saviour of man in general, but as a ſpecial ſuitable Saviour for them in particular. It proceeds upon Chriſt's being revealed *in* them as well as *to* them, by the ſpirit of wiſdom and revelation, in the knowledge of him as a Saviour that becomes them. It comes not merely through external teachings by the hearing of the word from men; for no man, ſaith our bleſſed Lord, can come to me except the Father draw him; but ſuch ſouls as are thus drawn, having heard and learned of the Father, believe not only in the *doctrine* of Chriſt, but alſo in *himſelf*, truſting in him alone for everlaſting life and ſalvation."

207 And of the more moderate Arminians.

Were it not that this author, in every thing that he writes, has an eye to the doctrine of election and reprobation, which he ſcrews up to a greater height than almoſt any other divine with whoſe works we are acquainted, he would differ little in his notions of juſtification from the more moderate Arminians. "Juſtification (ſays Limborch) is the merciful and gracious act of God, whereby he fully abſolves from all guilt the truly penitent and believing ſoul, through and for the ſake of Chriſt apprehended by a true faith: or gratuitouſly remits ſins upon the account of faith in

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[||] See his Private Thoughts of religion.

[*] Rom. viii, 4.

[*] Rom. iv. 6.

[§] Philip. iii. 8, 9.

[*] Body of Divinity, vol. i. book ii. § 5.

[‡] Rom. i. 17.

[†] 1 Cor. vi. 11.

[*] Body of Practical Divinity, book i. chap. 6.

in Jeſus Chriſt, and graciouſly imputes that faith for righteouſneſs." Here indeed the imputation of Chriſt's righteouſneſs is expreſsly denied; but our countryman Dr Waterland, who can hardly be conſidered as a Calviniſt, ſeems to contend for the imputation of that righteouſneſs to the ſinner, as well as for faith being the inſtrument by which it is received.

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Faith the inſtrument of it.

"It cannot be for nothing (ſays that able writer *) that St Paul ſo often and ſo emphatically ſpeaks of man's being juſtified by faith, or through faith in Chriſt's blood; and that he particularly notes it of Abraham, that he *believed*, and that his faith was counted to him for juſtification, when he might as eaſily have ſaid that Abraham, to whom the goſpel was preached, was juſtified by goſpel faith and obedience, had he thought faith and obedience equally inſtruments of juſtification. Beſides, it is on all hands allowed, that though St Paul did not directly oppoſe faith to *evangelical works*, yet he comprehended the works of the *moral law* under thoſe which he excluded from the office of *juſtifying*, in his ſenſe of the word juſtification. He even uſed ſuch arguments as extended to all kinds of works; for Abraham's works were excluded, though they were undoubtedly evangelical. To prove that he interprets the apoſtle's doctrine fairly, our author quotes, from the genuine epiſtle of Clemens of Rome, a paſſage, in which it appears beyond a doubt that this fellow-labourer of St Paul ſo underſtood the doctrine of juſtifying faith as to oppoſe it even to evangelical works, however exalted. It is true (continues our author), Clemens elſewhere, and St Paul almoſt everywhere, inſiſts upon true holineſs of heart and obedience of life as indiſpenſable conditions of ſalvation or juſtification; and of that, one would think, there could be no queſtion among men of any judgment or probity. But the queſtion about conditions is very diſtinct from the other queſtion about inſtruments; and therefore both parts may be true, viz. that faith and obedience are equally conditions, and equally indiſpenſable where opportunities permit; and yet faith over and above is emphatically the inſtrument both of receiving and holding juſtification, or a title to ſalvation.

"To explain this matter more diſtinctly, let it be remembered, that God may be conſidered either as a party contracting with man on very gracious terms, or as a Judge to pronounce ſentence on him. Man can enter into the covenant, ſuppoſing him adult, only by aſſenting to it, and accepting it, to have and to hold it on ſuch kind of tenure as God propoſes: that is to ſay upon a ſelf-denying tenure, conſidering himſelf as a guilty man ſtanding in need of pardon, and of borrowed merits, and at length reſting upon mercy. So here, the previous queſtion is, Whether a perſon ſhall conſent to hold a privilege upon this ſubmiſſive kind of tenure or not? Such aſſent or conſent, if he comes into it, is the very thing which St Paul and St Clemens call *faith*. And this previous and general queſtion is the queſtion which both of them determine againſt any proud claimants who would hold by a more ſelf-admiring tenure.

"Or if we next conſider God as ſitting in judgment, and man before the tribunal going to plead his cauſe; here the queſtion is, What kind of plea ſhall a man reſolve to truſt his ſalvation upon? Shall he ſtand upon his innocence, and reſt upon ſtrict law? or ſhall he plead guilty, and reſt in an act of grace? If he chooſes the former, he is proud, and ſure to be caſt: if he chooſes the latter, he is ſafe ſo far in throwing himſelf upon an act of grace. Now this queſtion alſo, which St Paul has decided, is previous to the queſtion, What conditions even the act of grace itſelf finally inſiſts upon? A queſtion which St James in particular, and the general tenure of the whole Scripture, has abundantly ſatisfied; and which could never have been made a queſtion by any conſiderate or impartial Chriſtian. None of our works are good enough to ſtand by themſelves before him who is of purer eyes than to behold iniquity. Chriſt only is pure enough for it at firſt hand, and they that are Chriſt's at ſecond hand in and through him. Now becauſe it is by faith that we thus interpoſe, as it were, Chriſt between God and us, in order to gain acceptance by him; therefore faith is emphatically the inſtrument whereby we receive the grant of juſtification. Obedience is equally a condition or qualification, but not an inſtrument, not being that act of the mind whereby we look up to God and Chriſt, and whereby we embrace the promiſes."

209
Faith and obedience its conditions.

But though our author contends that faith is the inſtrument of juſtification, he does not, like the Antinomians, teach that it will ſave men without works. "The covenant of grace, ſays he, has conditions annexed to it of great importance, for without them no inſtruments can avail. Theſe are faith and obedience, as St James hath particularly maintained. St Paul had before determined the general and previous queſtion reſpecting the plea by which we ought to abide; and when ſome libertines, as is probable, had perverted his doctrine of faith and grace, St James ſhowed that the very faith which reſts in a covenant of grace implies a cordial ſubmiſſion to the conditions of that covenant, otherwiſe it would be nothing but an empty ceremony. The perfect agreement between St Paul and St James in the article of *juſtification*, appears very clear and certain. St Paul declares, that in order to come at juſtification, it is neceſſary to ſtand upon grace, not upon merit; which St James does not deny, but rather confirms, in what he ſays of the perfect law of liberty (James i. 25. ii. 12). St Paul makes faith the inſtrument of receiving that grace; which St James does not diſpute, but approves by what he ſays of Abraham (ii. 23.); only he maintains alſo, that, in the conditionate ſenſe, juſtification depends equally upon faith and good works; which St Paul alſo teaches and inculcates in effect, or, in other words, through all his writings. If St Paul had had preciſely the ſame queſtion before him which St James happened to have, he would have decided juſt as St James did; and if St James had had preciſely the ſame queſtion before him which St Paul had, he would have determined juſt as St Paul did. Their principles were exactly the ſame, but the queſtions were diverſe; and they had different adverſaries to deal with, and oppoſite extremes to encounter, which is a common caſe.

"It may be noted, that that faith which is here called a *condition*, is of much wider compaſs than that particular kind of faith which is preciſely the inſtrument of juſtification. For faith as a condition means the whole complex of Chriſtian belief, as expreſſed in the creeds; while faith as an inſtrument means only the laying hold on grace, and reſting in Chriſt's merits in oppoſition to our own deſervings: though this alſo, if it is a vital and operative principle (and if it is not, it is nothing worth), muſt of courſe draw after it an hearty ſubmiſſion to, and obſervance of, all the neceſſary conditions of that covenant of grace wherein we repoſe our whole truſt and confidence. So that St Paul might well ſay, "Do we then make void the law (the moral law) through faith? God forbid: Yea, we eſtabliſh the law *." We exempt no man from religious duties; which are duties ſtill, though they do not merit nor are practicable to ſuch a degree as to be above the need of pardon: they are neceſſary conditions in their meaſure of juſtification, though not ſufficient in themſelves to juſtify, nor perfect enough to ſtand before God or to abide trial: therefore Chriſt's merits muſt be taken in to ſupply their defects: and ſo our reſting in Chriſt's atonement by an humble ſelf-denying faith is our laſt reſort, our anchor of ſalvation both ſure and ſtedfaſt,

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* Summary View of Juſtification.

* Rom. iii. 31.

faſt, after we have otherwiſe done our utmoſt towards the fulfilling of God's ſacred laws, towards the performing of all the conditions required.

"That good works, internal and external, are according as opportunities offer and circumſtances permit, *conditions* properly ſo called, is clear from the whole tenor of Scripture, as hath been often and abundantly proved by our own divines (M), and is admitted by the moſt judicious among the foreign Reformed (N). Yet ſome have been very ſcrupulous as to this innocent name, even while they allow the abſolute neceſſity of good works as indiſpenſable qualifications for future bleſſedneſs. Why not conditions therefore as well as qualifications? Perhaps becauſe that name might appear to ſtrike at abſolute predeſtination, or unconditional election; and there may lie the ſcruple: otherwiſe the difference appears to lie rather in words than in things.

"Some will have them called not conditions, but *fruits* or *conſequents* of juſtification. If they mean by juſtification the ſame as the grace of the Holy Spirit, and the firſt grace of faith ſpringing from it, they ſay true; and then there is nothing more in it than an improper uſe of the word *juſtification*, except that from abuſe of words very frequently ariſes ſome corruption of doctrine. If they mean only, that outward acts of righteouſneſs are fruits of inward habits or diſpoſitions; that alſo is undoubtedly true: but that is no reaſon why internal acts, virtues, graces (good works of the mind), ſhould not be called conditions of juſtification; or why the outward acts ſhould not be juſtly thought conditions of preſerving it. But if they mean that juſtification is ordinarily given to adults, without any preparative or previous conditions of faith and repentance, that indeed is very new doctrine and dangerous, and opens a wide door to carnal ſecurity and to all ungodlineſs."

Such is the doctrine of Chriſtian juſtification as it has been taught by the followers of Calvin, and by ſome of the moſt eminent Arminians who flouriſhed in the end of the laſt and beginning of the preſent century. They appear not, from this view of their opinions, to differ ſo widely as ſome of them have wiſhed the world to believe. It is evident that Dr Waterland, though he rejects ſome of the diſtinguiſhing tenets of Calviniſm, lays greater ſtreſs upon faith in his ſcheme of juſtification than Dr Gill himſelf; and that they both conſider it as the *inſtrument* by which the adult Chriſtian muſt receive the imputed righteouſneſs of Chriſt. The greater part of modern Arminians, however, exclaim againſt the imputation of Chriſt's righteouſneſs, as a doctrine falſe in itſelf, and fraught with the moſt pernicious conſequences; and they would be ready to tell Dr Gill, in his own words, that of his ſcheme every article is wrong. It is not true (ſay they) that God exacts of man, or ever did exact of him, an obedience abſolutely perfect; for under every diſpenſation man was in a ſtate of diſcipline, and had habits of virtue and piety to acquire; and it is probable that his progreſs in piety, virtue, and wiſdom, will continue for ever, as none but God is perfect and ſtationary, and incapable of deviating from the line of rectitude. Moſt of them, after Biſhop Bull, diſlike the uſe of ſuch unſcriptural phraſes as the *inſtrument of juſtification*, applied either to faith or to works; and think, that by conſidering God as the ſole juſtifier of man, upon certain conditions, they can more preciſely aſcertain the diſtinct provinces of faith and obedience in the ſcheme of juſtification, than either their brethren of the old ſchool of Arminius, or their rivals of the ſchool of Calvin.

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Objections of the more zealous Arminians to this ſtatement of the doctrine.

211
Their own ſtatement of it.

By the very conſtitution of man, piety and virtue are duties which, if he do not ſincerely perform, he muſt of courſe forfeit the favour of his Maker; but the moſt perfect performance of his natural duties would not entitle him to a ſupernatural and eternal reward. Eternal life is the *gift* of God through Jeſus Chriſt; and it is ſurely reaſonable that we ſhould acknowledge it to be ſo, and not claim it as a debt due to our merits. The pious and virtuous man has a natural claim to more happineſs than miſery during the period of his exiſtence, a claim founded on the attributes of that God who called him into being; but he has no natural claim to a future life, and ſtill leſs to a perpetuity of exiſtence. This is a truth not more clearly taught in the holy ſcripture than conſonant to the ſoundeſt philoſophy: and yet, by not attending to it, have St Paul and St James been ſet at variance, and the moſt oppoſite doctrines taught reſpecting the juſtification of Chriſtians.

Becauſe faith in Chriſt cannot entitle a wicked man to eternal *happineſs*, one claſs of divines ſeem to infer that ſuch faith is not neceſſary to Chriſtian *juſtification*, and that "his faith cannot be wrong whoſe life is in the right." They proceed upon the ſuppoſition that man is naturally immortal; that piety and virtue are entitled to reward; and that therefore the pious and virtuous man whatever be his belief, muſt undoubtedly inherit an eternal reward. But this is very fallacious reaſoning. That piety and virtue are through the divine juſtice and benevolence entitled to reward, is indeed a truth incontrovertible; but that man who is of yeſterday is naturally immortal; that a being who began to exiſt by the mere good will of his Maker, has in himſelf a principle of perpetual exiſtence independent of that will—is a direct contradiction. Whatever began to be, can be continued in being only by the power, and according to the pleaſure, of the infinite Creator; but it pleaſed the Creator of his free grace at firſt to promiſe mankind eternal life, on the ſingle condition of their firſt father's obſerving one poſitive precept. That precept was violated, and the free gift loſt: but the covenant was renewed in Chriſt, who "by his death hath aboliſhed death, and by his reſurrection hath brought to light life and immortality." The condition annexed to the gift thus reſtored was faith; for "being juſtified by faith §, we have peace with God through our Lord Jeſus Chriſt; by whom alſo we have acceſs by faith into his grace wherein we ſtand, and rejoice in the hope of the GLORY OF GOD." Faith therefore in the Son of God and Saviour of the world, is not only a condition, but the *ſole* condition, of that juſtification which is peculiarly Chriſtian; for ſince Chriſt, without any co-operation of ours, hath purchaſed for us the free gift of eternal life, we ſhall be guilty of the groſſeſt ingratitude to our Divine Benefactor, and impiouſly claim an independence on God, if we look upon that gift either as a right inherent in our nature, or as a debt due to our meritorious deeds.

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Faith the ſole condition of the juſtification peculiarly Chriſtian;
§ Rom. v. 1, 2.

213
But not of obtaining eternal happineſs.

But though faith be the condition of Chriſtian juſtification, as that implies the inheritance of *eternal life*, there are other conditions to be performed before a man can be put in poſſeſſion of *eternal felicity*. By a law long prior to the promulgation of the goſpel—a law interwoven with our very being—no man can enjoy the favour of his Maker, who does not make it his conſtant endeavour "to do juſtly, to love mercy, and to walk humbly with his God." This law was in force before man fell; it continues to be in force now that he is redeemed; and it will not be abrogated even at that

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(M) Bull. *Op. Latin.* p. 412, 414, 415, 430, 434, 514, 516, 544, 583, 645, 668. *Edit. ult.*—Stillingfleet's Works, vol. III. p. 367, 380, 393, 398.—Tillotſon's Poſthumous Sermons, vol. II. p. 484, 487.

(N) Voſſius *de Bonis Operibus*, Theſ. x. p. 370.—Op. tom. VI. *Frid. Spanhem. fil.* Op. tom. III. p. 141, 159.

that period when faith ſhall give place to viſion, and hope to enjoyment. By the grace of the Chriſtian covenant, all mankind are rendered immortal in conſequence of the death and reſurrection of Chriſt, who is the Lamb ſlain, in the divine decree, from the foundation of the world; but to obtain immortal *happineſs*, they muſt obſerve the conditions both of natural and of revealed religion, which are repentance from dead works, and faith in Chriſt the Redeemer. The former is that condition upon which alone we can retain the Divine favour, and of courſe enjoy either preſent or future happineſs; the latter is a moſt equitable acknowledgement required of us, that perpetual conſcious exiſtence is neither a right inherent in our nature, nor a debt due to our virtuous obedience, but merely the gift of God through Jeſus Chriſt our Lord.

214
The different conditions of divine favour and of eternal life.

“ To make the diſtinct provinces of faith and works in the buſineſs of juſtification clear, let us ſuppoſe (ſays biſhop Warburton †), that, at the publication of the goſpel, all to whom the glad tidings of immortality were offered on the condition of *faith in Jeſus* had been moral or virtuous men, and on that account entitled (as natural religion teacheth) to the favour of God and an abundant reward; is it not ſelf-evident, that FAITH ALONE, excluſive of the condition of good works, would, in that caſe, have been the very thing which *juſtified* or entitled them to life *everlaſting*? But are *good works*, therefore, of no uſe in the Chriſtian ſyſtem? So far from it, that thoſe only who ſerve God in ſincerity and in truth are capable of the juſtification which faith alone embraces; for, to illuſtrate this matter by a familiar inſtance, ſuppoſe a Britiſh monarch to beſtow, in *free gift*, a certain portion of his own *domains*, to which immortality may well be compared, upon ſuch of his ſubjects as ſhould perform a certain ſervice to which they were not obliged by the laws of the kingdom; it is evident that the performance of this laſt ſervice ONLY would be the thing which entitled them to the *free gift*. Yet it is obvious that obedience to the laws, which gave them a claim to protection as ſubjects, in the enjoyment OF THEIR OWN PROPERTY (to which the reward offered by natural religion may be compared), would be a previous and neceſſary qualification to their enjoyment of their new poſſeſſion; ſince it is abſurd to ſuppoſe that ſuch a *gift* could be intended for rebels and traitors, or indeed for any but good and faithful ſervants of their king and country.” Well therefore might the apoſtle reprove the ignorance or licentiouſneſs of certain of his converts at Rome, in his queſtion—“ Do we then make void the LAW through FAITH? God forbid! yea, we ESTABLISH THE LAW;” obedience to it being the previous qualification of all who are entitled to the fruits of juſtifying faith—LIFE AND IMMORTALITY.

† Div. Leg. book ix. chap. 3.

215
Illuſtrated by a familiar example.

Had proper attention been paid to this diſtinction, which St Paul everywhere makes between ſuch duties as are common to all religions that are true, and thoſe which are peculiar to the Chriſtian revelation, many uſeleſs controverſies might have been avoided reſpecting the inſtrument of juſtification and the conditions of the Chriſtian covenant. By not attending to it, the divines of one ſchool, who perceive that the mere belief of any truth whatever cannot entitle a man to eternal felicity, have almoſt dropt faith from their ſyſtem of Chriſtianity, and taught moral duties like Pagan philoſophers; whilſt another party, who err almoſt as far in their interpretations of ſcripture, finding eternal life repreſented as the *gift of God*, and faith in Chriſt as the inſtrument or means by which that gift muſt be accepted, have expunged from their ſyſtem the neceſſity of good works, forgetting ſurely that wicked believers, like believing devils, may be doomed to an eternity of torments. But the ſum of Chriſtianity, as we are taught by the beloved diſciple, is comprehended in this one commandment of God, “ that we ſhould believe on the name of his Son Jeſus Chriſt, and love one another as he gave us commandment.” In perfect harmony with him, the great apoſtle of the Gentiles, from whoſe miſtaken words much empty noiſe has been raiſed about this queſtion, aſſures us §, that “ in Chriſt Jeſus nothing can avail to our eternal happineſs but faith which WORKETH BY LOVE;” and he informs Titus ||, that it “ is a true ſaying, and what he wills to be conſtantly affirmed, that they who have believed in God be careful to maintain good works.”

216
Sum of Chriſtianity.

§ Gal. v. 6.

|| iii. 8.

Indeed no man can have complete faith in Chriſt, who believes not the promiſes of the goſpel; but all thoſe promiſes, except the ſingle one of a reſurrection from the dead to perpetual conſcious exiſtence, are made to us upon the expreſs condition that we obey the law of the goſpel; “ for God will render to every man according to his deeds: to them that are contentious and do not obey the truth, but obey unrighteouſneſs, indignation and wrath; tribulation and anguiſh upon every ſoul of man that doth evil, of the Jew firſt and alſo of the Gentile; but glory, honour, and peace to every man that worketh good, to the Jew firſt and alſo to the Gentile *.”

* Rom. ii. 8, 9.

Such are the notions of juſtification entertained by thoſe who in the preſent age have been conſidered as the leaders † of the ſect of Arminians. How far they are juſt, the reader muſt decide for himſelf, as our buſineſs is little more than to collect into one point of view the ſcattered opinions of others; but under every view of this doctrine which we have taken, the Chriſtian covenant appears much more gracious than that into which Adam was admitted in paradiſe; ſince it affords room for repentance, even to that man, who may be ſo unhappy as to be withdrawn for a time into apoſtacy from the terms of the covenant. Whether the death of Chriſt therefore was a *direct* atonement for the actual ſins of men, or only operated as ſuch *indirectly* by procuring for them repeated opportunities of repentance, it is an undoubted truth, that “ if through the offence of one many be dead, much more the grace of God, and the gift by grace, which is by one man, Jeſus Chriſt, hath abounded unto many. And not as it was by one that ſinned, ſo is the gift: for the judgment was of one offence to *condemnation*, but the free gift is of many offences to *juſtification* ||.”

† Warburton and Law, &c.

217
The Chriſtian covenant more gracious than the paradiſaical

|| Rom. v. 16, 17

Thus graciouſly has the divine goodneſs diſplayed itſelf in the reſtoration of our loſt inheritance. But it ſtopt not here. The ſame bountiful Lord of life, for its further ſecurity, imparts to every true believer the ſtrength and light of his holy ſpirit to ſupport faith in working out our own ſalvation. Our bleſſed Saviour, “ who gave himſelf for us, that he might redeem us not only from death, but likewiſe from all iniquity, and purify to himſelf a peculiar people zealous of good works §,” promiſed, before he left this world, to ſend to his followers the Holy Ghoſt or Comforter to abide with them for ever, to guide them into all truth, to bring all things to their remembrance whatſoever he had ſaid unto them, and as we learn from other paſſages of ſcripture, to “ work in them both to will and to do of his good pleaſure.” How amply this promiſe was fulfilled to the apoſtles, we have already ſeen; but we are not to ſuppoſe that it was reſtricted to them. As man is deſigned for a ſupernatural ſtate in heaven, he ſtands in need of ſupernatural direction to guide him to that ſtate. “ No man (ſays our Saviour) can come to me except the Father draw him; for as no man knoweth the things of a man ſave the ſpirit of a man which is in him, even ſo none knoweth the things of God but the Spirit of God.” This omniſcient Spirit indeed “ ſearcheth all things, yea even the deep things of God,” and revealeth them to the ſons of men, to enlighten

§ Titus ii. 14

218
Chriſtians ſanctified by the Holy Ghoſt, who

their underſtandings and purify their hearts. The grace which he ſheds abroad is either external and general, or internal and particular. The former has been extended to the whole church of God under the patriarchal, Moſaic, and Chriſtian diſpenſations, in ſuch a revelation of the divine will as was ſufficient to inſtruct men unto eternal life, whether they had a clear view or not of that ſtupendous plan of redemption, by which the kingdom of heaven was opened to them after the forfeiture of the terreſtrial paradiſe; for there have been "holy prophets ever ſince the world began; and prophecy came not at any time by the will of man, but holy men of God ſpake as they were moved by the Holy Ghoſt*." Hence it is that all ſcripture was given by inſpiration of God to teach us every thing which it is neceſſary for us to know and believe; and the ſcripture is that work of the ſpirit which is extended to the univerſal church.

But the ſame ſpirit which thus generally reveals the object of faith to the church, does likewiſe particularly illuminate the minds of individual believers, working in them an aſſent to that which is taught them from the written word. It was thus that "the Lord opened the heart of Lydia †, that ſhe attended to the things which were ſpoken of Paul;" it is thus that "the word preached doth not profit if it be not mixed with faith in them who hear it ‡;" and it is thus that "God deals to every man the meaſure of faith;‖" for "by grace are we ſaved through faith, which is not of ourſelves; it is the gift of God §." This illumination of the Spirit was conveyed to the apoſtles "in a ſound from heaven as of a ruſhing mighty wind," becauſe it was meant to teſtify to the world that they were choſen miniſters of the goſpel; but the ordinary Chriſtian receives it "in the ſtill ſmall voice," becauſe it is conveyed to him only to "open his underſtanding that he may underſtand the ſcriptures."

219
Regenerates them,

Another operation of the Spirit on the minds of believers is that which in ſcripture is called REGENERATION; for "according to his mercy God ſaveth us by the waſhing of regeneration and renewing of the Holy Ghoſt*, which he ſheds on us abundantly through Jeſus Chriſt our Lord." To thoſe who believe that we derive from Adam a corrupted nature, this particular grace muſt appear ſo abſolutely neceſſary, that without it we could have no reliſh for heaven or heavenly things. "The natural man (we are told) receiveth not the things of the ſpirit of God; for they are fooliſhneſs to him; neither can he know them, becauſe they are ſpiritually diſcerned." Indeed whatever be the powers of our moral faculties, when compared with thoſe of our firſt father, it is ſo long before they be completely developed, that we ſhould infallibly be loſt, if we were not bleſſed by a ſupernatural guide, when reaſon is incapable of directing our conduct. Our paſſions and appetites are in their full ſtrength before experience has furniſhed the mind with materials, by means of which motives may be weighed; and therefore it would be impoſſible during the giddy period of youth, to keep them in due ſubjection, or to prevent vicious habits from being formed, were we not influenced by divine grace. So true is it, that "except a man be born again of water and of the Holy Ghoſt, he cannot enter into the kingdom of God." This change in our diſpoſitions, from an immoderate attachment to earth to a reliſh for the things of heaven, is in ſcripture called "a renewing of our minds, a new creation, a new man;" in oppoſition to our natural diſpoſition, which is called "the old man, corrupted according to the deceitful luſts." The ancient fathers of the church, as well as ſome very eminent modern divines †, generally ſpeak of baptiſm as the inſtrument in God's hand of man's regeneration; and for the truth of their opinion they appeal to John iii. 3, 5, Epheſ. v. 25, 26. and 1 Cor. vi. 11. in which great ſtreſs is certainly laid upon the waſhing of water, as well as upon ſanctification by the word.

220
Guides them through life,

A third office of the Holy Spirit is to lead, direct, and govern us through all the periods of our lives. Without ſuch a leader and guide, the temptations with which we are ſurrounded would certainly overcome us, and we ſhould faint long before we arrive at the end of our journey. By the very conſtitution of our nature we are ſubjected in ſome degree to the influence of ſenſe, of which the objects are preſent, whilſt the enjoyments of heaven are future, and ſeen, as at a diſtance, only by the eye of faith; but "the law of the Spirit of life, in Chriſt Jeſus, hath made us free from the law of ſin and death; for God worketh in us both to will and to do of his good pleaſure; and as many as are thus led by the ſpirit of God, they are the ſons of God; and while they walk in the Spirit, they do not fulfil the luſts of the fleſh." Without the aid of the ſame Spirit, we could not even make our prayers acceptable; for ſince "our confidence in God is, that he heareth us only when we aſk any thing according to his will; and ſince we know not what we ſhould pray for as we ought, the Spirit itſelf maketh the interceſſion for us with groanings which cannot be uttered*."

221
Unites them to Chriſt,

A fourth operation of the Holy Ghoſt, as he is the ſanctifier of Chriſtians, is to join them to Chriſt, and make them members of that one body of which he is the head. "For by one Spirit are we all baptized into one body †; and as the body is one and hath many members, and all the members of that one body being many are one body, ſo alſo is Chriſt." "Hereby we know that God abideth in us, by the Spirit which he hath given us;" and as, in the ordinary courſe of his dealings with Chriſtians, this Spirit is firſt given in baptiſm, ſo is it continued to the faithful by the inſtrumentality of the Lord's ſupper. That ordinance we have elſewhere (ſee *SUPPER of the Lord*) proved to be a federal rite; and ſurely no time can be ſuppoſed ſo highly ſanctified for the reception of the graces of the Holy Spirit, as that in which we renew our federal union with our Lord and Maſter in the communion of his body and blood.

It is likewiſe the office of the Holy Ghoſt to give us an earneſt of our everlaſting inheritance, to create in us a ſenſe of the paternal love of God, and thereby to aſſure us of the adoption of ſons. "As many as are led by the Spirit of God, they are the SONS of God; and becauſe we are ſons, God hath ſent forth the ſpirit of his Son into our hearts. For we have not received the ſpirit of bondage again to fear; but we have received the Spirit of adoption, whereby we cry Abba Father; the Spirit itſelf bearing witneſs with our ſpirit, that we are the children of God ‡."

222
And ſanctifies the adminiſtrations of the miniſters of the goſpel.

As the gifts of grace are generally annexed to means, to the proper uſe of the word and ſacraments, it is a ſixth office of the ſame Spirit to ſanctify ſuch perſons as are regularly ſet apart for the work of the miniſtry, and ordained to offer up the public prayers of the people; to bleſs them in the name of God; to teach the doctrines of the goſpel; to adminiſter the ſacraments inſtituted by Chriſt; and to perform all things neceſſary "for the perfecting of the ſaints, for the work of the miniſtry, for the edifying of the body of Chriſt*." The ſame Spirit which illuminated the apoſtles, and endowed them with power from above to perform perſonally their apoſtolic functions, fitted them alſo for ſending others, as they were ſent by their Divine Maſter; and for eſtabliſhing ſuch a conſtitution of the church as was beſt adapted for preſerving Chriſtians in the unity of the Spirit and bond of peace. They committed a ſtanding power to a ſucceſſive miniſtry to be conveyed down to the end of the world; and thoſe who are veſted with that power are obliged to "take heed unto themſelves, and to all the flock over which the Holy Ghost hath made them overſeers, to ſeed the church of God, and to contend earneſtly for the faith which was once delivered unto the ſaints†." See Episcopacy, Independents, Presbyterians, Pope, and Quakers.

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* Luke i. 70. and 2 Peter i. 21.

† Acts xvi. 14.

‡ Heb. iv. 2.

‖ Rom. xii. 3.

§ Eph. ii. 8.

* Titus i. 5, 6.

† Clarke and Waterland.

* Rom. viii. 26.

† 1 Cor. xii. 12, 13.

‡ Gal. iv. 6. Rom. viii. 15, 16.

* Eph. iv. 12.

223
Controverſies occaſioned by this doctrine.

By theſe, and the like means, doth the Spirit of God ſanctify the ſons of men; and in conſequence of this ſanctification proceeding immediately from his office, he is called the Holy Spirit and the Comforter. This is ſuch a proviſion "for renewing us in the ſpirit of our minds, and enabling us to put on the new man, which, after God, is created in righteouſneſs and true holineſs," as, when made known by revelation appears to have been expedient, may be conceived to have been even neceſſary, and, though reaſon could hardly have hoped for it, is contradicted by none of our natural notions either of God or of man. Many, however, are the controverſies to which it has given riſe in the church of God; ſome contending that it is given only unto the elect, upon whom it operates with reſiſtleſs efficacy; others affirming that it is offered to all, but in ſuch a manner as that, by the abuſe of their free will, it may be "reſiſted, grieved, and quenched;" and ſome few, ſtill intoxicated with the pride of Pelagius, think it is not neceſſary, and of courſe is not beſtowed.

224
Diſcuſſed elſewhere.

The queſtions concerning *election*, the *efficacy of grace*, and the final *perſeverance of the ſaints*, we have ſtated elſewhere, and given a ſummary view of the arguments by which the contending parties maintain their reſpective opinions (ſee Predestination); and the texts of Scripture which we have juſt quoted, under the different heads of ſanctification, ſhow ſufficiently that the opinion of Pelagius is directly contrary to the doctrine of the apoſtles. It may not be improper to inquire whether it be as agreeable to reaſon and experience as its proud patrons ſeem to imagine.

225
Opinions of the heathens concerning it.

If it be unreaſonable to expect any aſſiſtance from the Spirit of God in carrying on the work of our own ſalvation, how came ſo many of the wiſeſt and beſt of men in all ages to believe, that he who ſincerely endeavours to diſcharge his duty is ſupported in that endeavour by aſſiſtance from heaven? That ſuch was the popular belief of the early Greeks, is evident from the poems of Homer; in which we everywhere find ſome god calming the paſſions of the heroes, altering their determinations when improper, and inſpiring them with wiſdom. Nor was this the ſentiment of the poets only. Socrates, it is well known, profeſſed to believe that his own conduct was under the direction of a ſuperior ſpirit, which he called a *demon*; and Plutarch, as we find him quoted by Wollaſton, ſpeaks of the gods aſſiſting men, by "exciting the powers or faculties of the ſoul; by ſuggeſting ſecret principles, imaginations, or thoughts; or, on the contrary, by diverting or ſtopping them." Of the ſame opinion muſt Cicero have been, when he ſaid, "ſtabit illud quidem, quod locum hunc continet, de quo agimus, eſſe Deos, et eorum providentia mundum adminiſtrari, eoſdemque conſulere rebus humanis, nec ſolum *univerſis*, verum etiam SINGULIS*;" for it is not conceivable that a particular providence can be adminiſtered without the influence of the Deity on the minds of men. That the poets and philoſophers of the heathen world derived theſe notions from primeval tradition, cannot, we think, be queſtioned; but if they were abſurd in themſelves, or apparently contradictory to the laws of nature, they would not ſurely have been ſo univerſally embraced; for it will hardly be denied, that Socrates and Cicero were men of as great natural ſagacity as Pelagius or any of his followers. It is indeed ſo far from being incredible that the Father of ſpirits occaſionally directs the thoughts and actions of men, that we believe there are very few who have made obſervations upon themſelves and their own affairs, who have not found, upon reflection, many inſtances in which their uſual judgment and ſenſe of things were *over-ruled*, they know not *how* or *why*; and that the actions which they performed in thoſe circumſtances have had conſequences very remarkable in their general hiſtory. See Providence, nº 18, 19.

This being the caſe, why ſhould the pride of Chriſtians make them heſitate to admit, upon the authority of divine revelation, what Socrates, and Plutarch, and Cicero, and all the virtuous and wiſe men of antiquity, admitted in effect, upon no better evidence than that of oral tradition, ſupported by their own meditations on their own thoughts, and the principles of their own conduct? Is it that they ſee not ſuch beneficial effects of Chriſtianity as to induce them to believe the profeſſors of that religion to be indeed "choſen to ſalvation through the ſanctification of the Spirit ||?" Let them ſtudy the practical precepts of the goſpel, conſider the conſequences which they have had on the peace and happineſs of ſociety, and compare the general conduct of Chriſtians with that of the Jews, Pagans, and Mahometans (ſee Religion), and they will doubtleſs find reaſon to alter their opinion; and let thoſe who embrace the truth, remember, that as they are the temple of God, if the Spirit of God dwell in them, "it is their indiſpenſable duty to cleanſe themſelves from all filthineſs of the fleſh and ſpirit; to follow peace with all men, and holineſs, without which no man ſhall ſee the Lord; and to work out their own ſalvation with fear and trembling, ſince it is God who worketh in them both to will and to do of his good pleaſure."

226
The goſpel the laſt revelation.

From this ſhort view of the ſeveral diſpenſations of revealed religion, it is evident that the goſpel is not only the beſt but the laſt gift of the kind which man has to expect from his Maker; that the ſcheme of revelation is completed; and that the pretences of Mahomet and of more modern enthuſiaſts to divine inſpiration are not only falſe, but fraught with contradictions. All theſe men admit the divine origin of the Moſaic and Chriſtian religions; but it appears from the ſcriptures, in which thoſe religions are taught, that the ſyſtem of revealed truths which conſtitute the Patriarchal, Moſaic, and Chriſtian revelations, commenced with the fall of man, and that it muſt therefore neceſſarily end with his reſtoration to life and immortality by the ſacrifice of Chriſt upon the croſs. A new revelation therefore like that of Mahomet cannot be admitted without rejecting the whole Bible, though the impoſtor himſelf everywhere acknowledges the inſpiration of Abraham, of Moſes, and of Chriſt. Nor is greater regard due to the claims of Chriſtian enthuſiaſts. Such of theſe men as pretend to have been in heaven †, and thence to have brought ſpiritual diſcoveries to the earth, have either forgotten or never underſtood, that in the ſcriptures of the Old and New Teſtaments the great ſcene of providence appears to be cloſed in the full completion of its one regular, entire, and eternal purpoſe; that St Paul has pronounced ‡ a curſe upon any man or angel from heaven who ſhall preach another goſpel than what has been already preached by the apoſtles and evangeliſts; that in their writings we are taught every thing which it is our duty to believe or to practiſe in order to our own ſalvation; and that we have the promiſe of our bleſſed Lord himſelf, that the Spirit of truth ſhall remain with us to guide us into all neceſſary truth, till that great day when he ſhall come again to judge the world in righteouſneſs, and render to every man according to his works.

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† Acts xx. 18. and Jude ver. 3.

* De Div. lib. 1. ſect. 51.

|| Theſſ. ii. 3.

† Boehman, Swedenbourgh, and others.

‡ Gal. i. 8.

THEOPHRASTA, in botany; a genus of plants belonging to the claſs of *pentandria* and order of *monogynia*. The corolla is campanulated, with diviſions and ſegments obtuſe; the capſule unilocular, globular, very large, and many-ſeeded. There is only one ſpecies, the *americana*.

THEOPHRASTUS, the philoſopher, was born about 371 years before Chriſt, and was ſucceſſively the diſciple of Plato and of Ariſtotle. He ſucceeded Ariſtotle in the Peripatetic ſchool, and conducted the charge with ſuch high reputation that he had about 2000 ſcholars. He is highly celebrated for his induſtry, learning, and eloquence; and for his generoſity and public ſpirit. He is ſaid to have twice freed his country from the oppreſſion of tyrants. He contributed liberally towards defraying the expence attending the public meetings of philoſophers; which were held, not for the ſake of ſhew, but for learned and ingenious converſation. In the public ſchools he commonly appeared, as Ariſtotle had done, in an elegant dreſs, and was very attentive to the graces of elocution. He lived to the advanced age of 85: Some ſay of 107. Towards the cloſe of his life, he grew exceedingly infirm, and was carried to the ſchool on a couch. He expreſſed great regret on account of the ſhortneſs of life; and complained that nature had given long life to ſtags and crows, to whom it is of ſo little value, and had denied it to man, who, in a longer duration, might have been able to attain the ſummit of ſcience; but now, as ſoon as he arrives within ſight of it, is taken away. His laſt advice to his diſciples was, that, ſince it is the lot of man to die as ſoon as he begins to live, they would take more pains to enjoy life as it paſſes, than to acquire poſthumous fame. His funeral was attended by a large body of Athenians. He wrote many valuable works, of which all that remain are, ſeveral treatiſes on the Natural Hiſtory of Plants and Foſſils; Of Winds, Of Fire, &c. a rhetorical work intitled "Characters," and a few Metaphyſical Fragments.

Enfield's Hiſtory of Philoſophy.

To Theophraſtus we are indebted for preſerving the works of Ariſtotle. See ARISTOTLE.

THEOPOMPUS, a celebrated Greek orator and hiſtorian, was born in the iſland of Chios, and flouriſhed in the reign of Alexander the Great. He was one of the moſt famous of all the diſciples of Iſocrates, and won the prize from all the panegyriſts whom Artemiſia invited to praiſe Mauſolus. He wrote ſeveral works, which are loſt.

THEOREM, a propoſition which terminates in theory, and which conſiders the properties of things already made or done; or it is a ſpeculative propoſition deduced from comparing together ſeveral definitions. A theorem is ſomething to be proved, and a problem ſomething to be done.

THEORETIC, ſomething relating to theory, or that terminates in ſpeculation.

THEORY, in general, denotes any doctrine which terminates in ſpeculation, without conſidering the practical uſes or application thereof.

THEOSOPHISTS, a ſect of men who pretend to derive all their knowledge from divine illumination. They boaſt that, by means of this celeſtial light, they are not only admitted to the intimate knowledge of God, and of all divine truth, but have acceſs to the moſt ſublime ſecrets of nature. They aſcribe it to the ſingular manifeſtation of divine benevolence, that they are able to make ſuch a uſe of the element of fire, in the chemical art, as enables them to diſcover the eſſential principles of bodies, and to diſcloſe ſtupendous myſteries in the phyſical world. They even pretend to an acquaintance with thoſe celeſtial beings which form the medium of intercourſe between God and man, and to a power of obtaining from them, by the aid of magic, aſtrology, and other ſimilar arts, various kinds of information and aſſiſtance. To this claſs belonged Paracelſus, Robert Fludd, Jacob Boehmen, Van Helmont, Peter Poiret, and the Roſicrucians. They are alſo called *Fire-Philoſophers*, which ſee.

Ibid.

THERAPEUTÆ, a term applied to thoſe that are wholly in the ſervice of religion. This general term has been applied to particular ſects of men, concerning whom there have been great diſputes among the learned.

THERAPEUTICS, that part of medicine which acquaints us with the rules that are to be obſerved, and the medicines to be employed, in the cure of diſeaſes.

THERIACA ANDROMACHI, a compound medicine made in the form of an electuary. See PHARMACY, nº 605.

THERMÆ, hot baths or bagnios. Luxury and extravagance were in nothing carried to ſuch heights as in the thermæ of the Roman emperors. Ammian complains, that they were built to ſuch an extent as to equal whole provinces; from which Valeſius would abate, by reading *piſcinæ* inſtead of *provinciæ*. And yet after all, the remains of ſome ſtill ſtanding are ſufficient teſtimonies for Ammian's cenſure; and the accounts tranſmitted of their ornaments and furniture, ſuch as being laid with precious ſtones (Seneca), ſet round with ſeats of ſolid ſilver (Pliny), with pipes and ciſterns of the ſame metal (Statius), add to, rather than take from, the cenſure. The moſt remarkable bagnios were thoſe of Diocleſian and Caracalla at Rome, great part of which remains at this day; the lofty arches, ſtately pillars, variety of foreign marble, curious vaulting of the roofs, great number of ſpacious apartments, all attract the curioſity of the traveller. They had alſo their ſummer and winter baths.

THERMOMETER, an inſtrument for meaſuring the degree of heat or cold in any body.

1 Invention of the thermometer. Martine's Eſſays.

The thermometer was invented about the beginning of the 17th century; but, like many other uſeful inventions, it has been found impoſſible to aſcertain to whom the honour of it belongs. Boerhaave[*] aſcribes it to Cornelius Drebbel of Alcmar, his own countryman. Fulgenzio[†] attributes it to his maſter Paul Sarpi, the great oracle of the Venetian republic; and Viviani gives the honour of it to Galilæo[§]. But all theſe are poſthumous claims. Sanctorio[‡] claims this honour to himſelf; and his aſſertion is corroborated by Borelli[§] and Malpighi[*] of the Florentine academy, whoſe partiality is not to be ſuſpected in favour of a member of the Patavinian ſchool.

Perhaps the beſt way to reconcile theſe different claims would be, to ſuppoſe that the thermometer was really invented by different perſons about the ſame time. We know that there are certain periods in the progreſs of the arts when the ſtream of human genius runs in the ſame direction, and moves towards the ſame object. That part of the current which reaches the object firſt may poſſeſs the title; but the other parts follow ſo rapidly and arrive ſo ſoon after, that it is impoſſible for a ſpectator to decide which is firſt in point of time.

2 The air thermometer deſcribed.

The firſt form of this inſtrument for meaſuring the degrees of heat and cold, was the air thermometer. It is a well known fact that air expands with heat ſo as to occupy more ſpace than it does when cold, and that it is condenſed by cold ſo as to occupy leſs ſpace than when warmed, and that this expanſion and condenſation is greater or leſs according to the degree of heat or cold applied. The principle then on which the air-thermometer was conſtructed is very ſimple. The air was confined in a tube by means of ſome coloured liquor; the liquor roſe or fell according as the air became expanded or condenſed. What the firſt form of the tube was, cannot now perhaps be well known; but the following deſcription of the air-thermometer will fully explain its nature.

The air thermometer conſiſts of a glaſs tube BE, connected

Plate DVI. fig. 1.

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[*] Chem. I. p. 152, 156.

[†] Life F. Paul p. 158.

[§] Vit. Galil. p. 67.

[‡] Corn. in Galen. p. 736—842.

[§] De Mot. Animal. II. prop. 175.

[*] Opera Poſth. p. 30.

nected at one end with a large glaſs ball A, and at the other end immerſed in an open veſſel, or terminating in a ball DE, with a narrow orifice at D; which veſſel, or ball, contains any coloured liquor that will not eaſily freeze. Aquafortis tinged of a fine blue colour with a ſolution of vitriol or copper, or ſpirit of wine tinged with cochineal, will anſwer this purpoſe. But the ball A muſt be firſt moderately warmed, ſo that a part of the air contained in it may be expelled through the orifice D; and then the liquor preſſed by the weight of the atmoſphere will enter the ball DE, and riſe, for example, to the middle of the tube at C, at a mean temperature of the weather; and in this ſtate the liquor by its weight, and the air included in the ball A, &c. by its elaſticity, will counterbalance the weight of the atmoſphere. As the ſurrounding air becomes warmer, the air in the ball and upper part of the tube, expanding by heat, will drive the liquor into the lower ball, and conſequently its ſurface will deſcend; on the contrary, as the ambient air becomes colder, that in the ball is condenſed, and the liquor preſſed by the weight of the atmoſphere will aſcend: ſo that the liquor in the tube will aſcend or deſcend more or leſs according to the ſtate of the air contiguous to the inſtrument. To the tube is affixed a ſcale of the ſame length divided upwards and downwards from the middle C into 100 equal parts, by means of which the aſcent and deſcent of the liquor in the tube, and conſequently the variations in the cold or heat of the atmoſphere, may be obſerved.

3
Its defects.

This inſtrument was extremely defective; for the air in the tube was not only affected by the heat and cold of the atmoſphere, but alſo by its weight.

4
The ſpirit of wine thermometer

The air being found improper for meaſuring with accuracy the variations of heat and cold according to the form of the thermometer which was firſt adopted, another fluid was propoſed about the middle of the 17th century by the Florentine academy. This fluid was ſpirit of wine, or alcohol, as it is now generally named. The alcohol being coloured, was incloſed in a very fine cylindrical glaſs tube previouſly exhauſted of its air, having a hollow ball at one end A, and hermetically ſealed at the other end D. The ball and tube are filled with rectified ſpirit of wine to a convenient height, as to C, when the weather is of a mean temperature, which may be done by inverting the tube into a veſſel of ſtagnant coloured ſpirit, under a receiver of the air pump, or in any other way. When the thermometer is properly filled, the end D is heated red hot by a lamp, and then hermetically ſealed, leaving the included air about $\frac{1}{3}$ of its natural denſity, to prevent the air which is in the ſpirit from dividing it in its expanſion. To the tube is applied a ſcale, divided from the middle, into 100 equal parts, upwards and downwards.

As ſpirit of wine is capable of a very conſiderable degree of rarefaction and condenſation by heat and cold, when the heat of the atmoſphere increaſes the ſpirit dilates, and conſequently riſes in the tube; and when the heat decreaſes, the ſpirit deſcends, and the degree or quantity of the motion is ſhown by a ſcale.

5
Its defects.

Martine's Eſſays.

The ſpirit of wine thermometer was not ſubject to ſome of the inconveniences which attended the air thermometer. In particular, it was not affected by variations in the weight of the atmoſphere: accordingly it ſoon came into general uſe among philoſophers. It was, at an early period, introduced into Britain by Mr Boyle. To this inſtrument, as then uſed, there are, however, many objections. The liquor was of different degrees of ſtrength, and therefore different tubes filled with it, when expoſed to the ſame degree of heat, would not correſpond. There was alſo another defect: The ſcale which was adjuſted to the thermometer did not commence at any fixed point. The higheſt term was adjuſted to the great ſunſhine heats of Florence, which are too variable and undetermined; and frequently the workman formed the ſcale according to his own fancy. While the thermometer laboured under ſuch diſadvantages it could not be of general uſe.

6
Different fixed points propoſed by philoſophers.

To obtain ſome fixed unalterable point by which a determined ſcale might be diſcovered, to which all thermometers might be accurately adjuſted, was the ſubject which next drew the attention of philoſophers. Mr Boyle, who ſeems at an early period to have ſtudied this ſubject with much anxiety, propoſed the freezing of the eſſential oil of anniſeeds as a convenient point for graduating thermometers; but this opinion he ſoon laid aſide. Dr Halley next propoſed that thermometers ſhould be graduated in a deep pit under ground, where the temperature both in winter and ſummer is pretty uniform; and that the point to which the ſpirit of wine ſhould riſe in ſuch a ſubterraneous place ſhould be the point from which the ſcale ſhould commence. But this propoſal was evidently attended with ſuch inconveniences that it was ſoon abandoned. He made experiments on the boiling point of water, of mercury, and of ſpirit of wine; and he ſeems rather to give a preference to the ſpirit of wine*. He objected to the freezing of water as a fixed point, becauſe he thought that it admitted conſiderable latitude.

7
Sir Iſaac Newton's oil thermometer.

It ſeems to have been reſerved to the all conquering genius of Sir Iſaac Newton to determine this important point, on which the accuracy and value of the thermometer depends. He choſe, as fixed, thoſe points at which water freezes and boils; the very points which the experiments of ſucceeding philoſophers have determined to be the moſt fixed and convenient. Senſible of the diſadvantages of ſpirit of wine, he tried another liquor which was homogeneous enough, capable of a conſiderable rarefaction, about 15 times greater than ſpirit of wine. This was linſeed oil. It has not been obſerved to freeze even in very great colds, and it bears a heat about four times that of water before it boils. With theſe advantages it was made uſe of by Sir Iſaac Newton, who diſcovered by it the comparative degree of heat for boiling water, melting wax, boiling ſpirit of wine, and melting tin; beyond which it does not appear that this thermometer was applied. The method he uſed for adjuſting the ſcale of this oil thermometer was as follows: Suppoſing the bulb, when immerged in thawing ſnow, to contain 10,000 parts, he found the oil expand by the heat of the human body ſo as to take up $\frac{1}{39}$th more ſpace, or 10,256 ſuch parts; and by the heat of water boiling ſtrongly 10,725, and by the heat of melting tin 11,516. So that reckoning the freezing point as a common limit between heat and cold, he began his ſcale there, marking it 0, and the heat of the human body he made 12°; and conſequently, the degrees of heat being proportional to the degrees of rarefaction, or $256 : 725 :: 12 : 34$, this number 34 will expreſs the heat of boiling water; and by the ſame rule, 72 that of melting tin‡. This thermometer was conſtructed in 1701.

8
Its imperfections.

To the application of oil as a meaſure of heat and cold, there are inſuperable objections. It is ſo viſcid, that it adheres too ſtrongly to the ſides of the tube. On this account it aſcends and deſcends too ſlowly in caſe of a ſudden heat or cold. In a ſudden cold, ſo great a portion remains adhering to the ſides of the tube after the reſt has ſubſided, that the ſurface appears lower than the correſponding temperature of the air requires. An oil thermometer is therefore not a proper meaſure of heat and cold.

9
Reaumur's ſpirit of wine thermometer.

All the thermometers hitherto propoſed were liable to many inconveniences, and could not be conſidered as exact ſtandards for pointing out the various degrees of temperature. This led Reaumur to attempt a new one, an account of which was publiſhed in the year 1730 in the Memoirs of the Academy of Sciences. This thermometer was made with ſpirit of wine. He took a large ball and tube, the dimenſions and capacities of which were known; he then graduated the tube, ſo that the ſpace from one diviſion to another might contain 1000th part of the liquor; the liquor containing 1000 parts when it ſtood at the freezing point. He adjuſted the thermometer to the freezing point by an artificial congelation of water: then putting the ball of his thermometer and part of the tube into boiling water, he obſerved whether it roſe 80 diviſions: if it exceeded theſe, he changed his liquor, and by adding water lowered it, till upon trial it ſhould juſt riſe 80 diviſions; or if the liquor, being too low, fell ſhort of 80 diviſions, he raiſed it by adding rectified ſpirit to it. The liquor thus prepared ſuited his purpoſe, and ſerved for making a thermometer of any ſize, whoſe ſcale would agree with his ſtandard.

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* Phil. Tranſ. Abr. II. 34.

‡ Phil. Tranſ. No. 270. or Abr. vol. iv. part 2.

Martine's Eſſays on the Conſtruction of Thermometers.

10
Its defects.

This thermometer was far from being perfect. As the bulbs were three or four inches in diameter, the ſurrounding ice would be melted before its temperature could be propagated to the whole ſpirits in the bulb, and conſequently the freezing point would be marked higher than it ſhould be. Dr Martine accordingly found, that inſtead of coinciding with the 32d degree of Fahrenheit, it correſponded with the 34th, or a point a little above it. Reaumur committed a miſtake alſo reſpecting the boiling point; for he thought that the ſpirit of wine, whether weak or ſtrong, when immerged in boiling water, received the ſame degree of heat with the boiling water. But it is well known that highly rectified ſpirit of wine cannot be heated much beyond the 175th degree of Fahrenheit, while boiling water raiſes the quickſilver 37 degrees higher. There is another thermometer that goes by the name of *Reaumur's*, which ſhall be afterwards deſcribed.

11
Mercurial thermometers.

At length a different fluid was propoſed, by which thermometers could be made free from moſt of the defects hitherto mentioned. This fluid was mercury, and ſeems firſt to have occurred to Dr. Halley in the laſt century; but was not adopted by him on account of its having a ſmaller degree of expanſibility than the other fluids uſed at that time*. Boerhaave ſays that the mercurial thermometer was firſt conſtructed by Olaus Roemer; but the honour of this invention is generally given to Fahrenheit of Amſterdam, who preſented an account of it to the Royal Society of London in 1724.

* Phil. Tranſ. vol. xvii. or Abr. vol. ii.

That we may judge the more accurately of the propriety of employing mercury, we will compare its qualities with thoſe of the fluids already mentioned, air, alcohol, and oil.

12
Properties of air, alcohol, and oil.

Air is the moſt expanſible fluid, but it does not receive nor part with its heat ſo quickly as mercury. Alcohol does not expand much by heat. In its ordinary ſtate it does not bear a much greater heat than 175° of Fahrenheit; but when highly rectified it can bear a greater degree of cold than any other liquor hitherto employed as a meaſure of temperature. At Hudſon's Bay, Mr Macnab, by a mixture of vitriolic acid and ſnow, made it to deſcend to 69 below 0 of Fahrenheit. There is an inconvenience, however, attending the uſe of this liquor; it is not poſſible to get it always of the ſame degree of ſtrength. As to oil, its expanſion is about 15 times greater than that of Alcohol; it ſuſtains a heat of 600°, and its freezing point is ſo low that it has not been determined; but its viſcoſity renders it uſeleſs.

13
Thermometrical properties of mercury.

Mercury is far ſuperior to alcohol and oil, and is much more manageable than air. 1. As far as the experiments already made can determine, it is of all the fluids hitherto employed in the conſtruction of thermometers, that which meaſures moſt exactly equal differences of heat by equal differences of its bulk: its dilations are in fact very nearly proportional to the augmentations of heat applied to it (A). 2. Of all liquids it is the moſt eaſily freed from air. 3. It is fitted to meaſure high degrees of heat and cold. It ſuſtains a heat of 600° of Fahrenheit's ſcale, and does not congeal till it fall 39 or 40 degrees below 0. 4. It is the moſt ſenſible of any fluid to heat and cold, even air not excepted. † Sir Benjamin Thompſon, now Count Rumford, found that mercury was heated from the freezing to the boiling point in 58 ſeconds, while water took two minutes 13 ſeconds, and common air 10 minutes and 17 ſeconds. 5. Mercury is a homogeneous fluid, and every portion of it is equally dilated or contracted by equal variations of heat. Any one thermometer made of pure mercury is, *cæteris paribus*, poſſeſſed of the ſame properties with every other thermometer made of pure mercury. Its power of expanſion is indeed about ſix times leſs than that of ſpirit of wine, but it is great enough to anſwer moſt of the purpoſes for which a thermometer is wanted.

Recherches ſur les Mod. de l'Atmoſphere.

† Phil. Tranſ. for 1786.

14
Fixed points.

The fixed points which are now univerſally choſen for adjuſting

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(A) We have affirmed that the expanſions of the bulk of quickſilver by heat are nearly (for they are not ſtrictly ſo) in a regular arithmetical progreſſion, according to the quantity of heat it is expoſed to; and ſuch ſeems to be the caſe according to the Table publiſhed by Mr de Luc, at page 309 of his firſt volume on the Modifications of the Atmoſphere. The following extract of this table ſhows theſe variations: and the firſt and ſecond differences are added, in order to render theſe irregularities more ſenſible. They are ſuch as can hardly be conceived from the nature of any ſubſtance, without the influence of extraneous and accidental cauſes, which may have eſcaped the attention of the obſerver; neither have they been found exactly true by Dr Crawford. Mr de Luc ſuppoſes the whole heat from melting ice to that of boiling water to be divided into 80 parts; by the fractional ſubdiviſions of which he expreſſes the abſolute quantities of heat, anſwering to each 5, or 10 degrees of Reaumur's thermometer (=22,5 of Fahrenheit's ſcale); ſo that the whole ſum of theſe fractions amounts exactly to the aſſumed number 80. They are as follow:

Cronſtedt's Mineralogy, vol. ii.

	Reaumur's Thermometer.	Fahrenheit's Thermometer.	Quantities of heat.	Firſt differences.	Second differences.
Degrees	80	212			
	70	189,5	9,44	,16	
	60	167	9,60	,10	+ ,06
	50	144,5	9,70	,16	— ,06
	40	122	9,86	,22	— ,06
	30	99,5	10,08	,12	+ ,10
	20	77	10,20	,18	— ,06
	10	54,5	10,38	,56	— ,18
	0	32	10,74		

adjuſting thermometers to a ſcale, and to one another, are the boiling and freezing water points. The boiling water point, it is well known, is not an invariable point, but varies ſome degrees according to the weight and temperature of the atmoſphere. In an exhauſted receiver, water will boil with a heat of 98° or 100°; whereas in Papin's digeſter it will acquire a heat of 412. Hence it appears that water will boil at a lower point, according to its height in the atmoſphere, or to the weight of the column of air which preſſes upon it. In order to enſure uniformity therefore in the conſtruction of thermometers, it is now agreed that the bulb of the tube be plunged in the water when it boils violently, the barometer ſtanding at 30 Engliſh inches (which is its mean height round London), and the temperature of the atmoſphere 55°. A thermometer made in this way, with its boiling point at 212°, is called by Dr. Horſley *Bird's Fahrenheit*, becauſe Mr Bird was the firſt perſon who attended to the ſtate of the barometer in conſtructing thermometers.

15 Rule for adjuſting thermometers to theſe.

As artiſts may be often obliged to adjuſt thermometers under very different preſſures of the atmoſphere, philoſophers have been at pains to diſcover a general rule which might be applied on all occaſions. M. de Luc, in his *Recherches ſur les Mod. de l'Atmoſphere* from a ſeries of experiments, has given an equation for the allowance on account of this difference, in Paris meaſure, which has been verified by Sir George Schuckburgh‡; alſo Dr Horſley, Dr Maſkelyne, and Sir George Schuckburgh, have adapted the equation and rules to Engliſh meaſures, and have reduced the allowances into tables for the uſe of the artiſt. Dr Horſley's rule, deduced from De Luc's, is this:

$$\frac{99}{8990000}\log. z - 92\cdot804 = h.$$

where h denotes the height of a thermometer plunged in boiling water, above the point of melting ice, in degrees of Bird's Fahrenheit, and z the height of the barometer in 10ths of an inch. From this rule he has computed the following table, for finding the heights, to which a good Bird's Fahrenheit will riſe when plunged in boiling water, in all ſtates of the barometer, from 27 to 31 Engliſh inches; which will ſerve, among other uſes, to direct inſtrument-makers in making a true allowance for the effect of the variation of the barometer, if they ſhould be obliged to finiſh a thermometer at a time when the barometer is above or below 30 inches; though it is beſt to fix the boiling point when the barometer is at that height.

16 Table formed from the rule.

Equation of the Boiling Point.

Barometer.	Equation.	Difference.
31·0	+ 1·57	0·78
30·5	+ 0·79	0·79
30·0	0·00	0·80
29·5	— 0·80	0·82
29·0	— 1·62	0·83
28·5	— 2·45	0·85
28·0	— 3·31	0·86
27·5	— 4·16	0·88
27·0	— 5·04	

The numbers in the firſt column of this table expreſs heights of the quickſilver in the barometer in Engliſh inches and decimal parts: the ſecond column ſhows the equation to be applied, according to the ſign prefixed, to 212° of Bird's Fahrenheit, to find the true boiling point for every ſuch ſtate of the barometer. The boiling point for all intermediate ſtates of the barometer may be had with ſufficient accuracy, by taking proportional parts, by means of the third column of differences of the equations. See *Phil. Tranſ.* lxiv. art. 30; alſo Dr Maſkelyne's *Paper*, vol. lxiv. art. 20.

17 Sir George Schuckburgh's obſervations compared with De Luc's rules.

In the following table we have the reſult of 15 different obſervations made by Sir George Schuckburgh compared with the reſult of M. de Luc's rules.

Height of the Barometer reduced to the ſame temperature of 50°	Mean boiling Point by Obſervation.	Boiling Point by De Luc's Rules.	Height of Barometer.	Boiling Point by Obſervation.	Boiling Point by De Luc's Rules.
Inch.	°	°	Inch.	°	°
26,498	207,07	208,54	30,008	213,22	213,47
27,241	208,64	208,84	30,207	213,58	213,79
27,954	209,87	210,03	30,489	214,15	214,23
28,377	210,50	210,81	30,763	214,37	214,66
28,699	211,27	211,34	30,847	214,83	214,79
28,898	211,50	211,67	30,957	214,96	214,96
28,999	211,60	211,85			
29,447	212,55	212,74			
29,805	212,95	213,15			

Sir George Schuckburgh has alſo ſubjoined the following general table for the uſe of artiſts in conſtructing the thermometer, both according to his own obſervations and thoſe of M. de Luc.

Height of the Barometer.	Correct of the boiling point.	Difference.	Correct accord. to M. de Luc.	Difference.
	°		°	
26,0	— 7,09	,91	— 6,83	,90
26,5	— 6,18	,91	— 5,93	,89
27,0	— 5,27	,90	— 5,04	,88
27,5	— 4,37	,89	— 4,16	,87
28,0	— 3,48	,89	— 3,31	,86
28,5	— 2,59	,87	— 2,45	,83
29,0	— 1,72	,87	— 1,62	,82
29,5	— 0,85	,85	— 0,80	,80
30,0	0,00	,85	0,00	,79
30,5	+ 0,85	,84	+ 0,79	,78
31,0	+ 1,69		+ 1,57	

18 Obſervations made by a committee of the Royal Society for adjuſting the fixed points.

The Royal Society, fully apprized of the importance of adjuſting the fixed points of thermometers, appointed a committee of ſeven gentlemen to conſider of the beſt method for this purpoſe; and their report is publiſhed in the Phil. Tranſ. vol. lxvii. part ii. art. 37.

They obſerved, that though the boiling point be placed ſo much higher on ſome of the thermometers now made than on others, yet this does not produce any conſiderable error in the obſervations of the weather, at leaſt in this climate; for an error of 10°½ in the poſition of the boiling point, will make an error only of half a degree in the poſition of 92°, and of not more than a quarter of a degree in the point of 62°. It is only in nice experiments, or in trying the heat of hot liquors, that this error in the boiling point can be of much importance.

In adjuſting the freezing as well as the boiling point, the quickſilver in the tube ought to be kept of the ſame heat as that in the ball. When the freezing point is placed at a conſiderable diſtance from the ball, the pounded ice ſhould be piled to ſuch a height above the ball, that the error which can ariſe from the quickſilver in the remaining part of the tube not being heated equally with that in the ball, ſhall be very ſmall, or the obſerved point muſt be corrected on that account according to the following table:

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‡ Phil. Tranſ. for 1775 and 1778.

19
Table for correcting the freezing point.

Heat of the Air.	Correction.
42°	,00087
52	,00174
62	,00261
72	,00348
82	,00435

The correction in this table is expreſſed in 1000th parts of the diſtance between the freezing point and the ſurface of the ice: *e.g.* if the freezing point ſtands ſeven inches above the ſurface of the ice, and the heat of the room is 62, the point of 32° ſhould be placed 7 × 00261, or ,018 of an inch lower than the obſerved point. A diagonal ſcale will facilitate this correction.

20
The quickſilver in the tube ought to be heated to the ſame degree as that in the ball.

The committee obſerve, that in trying the heat of liquors, care ſhould be taken that the quickſilver in the tube of the thermometer be heated to the ſame degree as that in the ball; or if this cannot be done conveniently, the obſerved heat ſhould be corrected on that account; for the manner of doing which, and a table calculated for this purpoſe, we muſt refer to their excellent report in the Phil. Tranſ. vol. lxvii. part ii. art. 37.

21
The tubes ought to be cylindrical and capillary.

With regard to the choice of tubes, they ought to be exactly cylindrical. But though the diameter ſhould vary a little, it is eaſy to manage that matter in the manner propoſed by the Abbé Nollet ||, by making a ſmall portion of the quickſilver, *e.g.* as much as fills up an inch or half an inch, ſlide backward and forward in the tube; and thus to find the proportions of all its inequalities, and from thence to adjuſt the diviſions to a ſcale of the moſt perfect equality. The capillary tubes are preferable to others, becauſe they require ſmaller bulbs, and they are alſo more ſenſible, and leſs brittle. The moſt convenient ſize for common experiments has the internal diameter about the 40th or 50th of an inch, about 9 inches long, and made of thin glaſs, that the riſe and fall of the mercury may be better ſeen.

22
The number of degrees into which the ſcale ought to be divided.

The next thing to be conſidered, is of what number of degrees or diviſions the ſcale ought to conſiſt, and from what point it ought to commence. As the number of the diviſions of the ſcale is an arbitrary matter, the ſcales which have been employed differ much from one another in this circumſtance. Fahrenheit has made 180 degrees between the freezing and boiling water point. Amonton's made 73, and Sir Iſaac Newton only 34. There is, however, one general maxim, which ought to be obſerved: *That ſuch an arithmetical number ſhould be choſen as can eaſily be divided and ſubdivided, and that the number of diviſions ſhould be ſo great that there ſhall ſeldom be occaſion for fractions.* The number 80 choſen by Reaumur anſwers extremely well in this reſpect, becauſe it can be divided by ſeveral figures without leaving a remainder; but it is too ſmall a number: the conſequence of which is, that the degrees are placed at too great a diſtance from one another, and fractions muſt therefore be often employed. We think, therefore, that 160 would have been a more convenient number. Fahrenheit's number 180 is large enough, but when divided its quotient ſoon becomes an odd number.

23
At what point the ſcale ought to commence.

As to the point at which the ſcale ought to commence, various opinions have been entertained. If we knew the beginning or loweſt degree of heat, all philoſophers would agree, that the loweſt point of the thermometer ought to be fixed there; but we know neither the loweſt nor the higheſt degrees of heat; we obſerve only the intermediate parts. All that we can do, then, is to begin it at ſome invariable point, to which thermometers made in different places may eaſily be adjuſted. If poſſible too, it ought to be a point at which a natural well known body receives ſome remarkable change from the effects of heat or cold. Fahrenheit began his ſcale at the point at which ſnow and ſalt congeal. Kirwan propoſes the freezing point of mercury. Sir Iſaac Newton, Hales, and Reaumur, adopted the freezing point of water. The objection to Fahrenheit's loweſt point is, that it commences at an artificial cold never known in nature, and to which we cannot refer our feelings, for it is what few can ever experience. There would be ſeveral great advantages gained, we allow, by adopting the freezing point of mercury. It is the loweſt degree of cold to which mercury can be applied as a meaſure; and it would render unneceſſary the uſe of the ſigns plus and minus, and the extenſion of the ſcale below 0. But we object to it, that it is not a point well known; for few, comparatively ſpeaking, who uſe thermometers, can have an opportunity of ſeeing mercury congealed. As to the other advantage to be gained by adopting the freezing point of mercury, namely, the abolition of negative numbers, we do not think it would counterbalance the advantage to be enjoyed by uſing a well-known point. Beſides, it may be aſked, Is there not a propriety in uſing negative numbers to expreſs the degree of cold, which is a negative thing? Heat and cold we can only judge of by our feelings: the point then at which the ſcale ſhould commence, ought to be a point which can form to us a ſtandard of heat and cold; a point familiar to us from being one of the moſt remarkable that occurs in nature, and therefore a point to which we can with moſt clearneſs and preciſion refer to in our minds on all occaſions. This is the freezing point of water choſen by Sir Iſaac Newton, which of all the general changes produced in nature by cold is the moſt remarkable. It is therefore the moſt convenient point for the thermometers to be uſed in the temperate and frigid zones; we may ſay over the globe, for even in the hotteſt countries of the torrid zone many of the mountains are perpetually covered with ſnow.

24
Only four thermometers generally uſed.

Having now explained the principles of the thermometer as fully as appears neceſſary, in order to make it properly underſtood, we will now ſubjoin an account of thoſe thermometers which are at preſent in moſt general uſe. Theſe are Fahrenheit's, De l'Iſle's, Reaumur's, and Celſius's. Fahrenheit's is uſed in Britain, De l'Iſle's in Ruſſia, Reaumur's in France, and Celſius's in Sweden. They are all mercurial thermometers.

25
Fahrenheit's deſcribed.

Fahrenheit's thermometer conſiſts of a ſlender cylindrical tube and a ſmall longitudinal bulb. To the ſide of the tube is annexed a ſcale which Fahrenheit divided into 600 parts, beginning with that of the ſevere cold which he had obſerved in Iceland in 1709, or that produced by ſurrounding the bulb of the thermometer with a mixture of ſnow or beaten ice and ſal ammoniac or ſea ſalt. This he apprehended to be the greateſt degree of cold, and accordingly he marked it, as the beginning of his ſcale, with 0; the point at which mercury begins to boil, he conceived to ſhow the greateſt degree of heat, and this he made the limit of his ſcale. The diſtance between theſe two points he divided into 600 equal parts or degrees; and by trials, he found that the mercury ſtood at 32 of theſe diviſions, when water juſt begins to freeze, or ſnow or ice juſt begins to thaw; it was therefore called the degree of the freezing point. When the tube was immerſed in boiling water, the mercury roſe to 212, which therefore is the boiling point, and is juſt 180 degrees above the former or freezing point. But the preſent method of making the ſcale of theſe thermometers, which is the ſort in moſt common uſe, is firſt to immerge the bulb of the thermometer in ice or ſnow

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|| Lecons de Phyſ. Exp. tom. iv. p. 376.

ſnow juſt beginning to thaw, and mark the place where the mercury ſtands with a 32; then immerge it in boiling water, and again mark the place where the mercury ſtands in the tube, which mark with the num. 212, exceeding the former by 180; dividing therefore the intermediate ſpace into 180 equal parts, will give the ſcale of the thermometer, and which may afterwards be continued upwards and downwards at pleaſure.

Other thermometers of a ſimilar conſtruction have been accommodated to common uſe, having but a portion of the above ſcale. They have been made of a ſmall ſize and portable form, and adapted with appendages to particular purpoſes; and the tube with its annexed ſcale has often been encloſed in another thicker glaſs tube, alſo hermetically ſealed, to preſerve the thermometer from injury. And all theſe are called *Fahrenheit's thermometers*.

26
De l'Iſle's thermometer.
Plate DVII.

In 1733, M. De l'Iſle of Peterſburgh conſtructed a mercurial thermometer on the principles of Reaumur's ſpirit thermometer. In his thermometer, the whole bulk of quickſilver, when immerged in boiling water, is conceived to be divided into 100,000 parts; and from this one fixed point the various degrees of heat, either above or below it, are marked in theſe parts on the tube or ſcale, by the various expanſion or contraction of the quickſilver, in all imaginable varieties of heat. Dr Martine apprehends it would have been better if De l'Iſle had made the integer 100,000 parts, or fixed point, at freezing water, and from thence computed the dilatations or condenſations of the quickſilver in thoſe parts; as all the common obſervations of the weather, &c. would have been expreſſed by numbers increaſing as the heat increaſed, inſtead of decreaſing, or counting the contrary way. However, in practice it will not be very eaſy to determine exactly all the diviſions from the alteration of the bulk of the contained fluid. And beſides, as glaſs itſelf is dilated by heat, though in a leſs proportion than quickſilver, it is only the exceſs of the dilatation of the contained fluid above that of the glaſs that is obſerved; and therefore if different kinds of glaſs be differently affected by a given degree of heat, this will make a ſeeming difference in the dilatations of the quickſilver in the thermometers conſtructed in the Newtonian method, either by Reaumur's rules or De l'Iſle's. Accordingly it has been found, that the quickſilver in De l'Iſle's thermometers has ſtood at different degrees of the ſcale when immerged in thawing ſnow: having ſtood in ſome at 154°, while in others it has been at 156° or even 158°.

27
Reaumur's, or rather De Luc's thermometer.

The thermometer preſently uſed in France is called *Reaumur's*; but it is very different from the one originally invented by Reaumur in 1730, and deſcribed in the Memoirs of the Academy of Sciences. The one invented by Reaumur was filled with ſpirit of wine; and tho' its ſcale was divided by the author into 80 parts, of which 0 was the freezing point and 80 the boiling water point, yet in fact 80 was only the boiling point of the ſpirit of wine that he employed, which, as Dr Martine computes, correſponded with 180 of Fahrenheit. But the thermometer now in uſe in France is filled with mercury; and the boiling water point which is at 80, correſponds with the 212th degree of Fahrenheit. The ſcale indeed commences at the freezing point, as the old one did. The new thermometer ought more properly to be called *De Luc's thermometer*, for it was firſt made by De Luc; and is in fact as different from Reaumur's as it is from Sir Iſaac Newton's. When De Luc had fixed the ſcale, and finiſhed an account of it, he ſhowed the manuſcript to M. De la Condamine. Condamine adviſed him to change the number 80; remarking, that ſuch was the inattention of phyſicians, that they would probably confound it with Reaumur's. De Luc's modeſty, as well as a predeliction for the number 80, founded as he thought, on philoſophical reaſons, made him decline following this advice. But he found by experience that the prediction of Condamine was too well founded.

28
Celſius's thermometer.

The thermometer of Celſius, which is uſed in Sweden, has a ſcale of 100 degrees from the freezing to the boiling water point.

29
How to compare theſe together.

Theſe are the principal thermometers now uſed in Europe; and the temperatures indicated by any of them may be reduced into the correſponding degrees on any of the others by means of the following ſimple canons; in which R ſignifies the degrees on the ſcale of Reaumur, F thoſe of Fahrenheit, and S thoſe of the Swediſh thermometer.

1. To convert the degrees of Reaumur into thoſe of Fahrenheit; $\frac{R \times 9}{4} + 32 = F$.

2. To convert the degrees of Fahrenheit into thoſe of Reaumur; $\frac{F - 32 \times 4}{9} = R$.

3. To convert the Swediſh degrees into thoſe of Fahrenheit; $\frac{S \times 9}{5} + 32 = F$.

Lavoiſier's Elements of Chemiſtry.

4. To convert Fahrenheit's into Swediſh; $\frac{F - 32 \times 5}{9} = S$.

5. To convert Swediſh degrees into thoſe of Reaumur; $\frac{S \times 4}{5} = R$.

6. To convert Reaumur's degrees into Swediſh; $\frac{R \times 5}{4} = S$.

To ſuch readers as are unacquainted with the algebraic expreſſion of arithmetical formulæ, it will be ſufficient to expreſs one or two of theſe in words to explain their uſe.—1. Multiply the degree of Reaumur by 9, divide the product by 4, and to the quotient add 32, the ſum expreſſes the degree on the ſcale of Fahrenheit.—2. From the degree of Fahrenheit ſubtract 32, multiply the remainder by 4, and divide the product by 9, the quotient is the degree according to the ſcale of Reaumur, &c.

As many other thermometers have been uſed beſides theſe, and conſequently obſervations taken by them, it is of importance to have them placed in ſuch a point of view that they may be eaſily compared with any of theſe four now in general uſe. We therefore give them in Plate DVII. in the ſame order as they were arranged by Dr Martine in his valuable Eſſay on the Conſtruction and Graduation of Thermometers, and at the ſame time adding thoſe of Celſius and De Luc. We call it by the name of De Luc for the ſake of diſtinguiſhing it from Reaumur's ſpirit of wine thermometer, which may be ſeen in the ſame Plate.

It is unneceſſary to deſcribe any of theſe more minutely, as they are no longer uſed. Thoſe who wiſh to read a more particular account of them may conſult Dr Martine's Eſſays.

30
Account of ſelf-regiſtering thermometers.

As in meteorological obſervations it is neceſſary to attend to the greateſt riſe and fall of the thermometer, attempts have been made to conſtruct a thermometer which might regiſter the greateſt degree of heat, or greateſt degree of cold, which took place during the abſence of the obſerver. In 1757 Lord Charles Cavendiſh preſented to the Royal Society of London a thermometer in two different forms; the one contrived to mark the greateſt degree of heat, and the other the greateſt degree of cold.

31
Lord Charles Cavendiſh's thermometer.
Plate DVI. Fig. 3.

The firſt conſiſts of a glaſs tube A B, with a cylindrical bulb B at the lower end, and capillary at the top, over which there is fixed a glaſs ball C. The bulb and part of the tube are filled with mercury, the top of which ſhows the degrees of heat as uſual. The upper part of the tube above the mercury is filled with ſpirit of wine; the ball C is alſo filled with the ſame liquor almoſt to the top of the capillary tube. When the mercury riſes the ſpirit of wine is alſo raiſed, and falls into the ball C, which is ſo made that the liquor cannot return into the tube when the mercury ſinks; conſequently the height of the ſpirit of wine in the ball, added to that in the tube, will give the greateſt degree of heat to which the thermometer has pointed ſince laſt obſervation. When a new obſervation is to be made, the inſtrument muſt be inclined till the liquor in the ball cover the end of the capillary tube.

In this thermometer it is evident that the mercury muſt be affected by the weight and elaſticity of the ſpirit of wine, and therefore it will not correſpond to any of the common mercurial thermometers.

The thermometer for ſhowing the greateſt degree of cold is repreſented in fig. 4. by the crooked tube ABCD. This inſtrument is filled with ſpirit of wine, with the addition of as much mercury as is ſufficient to fill both legs of the ſyphon, and about a fourth or fifth part of the hollow ball C. We are not told what the proportion of mercury was to that of ſpirit of wine. The degrees of heat are ſhown by the riſe or fall of the mercury in the leg AB. The thermometer marks the greateſt fall by means of the hollow ball C. When the mercury in the longer leg ſinks by cold, that in the ſhorter will riſe and run over into the ball C, from which it cannot return when the mercury ſubſides in the ſhorter and riſes in the longer leg. The upper part of the ſhorter leg will therefore be filled with a column of ſpirits of a length proportional to the increaſe of heat; the bottom or lower ſurface of which, by means of a proper ſcale, will ſhow how much the mercury has been lower than it is; which being ſubtracted from the preſent height will give the loweſt point to which the mercury has fallen. That the thermometer may be fitted for a new obſervation, the mercury muſt be made to run back from the ball into the ſhorter leg, by inclining the tube and heating the ball.

32
Mr Six's thermometer.
Fig. 5.

In 1782 Mr Six propoſed another ſelf-regiſtering thermometer. It is properly a ſpirit of wine thermometer, though mercury is alſo employed for ſupporting an index. *a b* is a thin tube of glaſs 16 inches long, and $\frac{5}{10}$ths of an inch caliber: *c d e* and *f g h* are ſmaller tubes about $\frac{1}{20}$th of an inch caliber. Theſe three tubes are filled with highly rectified ſpirit of wine, except the ſpace between *d* and *g*, which is filled with mercury. As the ſpirit of wine contracts or expands in the middle tube, the mercury falls or riſes in the outſide tubes. An index, ſuch as that repreſented in fig. 6. is placed on the ſurface, within each of theſe tubes, ſo light as to float upon it. *k* is a ſmall glaſs tube $\frac{3}{4}$ths of an inch long, hermetically ſealed at each end, and incloſing a piece of ſteel wire nearly of its own length. At each end *l*, *m*, of this ſmall tube, a ſhort tube of black glaſs is fixed, of ſuch a diameter as to paſs freely up and down within either of the outſide tubes of the thermometer *c e* or *f h*. From the upper end of the index is drawn a ſpring of glaſs to the fineneſs of a hair, and about $\frac{5}{7}$ths of an inch long; which being placed a little oblique, preſſes lightly againſt the inner ſurface of the tube, and prevents the index from deſcending when the mercury deſcends. Theſe indexes being inſerted one into each of the outſide tubes, it is eaſy to underſtand how they point out the greateſt heat or cold that has happened in the obſerver's abſence. When the ſpirit of wine in the middle tube expands, it preſſes down the mercury in the tube *h f*, and conſequently raiſes it in the tube *e c*; conſequently the index on the left hand tube is left behind and marks the greateſt cold, and the index in the right-hand tube riſes and marks the greateſt heat.

33
Rutherford's thermometer.

In 1790 a paper was given into the Royal Society of Edinburgh, deſcribing two thermometers, newly invented, by Dr John Rutherford of Middle Bailiſh; the one for regiſtering the higheſt and the other for regiſtering the loweſt degree of heat to which the thermometer has riſen or fallen during the abſence of the obſerver. An account of them may be found in the third volume of the Tranſactions of the Society.

34
Mr Keith's thermometer.

A new ſelf-regiſtering thermometer has more lately been invented by Mr Keith of Ravelſtone, which we conſider as the moſt ingenious, ſimple, and perfect, of any which has hitherto appeared. Its ſimplicity is ſo great, that it requires only a very ſhort deſcription to make it intelligible.

Fig. 7.

A B is a thin glaſs tube about 14 inches long and $\frac{3}{4}$ths of an inch caliber, cloſe or hermetically ſealed at top. To the lower end, which is open, there is joined the crooked glaſs tube BE, ſeven inches long, and $\frac{4}{10}$ths of an inch caliber, and open at top. The tube A B is filled with the ſtrongeſt ſpirit of wine, and the tube B E with mercury. This is properly a ſpirit of wine thermometer, and the mercury is uſed merely to ſupport a piece of ivory or glaſs, to which is affixed a wire for raiſing one index or depreſſing another, according as the mercury riſes or falls. E is a ſmall conical piece of ivory or glaſs, of ſuch a weight as to float on the ſurface of the mercury. To the float is joined a wire called the *float-wire*, which reaches upwards to H, where it terminates in a knee bent at right angles. The float-wire, by means of an eye at *a*, moves eaſily along the ſmall harpſichord wire GK. LL are two indexes made of thin black oiled ſilk, which ſlide upwards or downwards with a force not more than two grains. The one placed above the knee points out the greateſt riſe, and the one placed below it points out the greateſt fall, of the thermometer.

When the inſtrument is to be prepared for an obſervation, both indexes are to be brought cloſe to the knee H. It is evident, that when the mercury riſes, the float and float wire, which can be moved with the ſmalleſt force, will be puſhed upwards till the mercury become ſtationary. As the knee of the float-wire moves upwards it will carry along with it the upper index L. When the mercury again ſubſides, it leaves the index at the higheſt point to which it was raiſed, for it will not deſcend by its own weight: As the mercury falls the float-wire does the ſame; it therefore brings along with it the lower index L, and continues to depreſs it till it again become ſtationary or aſcend in the tube; in which caſe it leaves the lower index behind it as it had formerly left the upper. The ſcale to which the indexes point is placed parallel to the ſlender harpſichord wire. It may be ſeen more diſtinctly in fig. 8. That the ſcale and indexes may not be injured by the wind and rain, a cylindrical glaſs cover, cloſe at top, and made ſo as to exactly fit the part F G, is placed over it.

The ingenious inventor has another improvement in contemplation, which, if upon trial it be found to anſwer, will make this thermometer as perfect as can be deſired, provided there do not ariſe ſome errors from the variable preſſure of the atmoſphere. He propoſes to adapt clock-work to this thermometer, in ſuch a way as to regiſter with the utmoſt preciſion the degrees of heat and cold for every month, day, and minute in the year. The principles on which this clock-work is to be formed we ſhall forbear to deſcribe, hoping that the author himſelf, after his experiment has met with the ſucceſs which we ardently wiſh, will favour the world with his own account of it.

The ſame ingenious gentleman has invented a ſelf-regiſtering barometer, upon the ſame principles with his ſelf-regiſtering thermometer. We have had the pleaſure of ſeeing both; and are convinced that they will fully gratify the wiſhes of all who are engaged in meteorological ſtudies. He is alſo in expectation of being ſoon able to produce an air-thermometer free from the defects of thoſe which were formerly made, as he has found out a way of preventing it from being affected by the preſſure of the atmoſphere.

35
M. De Luc's ſuppoſed improvements.

M. De Luc has deſcribed the beſt method of conſtructing a thermometer, fit for determining the temperature of the air, in the menſuration of heights by the barometer. He has alſo ſhown how to divide the ſcale of a thermometer, ſo as to adapt it for aſtronomical purpoſes in the obſervation of refractions.

36
Mr Cavallo has propoſed a thermometrical barometer.

Mr Cavallo, in 1781, propoſed the conſtruction of a thermometrical barometer, which by means of boiling water, might indicate the various gravity of the atmoſphere, or the height of the barometer. But as he does not ſay that the inſtrument has been tried with the deſired ſucceſs, we forbear to deſcribe it. Thoſe who wiſh to know his ideas reſpecting it may conſult the Philoſophical Tranſactions vol. lxxi. page 524.

37
The thermometers deſcribed above too limited.

The thermometers hitherto deſcribed are very limited in their extent; they indeed point out to us the loweſt degrees of heat which are commonly obſerved even in cold climates, but they by no means reach to thoſe degrees of heat which are very familiar to us. The mercurial thermometer extends no farther than to 600 of Fahrenheit's ſcale, the heat of boiling mercury; but we are ſure that the heat of ſolid bodies, when heated to ignition, or till they emit light, far exceeds the heat of boiling mercury.

38
Sir Iſaac Newton's method of extending the ſcale of the thermometer.

In order to remedy this defect, Sir Iſaac Newton, whoſe genius overcame thoſe obſtacles which ordinary minds could not approach, attempted by an ingenious experiment to extend the ſcale to any degree required. Having heated a maſs of iron red-hot, and expoſed it to the cold air, he obſerved the time which elapſed till it became cold, or of the ſame temperature with the air; and when the heat ſo far decreaſed that he could apply ſome known meaſure (as a thermometer) to it, he obſerved the degrees of heat loſt in given times; and thence drew the general concluſion, that the quantities of heat loſt in given ſmall ſpaces are always proportional to the heat remaining in the body, reckoning the heat to be the exceſs by which it is warmer than the ambient air. So that taking the number of minutes which it took to cool after it came to a determined point in an arithmetical progreſſion, the decrements of the heat of the iron would be continually proportional. Having by this proportion found out the decrements of heat in a given time after it came to a known point, it was eaſy, by carrying upwards the ſame proportion to the beginning of its cooling, to determine the greateſt heat which the body had acquired. This proportion of Sir Iſaac's was found by Dr Martine to be ſomewhat inaccurate. The heat of a cooling body does not decreaſe exactly in proportion to that which the body retains. As the reſult of many obſervations, he found that two kinds of proportion took place, an arithmetical as well as the geometrical proportion which Sir Iſaac Newton had adopted; namely, that the decrements of heat were partly proportional to the times (that is, that quantities of heat are loſt in equal times), as well as partly in proportion to the remaining heat; and that if theſe two are added together the rule will be ſufficiently accurate. By the geometrical proportion which Sir Iſaac Newton adopted he diſcovered the heat of metals red-hot or in fuſion. This method, ſo ſucceſsfully purſued by Sir Iſaac, was ſufficient to form a ſcale of high degrees of heat, but was not convenient for practical purpoſes.

Martine's Eſſays.

39
Mr Wedgwood's thermometer for meaſuring high degrees of heat.

Accordingly the ingenious Mr Joſiah Wedgwood, who is well known for his great improvement in the art of pottery, applied himſelf in order to diſcover a thermometer which might be eaſily managed. After many experiments recorded in the Philoſophical Tranſactions, but which it is unneceſſary to detail in this place, he has invented a thermometer which marks with much preciſion the different degrees of ignition from a dull red heat viſible in the dark to the heat of an air-furnace. This thermometer is extremely ſimple. It conſiſts of two rulers fixed upon a ſmooth flat plate, a little farther aſunder at the one end than at the other, leaving an open longitudinal ſpace between them. Small pieces of alum and clay mixed together are made of ſuch a ſize as juſt to enter at the wide end; they are then heated in the fire along with the body whoſe heat we wiſh to determine. The fire, according to the degree of heat it contains, diminiſhes or contracts the earthy body, ſo that when applied to the wide end of the gage, it will ſlide on towards the narrow end, leſs or more according to the degree of heat to which it has been expoſed.

40
Deſcribed.

That this inſtrument may be perfectly underſtood, we have given a repreſentation of it in Plate DVI. fig. 9. ABCD is a ſmooth flat plate; and EF and GH two rulers or flat pieces, a quarter of an inch thick, fixed flat upon the plate, with the ſides that are towards one another made perfectly true, a little farther aſunder at one end EG than at the other end FH: thus they include between them a long converging canal, which is divided on one ſide into a number of ſmall equal parts, and which may be conſidered as performing the offices both of the tube and ſcale of the common thermometer. It is obvious, that if a body, ſo adjuſted as to fit exactly at the wider end of this canal, be afterwards diminiſhed in its bulk by fire, as the thermometer pieces are, it will then paſs further in the canal, and more and more ſo according as the diminution is greater; and converſely, that if a body, ſo adjuſted as to paſs on to the narrow end, be afterwards expanded by fire, as is the caſe with metals, and applied in that expanded ſtate to the ſcale, it will not paſs ſo far; and that the diviſions on the ſide will be the meaſures of the expanſions of the one, as of the contractions of the other, reckoning in both caſes from that point to which the body was adjuſted at firſt.

Philoſophical tranſactions, vol. lxxiv.

I is the body whoſe alteration of bulk is thus to be meaſured. This is to be gently puſhed or ſlid along towards the end FH, till it is ſtopped by the converging ſides of the canal.

41
Thermometer pieces of what compoſed.

Mr Wedgwood at firſt uſed clay for his thermometer pieces; but he ſoon found it impoſſible to procure freſh ſupplies of the ſame quality. He therefore had recourſe to an artificial preparation. As the earth of alum is the pure argillaceous earth to which all clays owe their property of diminiſhing in the fire, he mixed ſome of this earth with the clay, and found it to anſwer his wiſhes completely, both in procuring the neceſſary degree of diminution and of increaſing its unvitreſcibility. The only way of aſcertaining the proportion of alum earth to be added is by repeated trials. Mr Wedgwood found that 10 hundred weight of the porcelain clay of Cornwall required all the earth that was afforded by five hundred weight of alum. But as the clay or alum differs in quality, the proportion will alſo differ. There can now, however, be no difficulty in making thermometers of this kind, as common clay anſwers the purpoſe very well, and alum-earth can eaſily be procured. Thoſe who wiſh to ſee a more particular account of this ſubject may peruſe Mr Wedgwood's papers

Thermometer.

papers in the Philoſophical Tranſactions for 1782, 1784, and 1786.

As Mr Wedgwood's thermometer begins at the loweſt degree of ignition, and Fahrenheit's goes no higher than the boiling point of mercury, Mr Wedgwood continued to fill up the interval of the ſcale by uſing a piece of ſilver inſtead of his common thermometer pieces; and in this way he has found out that 130 degrees of Fahrenheit are equal to one of his. He has accordingly, by obſerving this proportion, continued Fahrenheit's ſcale to the top of his own. We are now therefore enabled to give a ſcale of heat from the higheſt degree of heat produced by an air-furnace to the greateſt degree of cold hitherto known, which was produced at Hudſon's Bay in December 1784 by a mixture of vitriolic acid and ſnow. Of the remarkable degrees between theſe extreme points we ſhall now lay before our readers a ſcale.

42
Scale of heat.

	Fahrenheit's ſcale.	Wedgwood's ſcale.
Extremity of Wedgwood's ſcale	32277°	240°
Greateſt heat of his ſmall air-furnace	21877	160
Caſt Iron melts - -	17977	130
Greateſt heat of a common ſmith's forge	17327	125
Welding heat of iron, greateſt	13427	95
——————leaſt - -	12777	90
Fine gold melts - -	5237	32
Fine ſilver melts - -	4717	28
Swediſh copper melts -	4587	27
Braſs melts - -	3807	21
Heat by which his enamel colours are burnt on - -	1857	6
Red-heat fully viſible in day-light	1077	0
Red-heat fully viſible in the dark	947	1
Mercury boils, alſo lintſeed and other expreſſed oils - -	600	
Oil of turpentine boils -	560	
Sulphuric acid boils - -	546	
Lead melts - - -	540	
Biſmuth melts - -	460	
Tin melts - -	408	
Sulphur melts - -	244	
Nitrous acid boils - -	242	
Cows milk boils - -	213	
Water Boils - -	212	
Human urine boils - -	206	
Brandy boils - -	190	
Alcohol boils - -	174	
Serum of blood and white of eggs harden	156	
Bees wax melts - -	142	
Heat of the air near Senegal ſometimes	111	
Hens hatch eggs about - -	108	
Heat of birds from - -	103 to 111	
Heat of domeſtic quadrupeds from	100 to 103	
Heat of the human body -	92 to 99	
Heat of a ſwarm of bees -	97	
Heat of the ocean under the equator	80	
Butter melts -	74	
Vitriolic acid of the ſpecific gravity of 1780 freezes at - -	45	
Oil of olives begins to congeal -	43	
Heat of hedgehogs and marmots in a torpid ſtate - - -	39½	
Water freezes and ſnow melts	32	
Milk freezes - -	30	
Urine and common vinegar freezes	28	
Human blood freezes - -	25	
Strong wines freeze - -	20	
A mixture of one part of alcohol and three parts of water freezes -	7	
A mixture of ſnow and ſalt freezes	0 to 4	
Brandy, or a mixture of equal parts of alcohol and water, freezes - -	—7	
Spirit of wine in Reaumur's thermometer froze at Torneo - -	—34	
Mercury freezes - -	—39 or 40	
Cold produced by Mr Macnab at Hudſon's Bay by a mixture of vitriolic acid and ſnow - - -	—69	

Thermopylæ ‖ Theſeus.

THERMOPYLÆ, (anc. geog.); a narrow paſs or defile, between the waſh of the Sinus Maliacus; on the eaſt, and ſteep mountains, reaching to Oeta, made dreadful by unpaſſable woods; on the weſt, leading from Theſſaly to Locris and Bœotia. Theſe mountains divide Greece in the middle, in the ſame manner as the Appennine does Italy; forming one continued ridge from Leucate on the weſt to the ſea on the eaſt, with thickets and rocks interſperſed; that perſons even prepared for travelling, much leſs an army encumbered with baggage, cannot eaſily find a commodious paſſage. In the valley verging towards the Sinus Maliacus, the road is only ſixty paces broad; the only military way for an army to paſs, if not obſtructed by an enemy; and therefore the place is called *Pylæ*, and by others, on account of its hot water, *Thermopylæ*. Ennobled by the brave ſtand made by Leonidas and three hundred Spartans againſt the whole army of Perſia; and by the bold reſolution of blind Euthycus, chooſing rather to fall there in fight, than return to Sparta and eſcape the common danger. Famous alſo for the Amphyctiones, the common council or ſtates general of Greece, aſſembling there twice a year, ſpring and autumn. For an account of the battle of Thermopylæ at which Leonidas with a handful of men engaged the Perſian army, ſee Sparta.

THESEA, in antiquity, feaſts celebrated by the Athenians in honour of Theſeus, conſiſting of ſports and games, with mirth and banquets; ſuch as were poor and unable to contribute to them were entertained at the public expenſe.

THESEUS, a famous hero of antiquity, ranked among the demi-gods, whoſe hiſtory is fabulous. He was the reputed ſon of Ægeus king of Athens. He threw Sciron, a cruel robber, down a precipice; faſtened Procruſtes tyrant of Attica to a bending pine, which being let looſe tore him aſunder; killed the Minotaur kept in the Labyrinth by king Minos, in Crete; and by the aſſiſtance of that prince's daughter, Ariadne, who gave him a clue, eſcaped out of that labyrinth, and ſailed with his deliverer to the iſle of Naxos, where he had the ingratitude to leave her.

Theſeus afterwards overcame the Centaurs, ſubdued the Thebans, and defeated the Amazons. He aſſiſted his friend Pirithous in his expedition to the infernal regions to carry off Proſerpine; but was impriſoned by Pluto, till he was releaſed by Hercules. He is alſo ſaid to have eſtabliſhed the Iſthmean games, in honour of Neptune; to have united the twelve cities of Attica; and to have founded a republic there, 1236 B. C. Some time after, taking a voyage into Epirus, he was ſeized by Aidonius king of the Moloſſians; meanwhile Meneſtheus rendered himſelf maſter of Athens. But at length Theſeus being releaſed from priſon, retired to Scyros, where king Lycomedes cauſed him to be thrown from the top of a rock. Theſeus had ſeveral wives; the firſt of whom was Helena the daughter of Tyndarus; the ſecond Hypolita queen of the Amazons; and the laſt, Phedra ſiſter to Ariadne, who puniſhed him for

Plate DVI

THERMOMETERS

Fig. 1.

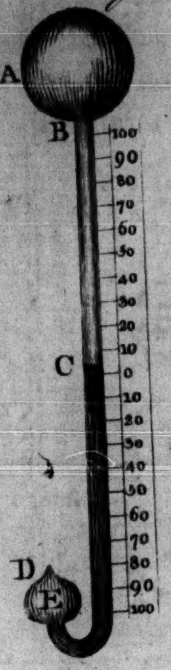
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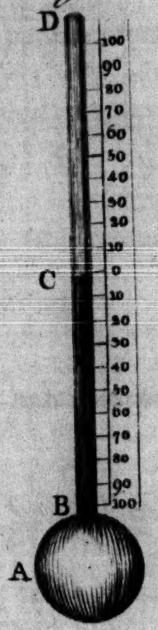
Fig. 2.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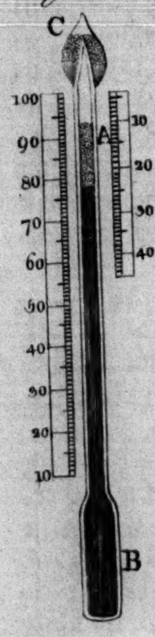
90
100

Fig. 3.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40

Fig. 4.

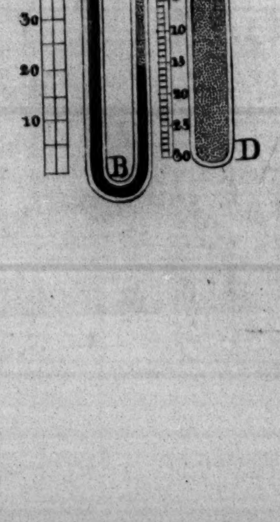
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Fig. 5.

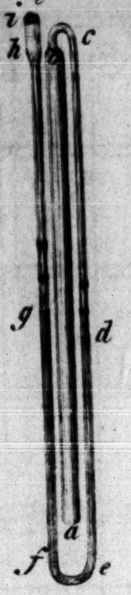

Fig. 6.

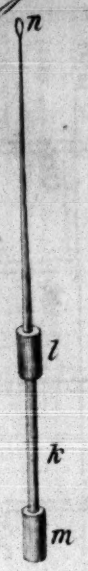

Fig. 7.

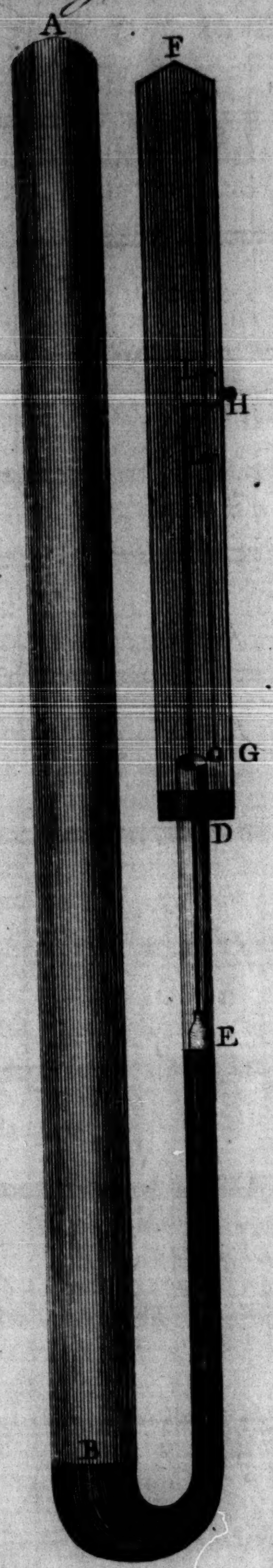

Fig. 8.

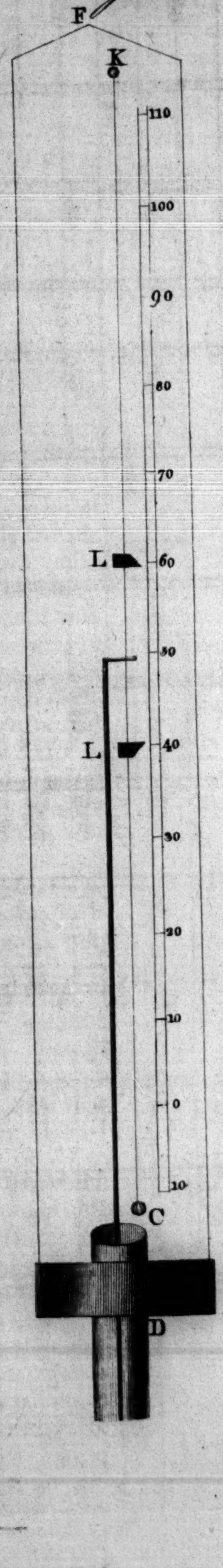
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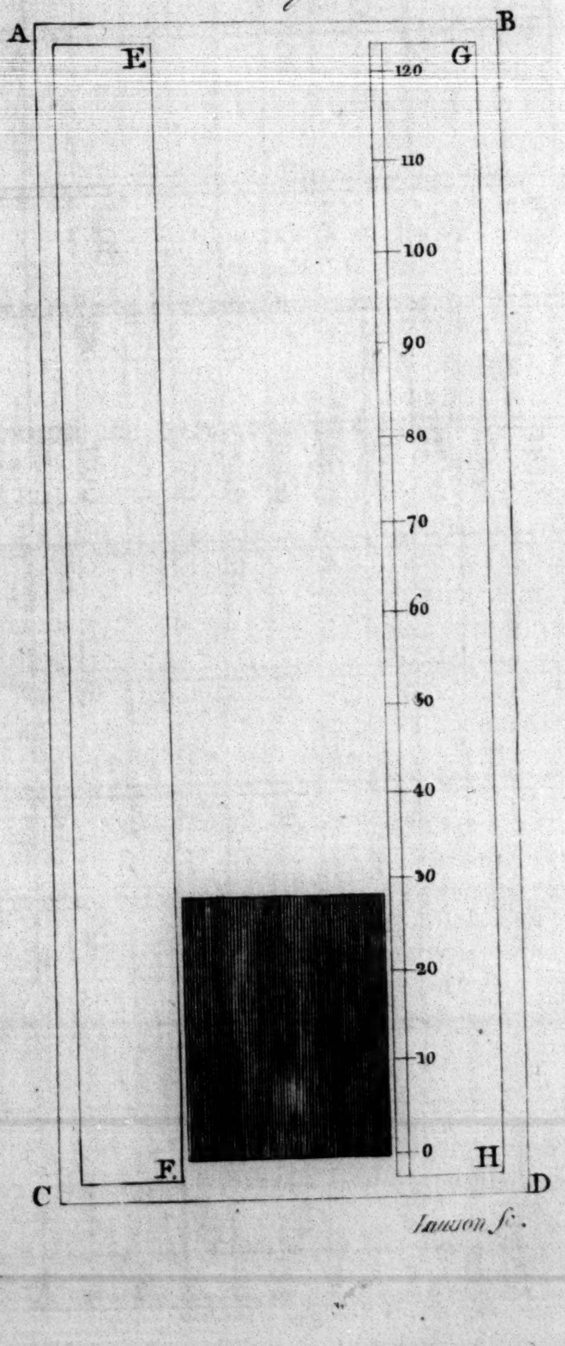
Fig. 9.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Lowson sc.

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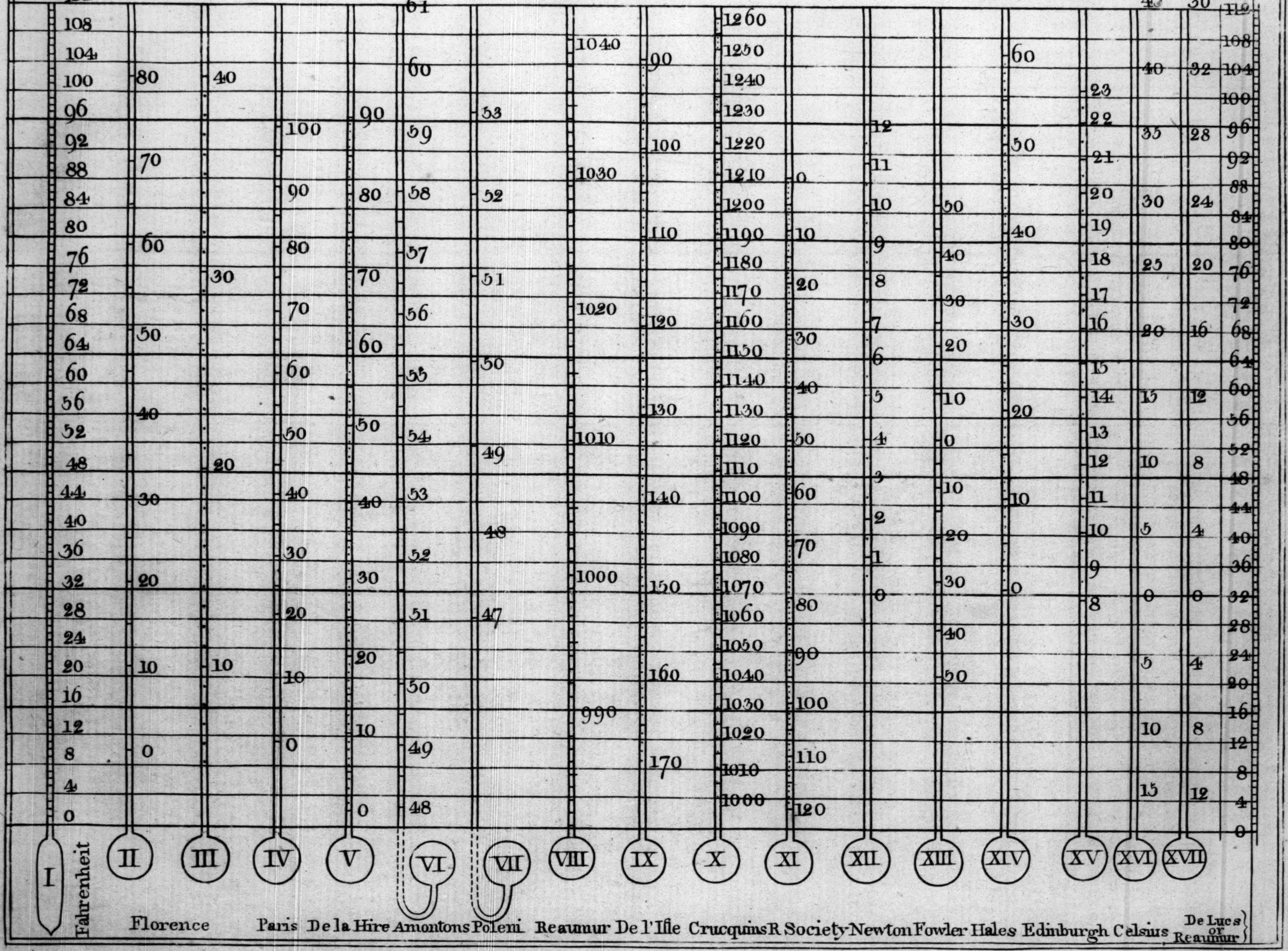
THERMOMETERS Plate DVII


I
Fahrenheit
112 108 104 100 96 92 88 84 80 76 72 68 64 60 56 52 48 44 40 36 32 28 24 20 16 12 8 4 0
II
80 70 60 50 40 30 20 10 0
III
40 30 20 10
IV
100 90 80 70 60 50 40 30 20 10 0
V
90 80 70 60 50 40 30 20 10 0
VI
61 60 59 58 57 56 55 54 53 52 51 50 49 48
VII
53 52 51 50 49 48 47
VIII
1040 1030 1020 1010 1000 990
IX
90 100 110 120 130 140 150 160 170
X
1260 1250 1240 1230 1220 1210 1200 1190 1180 1170 1160 1150 1140 1130 1120 1110 1100 1090 1080 1070 1060 1050 1040 1030 1020 1010 1000
XI
0 10 20 30 40 50 60 70 80 90 100 110 120
XII
12 11 10 9 8 7 6 5 4 3 2 1 0
XIII
50 40 30 20 10 0 10 20 30 40 50
XIV
60 50 40 30 20 10 0
XV
23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8
XVI
45 40 35 30 25 20 15 10 5 0 5 10 15
XVII
36 32 28 24 20 16 12 8 4 0 4 8 12
112 108 104 100 96 92 88 84 80 76 72 68 64 60 56 52 48 44 40 36 32 28 24 20 16 12 8 4 0
Florence
Paris
De la Hire
Amontons
Poleni
Reaumur
De l'Isle
Crucquius
R Society
Newton
Fowler
Hales
Edinburgh
Celsius
De Luc's or Reaumur

BRITISH MUSEUM

for his infidelity to her ſiſter, by her inceſtuous paſſion for his ſon Hippolitus.

THESIS, a general poſition which a perſon advances, and offers to maintain. In taking degrees in univerſities, the candidates are generally obliged to write a theſis, which they muſt afterwards defend.

THESIUM, BASE FLUELLIN, in botany; a genus of plants belonging to the claſs of *pentandria*, and order of *monogynia*. The calyx is monophyllous, with the ſtamina inſerted into it: there is only one ſeed, which is inferior. There are 17 ſpecies; one of which is a Britiſh plant, the *linophyllum* or baſtard toad-flax. It has a foliaceous panicle with linear leaves, and flowers in June and July.

THESPIS, a famous Greek tragic poet, and the firſt repreſenter of tragedy at Athens. He carried his troop from village to village in a waggon, from which they performed their pieces. Alceſtis was the firſt tragedy they performed at Athens, 536 B. C. See THEATRE.

THESSALIAN Chair, ſo called from Theſſaly, where chairs of this figure were moſt in uſe; it is recommended by Hippocrates * in place of a machine for reducing a recent luxation of the ſhoulder bone. The back of this chair is perpendicular to the ſeat, as Galen tells us; by which conſtruction it is diſtinguiſhed and accommodated to the operation.

* Lib. de rt.

THESSALY, a country of Greece, whoſe boundaries have been different at different periods. Properly ſpeaking, Theſſaly was bounded on the ſouth by the ſouthern parts of Greece or Græcia Propria; eaſt by the Ægean; north, by Macedonia and Mygdonia; and weſt, by Illyricum and Epirus. It was generally divided into four ſeparate provinces, Theſſaliotis, Pelaſgiotis, Iſtiæotis, and Phthiotis, to which ſome add Magneſia. It has been ſeverally called *Æmonia*, *Pelaſgicum*, *Argos*, *Hellas*, *Argeia*, *Dryopis*, *Pelaſgia*, *Pyrrhæa*, &c. The name of Theſſaly is derived from Theſſalus, one of its monarchs. Theſſaly is famous for a deluge which happened there in the age of Deucalion. Its mountains and cities are alſo celebrated, ſuch as Olympus, Pelion, Oſſa, Lariſſa, &c. The Argonauts were partly natives of Theſſaly. The inhabitants of the country paſſed for a treacherous nation, ſo that falſe money was called *Theſſalian coin*, and a perfidious action a *Theſſalian deceit*. Theſſaly was originally governed by kings, till it became ſubject to the Macedonian monarchs. The cavalry was univerſally eſteemed, and the people were ſuperſtitious and addicted to the ſtudy of magic and incantations. See *Lucan*. 6. v. 438, &c.; *Dionyſ*. 219; *Curt*. 3. c. 2; *Ælian*, *V. H*. 3. c. 1.; *Pauſ*. 4. c. 36. l. 10. c. 1; *Mela*. 2. c. 3; *Juſtin* 7. c. 6; *Diod*. 4.

Lempriere's Dictionary.

Theſſaly is now called *Janna*, a province of European Turkey, bounded by Macedonia on the north, by the Archipelago on the eaſt, by Achaia or Livadia on the ſouth, and by Epirus on the weſt.

THETIS, in Pagan mythology, the wife of Oceanus, and the mother of Nereus and Doris, who were married to each other; and from this marriage ſprung the nymphs of the earth and ſea. Among the ſea nymphs there was one named *Thetis the Younger*, who excelled all the reſt in beauty, and for whom Jupiter conceived ſuch a paſſion, that he reſolved to eſpouſe her; but being informed by the Deſtinies that ſhe would bring forth a ſon who would riſe above his father, he married her to Peleus. To their nuptials all the gods and goddeſſes were invited except Diſcord, who, to be revenged for this contempt threw a golden apple into the aſſembly, on which was engraven, *For the Faireſt*. Juno, Pallas, and Venus, diſputed for this apple; but Paris being choſen to decide the difference, adjudged it to Venus. From this marriage of Thetis and Peleus ſprung Achilles.

THEURGY, θεουργια, a name which the ancients gave to that ſacred part of magic which we ſometimes call *white magic*, or the *white art*.

The word is formed from Θεος, "God," and εργον "work;" *q. d.* the art of doing divine things, or things which God alone can do; or the power of working extraordinary and ſupernatural things, by invoking the names of God, ſaints, angels, &c. Accordingly thoſe who have written of magic in general, divide it into three parts: the firſt whereof is called *theurgy*, as operating by divine or celeſtial means; the ſecond, *natural magic*, performed by the powers of nature; and the third, comprehending *necromancy*, *ſorcery*, and *witchcraft* or *magic*, performed by the aſſiſtance of demons or departed men. See MAGIC.

THIBET. See TIBET.

THIGH, in anatomy. See ANATOMY, n° 58.

THINKING, a general name for any act or operation of the mind. See METAPHYSICS.

THIRLAGE. See LAW, n° clxx. 12—18.

THIRST, an uneaſy ſenſation ariſing from a deficiency of the ſaliva to moiſten the inward parts of the mouth. Hence ariſes a ſtrong deſire for drink; and thirſt is a ſymptom generally attending fevers of all kinds. Thirſt is beſt allayed by acids; water kept a while in the mouth, then ſpit out, and repeated as required; a bit of bread chewed with a little water, which latter may be gradually ſwallowed; if the perſon is very hot, brandy is the beſt for holding in the mouth, but ſhould be ſpit out again: except in fevers, large draughts of cold water are hurtful.

Preſervation againſt Hunger and THIRST. See HUNGER.

THISTLE, a well known weed in corn-fields. In Britain there are eight ſpecies of thiſtles according to the vulgar arrangement; the carduus lanceolatus or ſpear-thiſtle, the nutans or muſk-thiſtle, the paluſtris or marſh-thiſtle, the marianus or milk-thiſtle, acanthoides or welted-thiſtle, criſpus or curled-thiſtle, onopordum acanthium or cotton thiſtle, ſerratula arvenſis or corn-thiſtle. All theſe, except the laſt, are annual or biennial, and therefore may be eaſily deſtroyed by cutting them down before their ſeed ripens; but the ſerratula arvenſis is perennial, continues in the earth increaſing and throwing up new ſhoots every year. Mr Curtis aſcertained the annual increaſe of its root, by planting in a garden a piece of the root two inches long and about the thickneſs of a gooſe's quill, and a ſmall head of leaves. By the 2d of November the root had extended itſelf eight feet, and when dug and waſhed it weighed four pounds.

As to the uſes of the thiſtle, they are not well known. The corn-thiſtle is eaten by the aſs, and formerly was pulled with great care by the farmers in ſome parts of Scotland as food for their horſes. For a botanical deſcription of the different kinds of thiſtle, ſee CARDUUS, CACTUS, DIPSAUS, ONOPORDUM, SERRATULA, SONCHUS.

Order of the THISTLE, or *of St Andrew*, a military order of knighthood in Scotland, the riſe and inſtitution of which is variouſly related by different authors. Leſley, biſhop of Roſs reports, that the night before the battle between Athelſtan king of Northumberland, and Hungus king of the Picts, a bright croſs, in form of that whereon St Andrew (the tutelar ſaint of Scotland) ſuffered martyrdom, appeared to Hungus; who having gained the victory, ever after bore the figure of that croſs on his banners. Others aſſert, that Achaius king of Scotland firſt inſtituted this order, after having made the famous league offenſive and defenſive with Charlemagne king of France. But although the thiſtle had been acknowledged as the ſymbol of the kingdom of Scotland from the reign of Achaius, yet ſome refer the beginning of this order to Charles VII. of France. Others place the foundation of it as low as the year 1500.

The chief and principal enſign is a gold collar compoſed of thiſtles and ſprigs of rue interlinked with amulets of gold, having pendent thereto the image of St Andrew with his croſs, and the motto, NEMO ME IMPUNE LACESSET. "No body ſhall provoke me with impunity."

The ordinary or common enſign worn by the knights is a ſtar of four ſilver points, and over them a green circle, bordered and lettered with gold, containing the ſaid motto, and in the centre is a thiſtle; all which is embroidered on their left breaſt, and worn with the collar, with a green riband over the left ſhoulder, and brought under the right arm; pendent thereto is the image of St Andrew, with his croſs, in a purple robe, within an oval of gold enamelled vert, with the former motto; but ſometimes they wear, encircled in the ſame manner, a thiſtle crowned.

About the time of the Reformation, this order was dropped, till James II. of Great Britain reſumed it, by creating eight knights. The Revolution unſettled it again; and it lay neglected, till queen Anne, in 1703, reſtored it to the primitive deſign, of twelve knights of St Andrew.

THLAPSI, BASTARD-CRESS, or *mithridate-muſtard*, in botany: A genus of plants belonging to the claſs of *tetradynamia*, and order of *ſiliculoſa*; and in the natural ſyſtem ranging under the 39th order, *Siliquoſa*. The pod is emarginated, obcordate, and polyſpermous; the valves are boatſhaped and marginato-carinated. There are 12 ſpecies; of which ſix only are natives of Britain, the *arvenſe*, *hirtum*, *campeſtre*, *montanum*, *perfoliatum*, and *burſa paſtoris*.

1. The *arvenſe*, treacle-muſtard or penny-creſs, has orbiculate pods, and leaves oblong, ſmooth, and ſcalloped. It ſmells like garlic, and has a white flower. 2. The *hirtum*, or perennial mithridate muſtard, has roundiſh hairy pods; the cauline leaves are ſagittate and villous. 3. The *campeſtre*, or mithridate-muſtard, has roundiſh pods, ſagittate leaves, dentated and hairy. 4. *Montanum*, or mountain mithridate muſtard, has obcordate pods, ſmooth leaves; the radical leaves ſomewhat fleſhy, obovate and entire; the cauline embracing the ſtalk, and the corolla being larger than the calyx. 5. The *perfoliatum*, or perfoliate treacle-muſtard, has obcordate pods; the cauline leaves are ſmooth and ſubdentate; the petals of the length of the calyx, and the ſtalk branchy. 6. The *burſa paſtoris*, or ſhepherd's purſe, has obcordate pods; the radical leaves are pinnatifid.

The ſeeds of ſome of theſe ſpecies have an acrid biting taſte, approaching to that of the common muſtard; with which they agree nearly in their pharmaceutic properties. They are rarely made uſe of any otherwiſe than as ingredients in the compoſitions whoſe names they bear; though ſome recommend them in different diſorders, preferably to the common muſtard.

Lewis's Materia Medica, vol. ii. p. 429.

THOLOUSE. See TOULOUSE.

THOMÆANS, THOMISTS. See *CHRISTIANS of St Thomas*.

THOMAS AQUINAS. See AQUINAS.

St THOMAS's Day, a feſtival of the Chriſtian church, obſerved on December 21. in commemoration of St Thomas the apoſtle.

St THOMAS of Canterbury's Day, a feſtival of the Romiſh church, obſerved on December 29. in memory of Thomas Becket archbiſhop of Canterbury, who was murdered, or, as the Romaniſts ſay, martyred, in the reign of king Henry II.

THOMAS the Reymour, called alſo *Thomas Lermont*, and *Thomas of Erceldon*, was born at Erceldon, a village near Melroſe in Tweedale, in what year is uncertain; but he was an old man when Edward I. was carrying on war in Scotland.

The character of Lermont as a prophet, and which was common to him with Linus, Orpheus, and other early poets in many countries, aroſe, if we may believe Mackenyie in his Lives of Scottiſh Writers, from his having conferences with Eliza, a nun and propheteſs at Haddington. Lermont put her predictions into verſe, and thus came in for his ſhare of the prophetic ſpirit. None of theſe ancient prophecies now remain; but the following, which pretends to be one of them, is given from a manuſcript of the time of Edward I. or II. The counteſs of Dunbar is the lady famous for the defence of her caſtle againſt the Engliſh. Her proper title was *Counteſs of March*; but it was common in theſe times to ſtyle a nobleman from his chief reſidence. Thus Gilbert Strongbow, earl of Pembroke, is called *Earl of Striguil*, from his reſidence at Striguil caſtle, near Chepſtow, Monmouthſhire, &c.

Pinckerton's Account of Scottiſh Poets.

La Counteſſe de Donbar demande a Thomas de Eſſedoune, quant la guere d'Eſcoce prendreit ſyn. E yl l'a repoundy, et dyt.

When man as mad a kyng of a capped mon.
When mon is levere other mons thyng than his owen.
When londe thouys foreſt, and foreſt ys felde.
When hares kendles othe herſton.
When Wyt and Wille werres togedere.
When mon makes ſtables of kyrkes; and ſteles caſtles with ſtyes.
When Rokeſbourh nys no burgh; ant market is at Forwyleye.
When the alde is gan, and the newe is come that doue noht.
When Bambourne ys donged with dede men.
When men ledes men in ropes to buyen ant to ſellen.
When a quarter of whaty whete is chaunged for a colt of ten markes.
When prude prikes, ant pees is leyd in priſoun.
When a Scot ne may hym hude aſe hare in forme, that the Engliſh ne ſhal hym fynde.
When ryht ant wrong aſtente the togedere.
When laddes weddeth lovedies.
When Scottes flen ſo faſte, that for faute of ſhip, hy drouneth hemſelve.
When ſhal this be?
Nouther in thine tyme, ne in myne.
Ah comen, ant gone,
Withinne twenty wynter ant on.

In fact, the prophecies of Lermont appear to have been merely traditional; nay, it ſeems doubtful if he ever pretended to ſuch folly, notwithſtanding Mackenyie's ſtory of Eliza. The reverence of the people for a learned and reſpectable character ſeems to have been the ſole foundation of Thomas's claim to prophecy. But, in the 16th century, prophecies were made, and aſcribed to him, as well as others given to Bede, Merlin, &c. (A). They were printed at Edinburgh, 1615, reprinted 1680, and 1742.

THOMISM. See AQUINAS.

THOMSON

(A) Sibilla and Baniſter Anglicus are mentioned in the time of Edward IV. (MSS Cot. Dom. A. IX.) A long Latin prophecy of Bridlington is there given. Waldhave and Eltraine ſeem alſo Engliſh prophets. In the whole collection, therefore, Thomas is the only Scottiſh one.

THOMSON (James), an excellent Britiſh poet, the ſon of a Scotch divine, was born in the ſhire of Roxburgh in 1700, and was educated in the univerſity of Edinburgh with a view to the miniſtry. But his genius inclining him to the ſtudy of poetry, which he ſoon found would be incompatible with that of theology, or at leaſt might prevent his being provided for in that way in his own country, he relinquiſhed his views of engaging in the ſacred function, and repaired to London in conſequence of ſome encouragement which he had received from a lady of quality there, a friend of his mother.

The reception he met with wherever he was introduced, emboldened him to riſk the publication of his excellent poem on Winter.—This piece was publiſhed in 1726; and from the univerſal applauſe it met with, Mr Thomſon's acquaintance was courted by people of the firſt taſte and faſhion. But the chief advantage which it procured him was the acquaintance of Dr Rundle, afterwards biſhop of Derry, who introduced him to the late lord Chancellor Talbot; and ſome years after, when the eldeſt ſon of that nobleman was to make his tour on the continent, Mr Thomſon was choſen as a proper companion for him. The expectations which his Winter had raiſed, were fully ſatisfied by the ſucceſſive publications of the other ſeaſons; of Summer, in the year 1727; of Spring, in the following year; and of Autumn, in a quarto edition of his works, in 1730. Beſide the Seaſons, and his tragedy of Sophoniſba, written and acted with applauſe in the year 1729, he had, in 1727, publiſhed his poem to the memory of Sir Iſaac Newton, with an account of his chief diſcoveries; in which he was aſſiſted by his friend Mr Gray, a gentleman well verſed in the Newtonian philoſophy. That ſame year the reſentment of our merchants, for the interruption of their trade by the Spaniards in America, running very high, Mr Thomſon zealouſly took part in it, and wrote his Britannia, to rouſe the nation to revenge.

With the Honourable Charles Talbot, our author viſited moſt of the courts in Europe, and returned with his views greatly enlarged; not only of exterior nature and the works of art, but of human life and manners, and of the conſtitution and policy of the ſeveral ſtates, their connections, and their religious inſtitutions. How particular and judicious his obſervations were, we ſee in his poem on Liberty, begun ſoon after his return to England. We ſee at the ſame time to what a high pitch his care of his country was raiſed, by the compariſons he had all along been making of our happy government with thoſe of other nations. To inſpire his fellow-ſubjects with the like ſentiments, and ſhow them by what means the precious freedom we enjoy may be preſerved, and how it may be abuſed or loſt, he employed two years in compoſing that noble work, upon which he valued himſelf more than upon all his other writings. On his return to England with Mr Talbot (who ſoon after died), the chancellor made him his ſecretary of briefs; a place of little attendance, ſuiting his retired indolent way of life, and equal to all his wants. From this office he was removed, when death, not long after, deprived him of his noble patron. He then found himſelf reduced to a ſtate of precarious dependence. In this ſituation, having created ſome few debts, and his creditors finding that he had no longer any certain ſupport, became inexorable; and imagined by confinement to force that from his friends, which his modeſty would not permit him to aſk. One of theſe occaſions furniſhed Quin, the celebrated actor, with an opportunity of diſplaying the natural goodneſs of his heart, and the diſintereſtedneſs of his friendſhip. Hearing that Thomſon was confined in a ſpunging houſe for a debt of about 70l. he repaired to the place; and, having inquired for him, was introduced to the bard. Thomſon was a good deal diſconcerted at ſeeing Quin, as he had always taken pains to conceal his wants; and the more ſo, as Quin told him he was come to ſup with him. His anxiety upon this head was however removed, upon Quin's informing him, that, as he ſuppoſed it would have been inconvenient to have had the ſupper dreſſed in the place they were in, he had ordered it from an adjacent tavern; and, as a prelude, half a dozen of claret was introduced. Supper being over, and the bottle circulating pretty briſkly, Quin ſaid, "It is time now we ſhould balance accounts." This aſtoniſhed Thomſon, who imagined he had ſome demand upon him; but Quin perceiving it, continued, "Mr. Thomſon, the pleaſure I have had in peruſing your works I cannot eſtimate at leſs than a hundred pounds, and I inſiſt upon now acquitting the debt." On ſaying this, he put down a note of that value, and took his leave, without waiting for a reply.

The profits ariſing from his works were not inconſiderable; his tragedy of Agamemnon, acted in 1738, yielded a good ſum. But his chief dependence was upon the prince of Wales, who ſettled on him a handſome allowance, and honoured him with many marks of particular favour. Notwithſtanding this, however, he was refuſed a licence for his tragedy of Edward and Eleanora, which he had prepared for the ſtage in the year 1736, for ſome political reaſons. Mr Thomſon's next performance was the Maſque of Alfred, written in the year 1740 jointly with Mr Mallet, by the command of the prince of Wales, for the entertainment of his royal highneſs's court at Cliſden, his ſummer reſidence.

Mr Thomſon's poem, entitled the Caſtle of Indolence, was his laſt work publiſhed by himſelf; his tragedy of Coriolanus being only prepared for the theatre, when a fatal accident robbed the world of one of the beſt of men and beſt of poets. He would commonly walk the diſtance between London and Richmond (where he lived) with any acquaintance that offered, with whom he might chat and reſt himſelf, or perhaps dine by the way. One ſummer evening being alone in his walk from town to Hammerſmith, he had over-heated himſelf, and in that condition imprudently took a boat to carry him to Kew; apprehending no bad conſequence from the chill air on the river, which his walk to his houſe, towards the upper end of Kew-lane, had always hitherto prevented. But now the cold had ſo ſeized him, that the next day he was in a high fever. This, however, by the uſe of proper medicines, was removed, ſo that he was thought out of danger; till the fine weather having tempted him to expoſe himſelf once more to the evening dews, his fever returned with violence, and with ſuch ſymptoms as left no hopes of a cure. His death happened on the 27th of Auguſt 1748.

Mr Thomſon had improved his taſte upon the fineſt originals, ancient and modern. The autumn was his favourite ſeaſon for poetical compoſition, and the deep ſilence of the night he commonly choſe for his ſtudies. The amuſement of his leiſure hours were civil and natural hiſtory, voyages, and the beſt relations of travellers. Though he performed on no inſtrument, he was paſſionately fond of muſic, and would ſometimes liſten a full hour at his window to the nightingales in Richmond gardens; nor was his taſte leſs exquiſite in the arts of painting, ſculpture, and architecture. As for the more diſtinguiſhing qualities of his mind and heart, they beſt appear in his writings. There his devotion to the Supreme Being, his love of mankind, of his country, and friends, ſhine out in every page; his tenderneſs of heart was ſo unbounded, that it took in even the brute creation. It is not known, that through his whole life he ever gave any perſon a moment's pain, either by his writings or otherwiſe. He took no part in the political ſquabbles of his time, and was therefore reſpected and left undiſturbed by both ſides. Theſe amiable virtues did not fail of their due reward; the applauſe of the public attended all his productions, and his friends loved him with an enthuſiaſtic ardour.

"As a writer (ſays Dr Johnſon), he is intitled to one praiſe of the higheſt kind; his mode of thinking, and of expreſſing his thoughts, is original. His blank verſe is no more the blank verſe of Milton, or of any other poet, than the rhymes of Pryor are the rhymes of Cowley. His numbers, his pauſes, his diction, are of his own growth, without tranſcription, without imitation. He thinks in a peculiar train, and he thinks always as a man of genius; he looks round on Nature and on life with the eye which Nature beſtows only on a poet; the eye that diſtinguiſhes, in every thing repreſented to its view, whatever there is on which imagination can delight to be detained, and with a mind that at once comprehends the vaſt, and attends to the minute. The reader of the Seaſons wonders that he never ſaw before what Thomſon ſhews him, and that he never yet has felt what Thomſon impreſſes."

Johnſon's Lives of the Poets.

His teſtamentary executors were the lord Lyttleton, whoſe care of our poet's fortune and fame ceaſed not with his life; and Mr Mitchell, a gentleman equally noted for the truth and conſtancy of his private friendſhip, and for his addreſs and ſpirit as a public miniſter. By their united intereſts, the orphan play of Coriolanus was brought on the ſtage to the beſt advantage; from the profits of which, and the ſale of manuſcripts and other effects, a handſome ſum was remitted to his ſiſters. His remains were depoſited in the church of Richmond, under a plain ſtone, without any inſcription. A handſome monument was erected to him in Weſtminſter abbey in the year 1762, the charge of which was defrayed by the profits ariſing from a ſplendid edition of all his works in 4to; Mr Millar the bookſeller, who had purchaſed all Mr Thomſon's copies, giving up his property on this grateful occaſion. A monument has alſo been erected to him at the place of his birth.

THOR, the eldeſt and braveſt of the ſons of Odin and Frea, was, after his parents, the greateſt god of the Saxons and Danes while they continued heathens. They believed, that Thor reigned over all the aerial regions, which compoſed his immenſe palace, conſiſting of 540 halls; that he launched the thunder, pointed the lightning, and directed the meteors, winds, and ſtorms. To him they addreſſed their prayers for favourable winds, refreſhing rains, and fruitful ſeaſons; and to him the fifth day of the week, which ſtill bears his name, was conſecrated.

Henry's Hiſtory of Great Britain, vol. ii. part 4.

THORAX. See Anatomy.

White or *Haw* THORN. See Cratægus.

Thorn, a town of Poland, in Regal Pruſſia, and in the palatinate of Culm. It was formerly a Hanſeatic town, and ſtill enjoys great privileges; is large and well fortified; but part of the fortifications, and a great number of houſes, were ruined by the Swedes in 1703. It is ſeated on the Viſtula, and contains 10,000 inhabitants. E. Long. 18. 42. N. Lat. 53. 6.

THORNBACK, in ichthyology. See Raia.

THORNHILL (Sir James), an eminent Engliſh painter, was born in Dorſetſhire in 1676, of an ancient family; but was conſtrained to apply to ſome profeſſion by the diſtreſſes of his father, who had been reduced to the neceſſity of ſelling his family eſtate. His inclination directed him to the art of painting; and on his arrival at London he applied to his uncle, the famous Dr Sydenham, who enabled him to proceed in the ſtudy of the art under the direction of a painter who was not very eminent. However, the genius of Thornhill made ample amends for the inſufficiency of his inſtructor, and by an happy application of his talents he made ſo great a progreſs, that he gradually roſe to the higheſt reputation.

Dictionary of Painters.

His genius was well adapted to hiſtorical and allegorical compoſitions; he poſſeſſed a fertile and fine invention; and he ſketched his thoughts with great eaſe, freedom, and ſpirit. He excelled alſo equally in portrait, perſpective, and architecture; ſhewed an excellent taſte for deſign, and had a free and firm pencil. Had he been ſo fortunate as to have ſtudied at Rome and Venice, to acquire greater correctneſs at the one, and a more exact knowledge of the perfection of colouring at the other, no artiſt among the moderns might perhaps have been his ſuperior. Nevertheleſs, he was ſo eminent in many parts of his profeſſion, that he muſt for ever be ranked among the beſt painters of his time; and his performances in the dome of St Paul's church at London, in the hoſpital at Greenwich, and at Hampton court, are ſuch public proofs of his merit as will convey his name to poſterity with great honour.

This painter lived in general eſteem; he enriched himſelf by the excellence of his works; was appointed ſtate-painter to Queen Anne, from whom he received the honour of knighthood; had the ſingular ſatisfaction to repurchaſe his family eſtate; and was ſo much diſtinguiſhed as to be elected one of the members of parliament. He died in 1732.

THOROUGH-wax, in botany. See Bupleurum.

THOTH, or Theut, (called by the Phœnicians *Taaut*, by the Greeks *Hermes*, and by the Romans *Mercury*), was a Phœnician of very ſuperior talents, and one of the civilizers of mankind. He was prime miniſter to Oſiris, whom, after his death, he deified; and he was himſelf deified by his countrymen the Egyptians, for the benefits that he had rendered to the human race. See Mercury, Mythology, n° 34, and Polytheism, n° 18.

THOUGHT, a general name for all the ideas conſequent on the operations of the mind, and even on the operations themſelves. See Metaphysics.

Thought, in compoſition. See Oratory, Part I. and II.

THOUINIA, in botany; a genus of plants belonging to the claſs of *diandria*, and order of *monogynia*. The corolla is quadripetalous; the calyx quadripartite, and the antheræ ſeſſile. There is only one ſpecies diſcovered, the *nutans*.

THRACE, a country very frequently mentioned by the Greek and Latin writers, deriving its name, according to Joſephus, from Tiras one of the ſons of Japhet. It was bounded on the north by mount Hæmus; on the ſouth, by the Ægean Sea; on the weſt, by Macedon and the river Strymon; and on the eaſt, by the Euxine Sea, the Helleſpont, and the Propontis.—The Thracian Cherſoneſus is a peninſula incloſed on the ſouth by the Ægean Sea, on the weſt by the gulf of Melas, and on the eaſt by the Helleſpont; being joined on the north to the continent by a neck of land about 37 furlongs broad. The inland parts of Thrace are very cold and barren, the ſnow lying on the mountains the greateſt part of the year; but the maritime provinces are productive of all ſorts of grain and neceſſaries for life; and withal ſo pleaſant that Mela compares them to the moſt fruitful and agreeable countries of Aſia.

The ancient Thracians were deemed a brave and warlike nation, but of a cruel and ſavage temper; being, according to the Greek writers, ſtrangers to all humanity and good nature. It was to the Thracians, however, that the Greeks were chiefly indebted for the polite arts that flouriſhed among them; for Orphæus, Linus, Muſæus, Thamyris, and Eumolpus, all Thracians, were the firſt, as Euſtathius informs us, who charmed the inhabitants of Greece with their eloquence and melody, and perſuaded them to exchange their fierceneſs for a ſociable life and peaceful manners; nay, great part of Greece was anciently peopled by Thracians. Tereus, a Thracian, governed at Daulis in Phocis, where the tragical ſtory of Philomela and Progne was acted. From thence a body of Thracians paſſed over to Eubœa, and poſſeſſed themſelves of that iſland. Of the ſame nation were the Aones, Tembices, and Hyanthians, who made themſelves maſters of Bœotia; and great part of Attica itſelf was inhabited by Thracians, under the command of the celebrated Eumolpus. It is not therefore without the utmoſt ingratitude and injuſtice that the Greeks ſtyle them *Barbarians*, ſince to them chiefly they were indebted both for the peopling and poliſhing of their country.

Thrace was anciently divided into a number of petty ſtates, which were firſt ſubdued by Philip of Macedon. On the decline of the Macedonian empire, the country fell under the power of the Romans. It continued under ſubjection to them till the irruption of the Turks, in whoſe hands it ſtill remains.

THRASHING, in agriculture, the operation by which corn is ſeparated from the ſtraw. This operation is performed in a variety of ways, ſometimes by the feet of animals, ſometimes by a flail, and ſometimes by a machine.

The moſt ancient method of ſeparating the corn from the ſtraw was by the hoofs of cattle or horſes. This was practiſed by the Iſraelites, as we find from the books of Moſes; it was alſo common among the Greeks and Romans*. Flails and thraſhing machines were alſo not uncommon among theſe nations †. The flail which was uſed by the Romans, called *baculus*, *fuſtis*, or *pertica*, was probably nothing more than a cudgel or pole. The thraſhing machine, which was called *tribula* or *tribulum*, and ſometimes *traha*, was a kind of ſledge made of boards joined together, and loaded with ſtone or iron. Horſes were yoked to this machine, and a man was ſeated upon it to drive them over the ſheaves of corn.

Different methods are employed in different countries for ſeparating the corn from the ſtalk. In the greateſt part of France the flail is uſed; but in the ſouthern diſtricts it is generally performed by the feet of animals: animals are alſo uſed for the ſame purpoſe in Spain, in Italy, in the Morea, in the Canaries, in China, and in the vicinity of Canton, where the flail is alſo ſometimes uſed. It appears that in hot climates the grains do not adhere ſo firmly to the ſtalk as in cold countries, and therefore may be more eaſily ſeparated. This will explain the reaſon why animals are ſo frequently employed in hot countries for treading out the corn; whereas in cold climates we know they are ſeldom tried, and have no reaſon to ſuppoſe that they would anſwer the purpoſe. In the Iſle of France in Africa, rice and wheat are thraſhed with poles, and maize with ſticks; for it has not been poſſible to teach the negroes the uſe of the flail.

The animals uſed for treading out corn are, oxen, cows, horſes, mules, and even aſſes when the quantity is not great. The operation is performed in this manner: The ſheaves, after being opened, are ſpread in ſuch a manner that the ears of the corn are laid as much uppermoſt as poſſible, and a man ſtanding in the centre, holds the halters of the cattle, which are made to trot round as in a manege; whilſt other men with forks ſhake the ſtraw up from time to time, and the cattle are trotted over it again and again till they have beaten out all the grain. This method is expeditious enough; but beſides bruiſing a conſiderable quantity of corn, it requires a great many cattle, and injures the legs of the horſes and mules, which are preferred before cows and oxen for this work.

The flail is undoubtedly a much better inſtrument for thraſhing corn than the feet of animals, for it ſeparates the grain from the ſtraw and huſks both more effectually and more expeditiouſly; yet it is liable to many objections. It is a very laborious employment, too ſevere indeed even for a ſtrong man; and as it is uſually the intereſt of the thraſher rather to thraſh much than to thraſh clean, a good deal of corn will generally be left upon the ſtraw. It is therefore an object of great importance in huſbandry to procure a proper machine for ſeparating the corn from the ſtraw.

The firſt thraſhing machine attempted in modern times, of which we have received any account, was invented in Edinburgh by Mr Michael Menzies about the year 1732. It conſiſted of a number of inſtruments like flails, fixed in a moveable beam, and inclined to it at an angle of ten degrees. On each ſide of the beam in which the flails were fixed, floors or benches were placed for ſpreading the ſheaves on. The flails were moved backwards and forwards upon the benches by means of a crank fixed on the end of an axle, which made about 30 revolutions in a minute.

The ſecond thraſhing machine was invented by Mr Michael Stirling, a farmer in the pariſh of Dunblane, Perthſhire. Of this diſcovery we have received a very accurate and authentic account from his ſon, the Reverend Mr Robert Stirling, miniſter of Crieff.

It is an old proverb, that neceſſity is the mother of invention. This was verified on the preſent occaſion. Beſides his ordinary domeſtic ſervants, Mr M. Stirling had occaſion ſometimes to hire an additional number to thraſh out his grain, and frequently found it difficult to procure ſo many as he needed. This naturally led him to reflect whether the operation of thraſhing could not eaſily be performed by machinery. Accordingly, ſo early as the year 1753, under the pretence of joining in the amuſements of his children, he formed in miniature a water mill, in which two iron ſprings, made to riſe and fall alternately, repreſented the motion of two flails, by which a few ſtalks of corn put under them might be ſpeedily thraſhed. This plan he executed on a ſcale ſufficiently large within two years after, making the ſprings about ten feet long, each of which had one end firmly ſcrewed into a ſolid plank, and the other terminated in a round batoon of ſolid iron, two feet long and above an inch in diameter. Under theſe the ſheaves were conveyed gradually forward in a narrow channel or trough, by paſſing between two indented horizontal cylinders, ſimilar to thoſe now uſed in moſt of the thraſhing mills in that part of the country, and called *feeders*. In this manner the thraſhing was executed completely, and with conſiderable rapidity; but as the operation was performed on a low floor, and no method contrived for carrying off the ſtraw, the accumulation of it produced ſuch confuſion, and the removal of it was attended with ſuch danger, that this ſcheme was very ſoon entirely abandoned. The mortification ariſing from diſappointment, and eſpecially the ſcoffs of his neighbours, for what was univerſally accounted an abſurd and ridiculous attempt, ſerved only to ſtimulate the exertions of the inventor to accompliſh his deſigns on another plan.

Laying aſide therefore the iron ſprings with the feeders, and all the apparatus adapted to them, he retained only an outer or water wheel, with an inner or cog wheel moving on the ſame axle; to this inner wheel, which had 48 teeth or cogs, he applied a vertical trundle or pinion, with ſeven notches, the axle of which paſſed through a floor above the wheel, and having its upper pivot ſecured in a beam ſix feet above that floor. At the diſtance of three feet three inches above the floor two ſtraight pieces of ſquared wood, each four feet long, paſſed through the axle of the trundle at right angles, forming four arms, to be moved round horizontally. To the extremities of theſe arms were fixed four

* Pliny, xviii. 30. Virgil, Georg. iii. 132. Col ii. 21. Tibull. i. 5. 21.

† Iſaiah xviii. 27. Homer, Il. xx. 495.

four iron plates, each 20 inches long, and eight broad at the end next the arms, but tapering towards a point at the other end. This large horizontal fly, conſtituting four thraſhers, was incloſed within a wooden cylindrical box three and an half feet high and eight in diameter. On the top of the box was an opening or port (two or three ports were made at firſt, but one was found ſufficient) eight inches wide, and extending from the circumference a foot and an half towards its centre, through which the corn ſheaves deſcended, being firſt opened and laid one by one on a board with two ledges gently declining towards the port; on which board they were moderately preſſed down with a boy's hand, to prevent them from being too haſtily drawn in by the repeated ſtrokes of the thraſhers. Within the box was an inclined plane, along which the ſtraw and grain fell down into a wide wire riddle two feet ſquare, placed immediately under a hole of nearly the ſame ſize. The riddle received a jerk at every revolution of the ſpindle from a knob placed on the ſide of it, and was inſtantly thruſt backward by a ſmall ſpring preſſing it in the oppoſite direction. The ſhort ſtraw, with the grain and chaff which paſſed through the wide riddle, fell immediately into an oblong ſtrait riddle, which hung with one end raiſed and the other depreſſed, and was moved by a contrivance equally ſimple as the other; and having no ledge at the lower end, the long chaff which could not paſs through the riddle dropped from thence to the ground; while the grain and moſt of the chaff falling through the riddle into a pair of common barn-fanners that ſtood under it on the ground floor, the ſtrong grain, the weak, and the chaff, were all ſeparated with great exactneſs. The fanners were moved by a rope or band running circuitouſly in a ſhallow niche cut on the circumference of the cog-wheel. The ſtraw collected gradually in the bottom of the box over the wide riddle, and through an opening two and an half feet wide, and as much in height, left in that ſide of the box neareſt the brink of the upper floor, was drawn down to the ground with a rake by the perſon or perſons employed to form it into ſheaves or rolls.

Such was the thraſhing mill invented by Mr Michael Stirling, which, after various alterations and improvements, he completed in the form now deſcribed, A. D. 1758. By experiment it was found that four bolls of oats, Linlithgow meaſure, could be thraſhed by it in 25 minutes. From that period he never uſed a common flail in thraſhing, except for humbling or bearding barley. In every other kind of grain he performed the whole operation of thraſhing with the mill; and continued always to uſe it till 1772, when he retired from buſineſs, and his thraſhing mill became the property of his ſecond ſon, who continues to uſe it with equal advantage and ſatisfaction. Several machines were conſtructed on the ſame plan, particularly one near Stirling, under Mr Stirling's direction, for Mr Moir of Leckie, in 1765, which, we underſtand has been uſed ever ſince, and gives complete ſatisfaction to the proprietor. There was another erected in 1778 by Mr Thomas Keir (in the pariſh of Muthil and county of Perth), who has contrived a method of bearding barley with it: and by the addition of a ſmall ſpindle with ſhort arms contiguous to the front of the box, and moved by a band common to it and the great ſpindle to which it is parallel, the ſtraw is ſhaken and whirled out of the box to the ground. That this machine did not come immediately into general uſe, was owing partly to the ſmallneſs of the farms in that part of the country, whoſe crops could eaſily be thraſhed by the few hands neceſſarily retained on them for other purpoſes; and chiefly to an apprehenſion that the machine could only be moved by water; an apprehenſion which experience proves to be entirely groundleſs. The machine however, was ingenious, and did great credit to the worthy inventor, and certainly deſerved a better fate than it was deſtined to undergo.

A third threſhing mill was invented in 1772, by two perſons nearly about the ſame time, and upon the ſame principles. The inventors were, Mr Alderton who lived near Alnwick, and Mr Smart at Wark in Northumberland. The operation was performed by rubbing. The ſheaves were carried round between an indented drum of about ſix feet diameter, and a number of indented rollers arranged round the circumference of the drum, and attached to it by means of ſprings; ſo that while the drum revolved, the fluted rollers rubbed the corn off from the ſtraw by rubbing againſt the flutings of the drum. But as a conſiderable quantity of the grain was bruiſed in paſſing between the rollers, the machine was ſoon laid aſide.

In 1776 an attempt was made by Mr Andrew Meikle, an ingenious millwright in the pariſh of Tyningham, Eaſt Lothian, to conſtruct a new machine upon the principles which had been adopted by Mr. Menzies already mentioned. This conſiſted in making joints in the flails, which Mr Menzies had formed without any. But this machine, after much labour and expence, was ſoon laid aſide, on account of the difficulty of keeping it in repair, and the ſmall quantity of work performed, which did not exceed one boll or ſix Wincheſter buſhels of barley *per* hour.

Some time after this, Mr Francis Kinloch, then junior of Gilmerton, having viſited the machine invented in Northumberland, attempted an improvement upon it. He incloſed the drum in a fluted cover; and inſtead of making the drum itſelf fluted, he fixed upon the outſide of it four fluted pieces of wood, which by means of ſprings could be raiſed a little above the circumference of the drum, ſo as to preſs againſt the fluted covering, and thus rub off the ears of corn as the ſheaves paſſed round between the drum and the fluted covering. But not finding this machine to anſwer his expectation (for it bruiſed the grain in the ſame manner as the Northumberland machine did), he ſent it to Mr Meikle, that he might, if poſſible, rectify its errors.

Mr. Meikle, who had long directed his thoughts to this ſubject, applied himſelf with much ardour and perſeverance to the improvement and correction of this machine; and after ſpending a good deal of time upon it, found it was conſtructed upon principles ſo erroneous, that to improve it was impracticable.

At length, however, Mr Meikle's own genius invented a model, different in principle from the machines which had already been conſtructed. This model was made in the year 1785; and in the following year the firſt thraſhing machine on the ſame principles was erected in the neighbourhood of Alloa, in the county of Stirling, by Mr George Meikle the ſon of the inventor. This machine anſwered completely the wiſhes of Mr Stein, the gentleman for whom it was erected, who gave the moſt ample teſtimony of his ſatisfaction both to the inventor and to the public. The fame of this diſcovery ſoon ſpread over the whole country, and a great many farmers immediately applied to Mr Meikle, deſiring to have thraſhing mills erected on their farms. The diſcovery, it appeared, would be profitable, and it was reaſonable that the inventor ſhould enjoy the profits of his invention. He accordingly applied for a patent; which, after conſiderable expence, ariſing from the oppoſition of ſome perſons, who claimed a ſhare in the diſcovery, was granted. Theſe machines are now becoming very common in many parts of Scotland, and are increaſing very conſiderably in number every year over all the united kingdom.

We will now endeavour to deſcribe this machine in its moſt improved ſtate; which is ſo ſimple, that with the aſſiſt-

Thraſhing.

Plate DVIII.

ance of a plate, exhibiting the plan of elevation, n° 1. the ground plan, n° 2. and the 3d ſhowing its eſſential parts in a diſtinct manner, we hope it will be eaſily underſtood by all our readers who have not had an opportunity of ſeeing it. The power employed for turning that part of the machine which ſeparates the corn from the ſtraw is produced by four wheels (when moved by horſes), the teeth of which move in one another and turn the drum, on which four ſcutchers are fixed. The ſheaves are introduced between two fluted rollers, which hold them firm, and draw them in gradually, while the ſcutchers ſtrike off the grain from the ſtraw as it paſſes through. This will ſuffice for a general idea of this machine. We will now be more particular.

The large ſpur-wheel A, n° 1. and 2. which has 276 cogs, is horizontal, and moves the pinion B, which has 14 teeth. The pinion B moves the crown-wheel C, which has 84 teeth; the wheel C moves a ſecond pinion D, which has 16 teeth; and the pinion D moves the drum HIKL. The drum is a hollow cylinder three feet and an half diameter, and placed horizontally; on the outſide of which the ſcutchers are fixed by ſtrong ſcrew bolts. The ſcutchers conſiſt of four pieces of wood, faced on one ſide with a thin plate of iron, placed at an equal diſtance from each other, and at right angles to the axis of the drum.

The ſheaves are ſpread on an inclined board F, n° 3. from which they are introduced between two fluted rollers GG made of caſt iron, about three inches and an half in diameter, and making about 35 revolutions in a minute. As theſe rollers are only about three quarters of an inch diſtant from the ſcutchers or leaves of the drum HIKL, they ſerve to hold the ſheaves faſt, while the ſcutchers *a*, *b*, *c*, *d*, moving with prodigious velocity, ſeparate the grain completely from the ſtraw, and at the ſame time throw out both grain and ſtraw upon the concave rack M, lying horizontally with ſlender parallel ribs, ſo that the corn paſſes through them into a hopper N placed below. From the hopper it paſſes through a harp or riddle O into a pair of fanners P, from which, in the moſt improved machines, it comes out clean and fit for the market. The ſtraw, after being thrown by the ſcutchers *a*, *b*, *c*, *d*, into the rack, is removed from it by a rake QRST into a place contiguous V. The rake conſiſts of four thin pieces of wood or leaves; on the end of each of theſe leaves is ranged a row of teeth *e*, *f*, *g*, *h*, five inches long. The rake moves in a circular manner in the concave rack, while the teeth catch hold of the ſtraw, and throw it out of the rack. Theſe are all the eſſential parts of the machine; the reſt may be eaſily underſtood by the references to the Plate. W is the horſe-courſe, n° 1, which is 27 feet diameter. X is the pillar for ſupporting the beams on which the axle of the ſpur-wheel is fixed. YYY are three ſpindles for moving the two fluted rollers, the rake, and fanners. To the deſcription now given we have only to add, that the drum has a covering of wood Z at a ſmall diſtance above it, for the purpoſe of keeping the ſheaves cloſe to the ſcutchers.

The advantages of this machine are many. As the drum makes 300 revolutions in a minute, the four ſcutchers together make 1200 ſtrokes in the ſame ſpace of time. From ſuch power and velocity, it is evident that much work muſt be performed. When the horſes go at the rate of two and one-third miles *per* hour, from three to ſix bolls will be thraſhed; but as the quantity thraſhed will be leſs when the ſtraw is long than when it is ſhort, we ſhall take the average at four bolls. One gentleman, whoſe veracity and accuracy we can depend on, aſſures us, that his mill thraſhed 63 bolls in a day; by which, we ſuppoſe, he meant 10 hours. To prove the ſuperior advantage of this machine to the common method of thraſhing with flails, a gentleman ordered two equal quantities of oats to be thraſhed by the mill and by flails. When the corn was cleaned and meaſured, he obtained $\frac{1}{16}$ more from the ſheaves thraſhed by the mill than from thoſe thraſhed by the flail. We are alſo informed by another gentleman who has ſtudied this machine with much attention, and calculated its advantages with care, that, independently of having the corn much cleaner ſeparated from the ſtraw than is uſually done by flails, there is a ſaving of 30 or 40 *per cent.* in the expence of thraſhing.

Thraſhing ‖ Thread.

The number of perſons requiſite for attending the mill when working is ſix: One perſon drives the horſes; a ſecond hands the ſheaves to a third, who unties them, while a fourth ſpreads them on the inclined boards and preſſes them gently between the rollers; a fifth perſon is neceſſary to riddle the corn as it falls from the fanners, and a ſixth to remove the ſtraw (A).

This machine can be moved equally well by water, wind, or horſes. Mr Meikle has made ſuch improvements on the wind-mill as to render it much more manageable and convenient than formerly; and we are informed many wind-mills are now erecting in different parts of the country. As to the comparative expence of theſe different machines, the erection of the horſe machine is leaſt; but then the expence of employing horſes muſt be taken into conſideration. One of this kind may be erected for L.70. A water-mill will coſt L.10 more on account of the expence of the water-wheel. A wind-mill will coſt from L.200 to L.300 Sterling.

THRAVE *of* CORN, an expreſſion denoting 24 ſheaves, or four ſhocks of ſix ſheaves to the ſhock; though in ſome countries they only reckon 12 ſheaves to the thrave.

THRASYBULUS, a renowned Athenian general and patriot, the deliverer of his country from the yoke of the 30 tyrants, lived about 294 B. C*.

* See Attica, n° 199—174.

THRASYMENUS LACUS (anc. geog.), a lake of Etruria, near Peruſia, and not far from the Tiber, fatal to the Romans in the Punic war. Now *Il Lago de Perugia* on the Eccleſiaſtical State.

THREAD, a ſmall line made up of a number of fine fibres of any vegetable or animal ſubſtance, ſuch as flax, cotton, or ſilk; from which it takes its name of linen, cotton, or ſilk thread.

Dyeing THREAD *Black.* Linen and cotton thread may be dyed of a durable and deep black by ſolution of iron in ſour beer, in which the linen is to be ſteeped for ſome time, and afterwards boiled in madder. See the article DYEING, n° 87.

Thread may be eaſily bleached by the oxygenated muriatic acid diſcovered by Mr Scheele. This acid whitens cloth remarkably well, but it is ſtill more advantageous for bleaching thread. M. Welter has formed at Liſle, with two partners, an eſtabliſhment for bleaching thread with great ſucceſs, and he has already begun ſome others. He has

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(A) We add, on the authority of an experienced farmer, that of the ſix perſons neceſſary to attend the thraſhing machine, only two can in juſtice be charged to the account of the machine; namely, the perſon who manages the horſes, and the one who feeds the machine: For in the uſual mode of thraſhing by the flail, it requires the ſame number of perſons as the thraſhing machine does to clear an equal quantity of corn from the chaff in the ſame time.

has found that 10 or 12 leys and as many immerſions are required for ſome ſorts of thread; and that the thread may be ſurrounded with the liquor, it is neceſſary to place it, quite looſely, in a baſket, which permits the liquor to penetrate to all its ſurfaces: when the liquor is much weakened, it is ſtill fit to be uſed for the bleaching of cotton.

Thoſe who wiſh more information upon the powerful effects of the oxygenated muriatic acid in bleaching, as well as on the cheapeſt method of preparing it, may conſult a Paper written by M. Bertholet, and publiſhed in the *Annales de Chimie*, a tranſlation of which is given in the *Repert. of Arts*, vol. i.

THREATENING LETTERS. Knowingly to ſend any letter without a name, or with a fictitious name, demanding money, or any other valuable thing, or threatening (without any demand) to kill or fire the houſe of any perſon, is made felony without benefit of clergy. And ſending letters, threatening to accuſe any perſon of a crime puniſhable with death, tranſportation, pillory, or other infamous puniſhment, with a view to extort from him any money or other valuable chattels, is puniſhable by ſtatute 30 Geo. II. c. 24. at the diſcretion of the court, with fine, impriſonment, pillory, whipping, or tranſportation for ſeven years.

THRESHING. See THRASHING.

THRIFT, in botany. See STATICE.

THRINAX, SMALL JAMAICA FAN-PALM, in botany; a genus of plants belonging to the natural claſs of *palmæ*, and order of *flabellifoliæ*. The calyx is ſexdentate; there is no corolla; there are ſix ſtamina; the ſtigma is emarginate, and the berry monoſpermous. This plant was brought from Jamaica to Kew garden by Dr William Wright.

THRIPS, a genus of inſects belonging to the order of *hemiptera*. The roſtrum is obſcure, or ſo ſmall as to be ſcarce perceptible. The antennæ are filiform, and as long as the thorax. The body is ſlender, and of equal thickneſs in its whole length. The abdomen is reflexible, or bent upwards. The four wings are extended, incumbent upon the back of the inſect, narrow in proportion to their length, and croſs one another at ſome diſtance from their baſe. The tarſi of the feet are compoſed of only two articulations.

There are eleven ſpecies mentioned by Gmelin; of which three are natives of Britain; the phyſapus, juneperina, and faſciata.

THROAT, the anterior part of an animal, between the head and the ſhoulders.

THROAT-WORT. See CAMPANULA.

THRONE, a royal ſeat or chair of ſtate, enriched with ornaments of architecture and ſculpture, raiſed on one or more ſteps, and covered with a kind of canopy. Such are the thrones in the rooms of audience of kings and other ſovereigns.

THROSTLE, in ornithology. See TURDUS.

THRUSH, in ornithology. See TURDUS.

THRUSH, or *Aphtha*. See MEDICINE, n° 233.

THRYALLIS, in botany: a genus of plants belonging to the claſs of *decandria*, and order of *monogynia*; and in the natural ſyſtem ranging under the 38th order, *Tricoccæ*. The calyx is quinquepartite; there are five petals, and the capſule is tricoccous. There is only one ſpecies known, the *braſilienſis*.

THUANUS (Jacobus Auguſtus), youngeſt ſon of the preſident de Thou, was famous for the depth and erudition of his works. He was born in 1553; and having finiſhed his ſtudies and travels, was made preſident a-Mortier, and took poſſeſſion thereof in 1595. He was employed in ſeveral important offices of ſtate, and in reforming the univerſity of Paris; which he diſcharged with ſo much prudence, that he was eſteemed the Cato of his age, and the ornament of France. He wrote the hiſtory of his own time in Latin, from the year 1543 to 1608, in 138 books; a work, both for ſubject and ſtyle, worthy of the ancients. He alſo left memoirs of his own life, beſides poems; and died at Paris, 1617.

THUCYDIDES, a celebrated Greek hiſtorian, was born at Athens 471 B. C. He was the ſon of Olorus, and grandſon of Miltiades, who is thought to have been deſcended from Miltiades the famous Athenian general, and to have married the king of Thrace's daughter. He was educated in a manner ſuitable to his quality, that is, in the ſtudy of philoſophy and eloquence. His maſter in the former was Anaxagoras, in the latter Antiphon; one, by his deſcription in the eighth book of his Hiſtory, for power of ſpeech almoſt a miracle, and feared by the people on that account. Suidas and Photius relate, that when Herodotus recited his hiſtory in public, a faſhion in uſe then and many ages after, Thucydides felt ſo great a ſting of emulation, that it drew tears from him; inſomuch that Herodotus himſelf took notice of it, and congratulated his father on having a ſon who ſhowed ſo wonderful an affection to the Muſes. Herodotus was then 29 years of age, Thucydides about 16.

When the Peloponneſian war began to break out, Thucydides conjectured truly, that it would prove a ſubject worthy of his labour; and it no ſooner commenced than he began to keep a journal. This explains the reaſon why he has attended more to chronological order than to unity of deſign. During the ſame war he was commiſſioned by his countrymen to relieve Amphipolis; but the quick march of Braſidas the Lacedæmonian general defeated his operations; and Thucydides, unſucceſsful in his expedition, was baniſhed from Athens. This happened in the eighth year of this celebrated war; and in the place of his baniſhment the general began to write an impartial hiſtory of the important events which had happened during his adminiſtration, and which ſtill continued to agitate the ſeveral ſtates of Greece. This famous hiſtory is continued only to the 21ſt year of the war, and the remaining part of the time till the demolition of the walls of Athens was deſcribed by the pen of Theopompus and Xenophon. Thucydides wrote in the Attic dialect, as being poſſeſſed of moſt vigour, purity, elegance, and energy. He ſpared neither time nor money to procure authentic materials; and the Athenians, as well as their enemies, furniſhed him with many valuable communications, which contributed to throw great light on the different tranſactions of the war. His hiſtory has been divided into eight books; the laſt of which is imperfect, and ſuppoſed to have been written by his daughter.

Lempriere's Dictionary.

The hiſtorian of Halicarnaſſus has often been compared with the ſon of Olorus, but each has his peculiar excellence. Sweetneſs of ſtyle, grace and elegance of expreſſion, may be called the characteriſtics of the former; while Thucydides ſtands unequalled for the fire of his deſcriptions, the conciſeneſs, and at the ſame time the ſtrong and energetic manner of his narratives. His relations are authentic, as he himſelf was intereſted in the events he mentions; his impartiality is undubitable, as he nowhere betrays the leaſt reſentment againſt his countrymen, and the factious partizans of Cleon, who had baniſhed him from Athens. The hiſtory of Thucydides was ſo admired by Demoſthenes, that he tranſcribed it eight different times, and read it with ſuch attention, that he could almoſt repeat it by heart. Thucydides died at Athens, where he had been recalled from his exile about 411 years before Chriſt.

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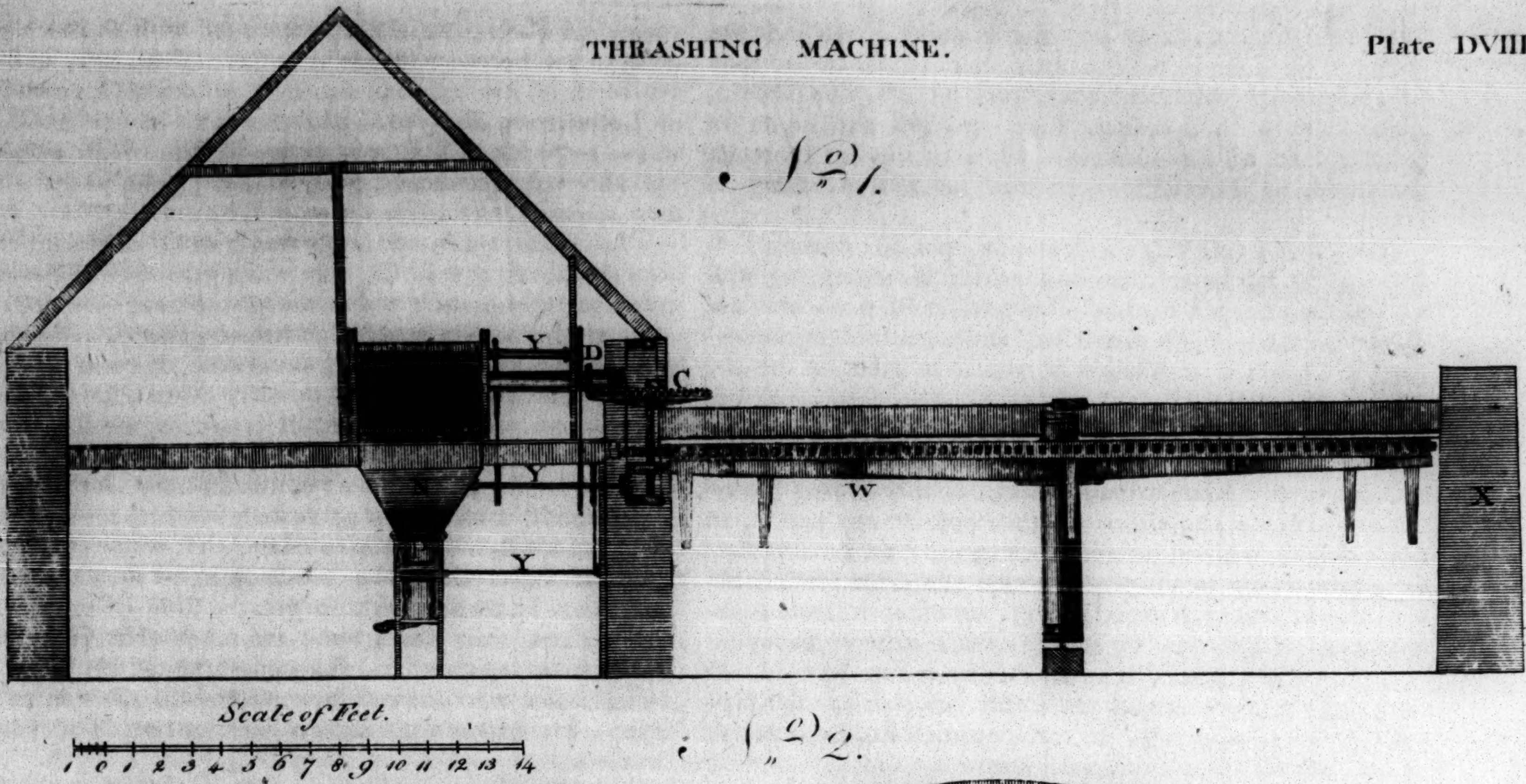
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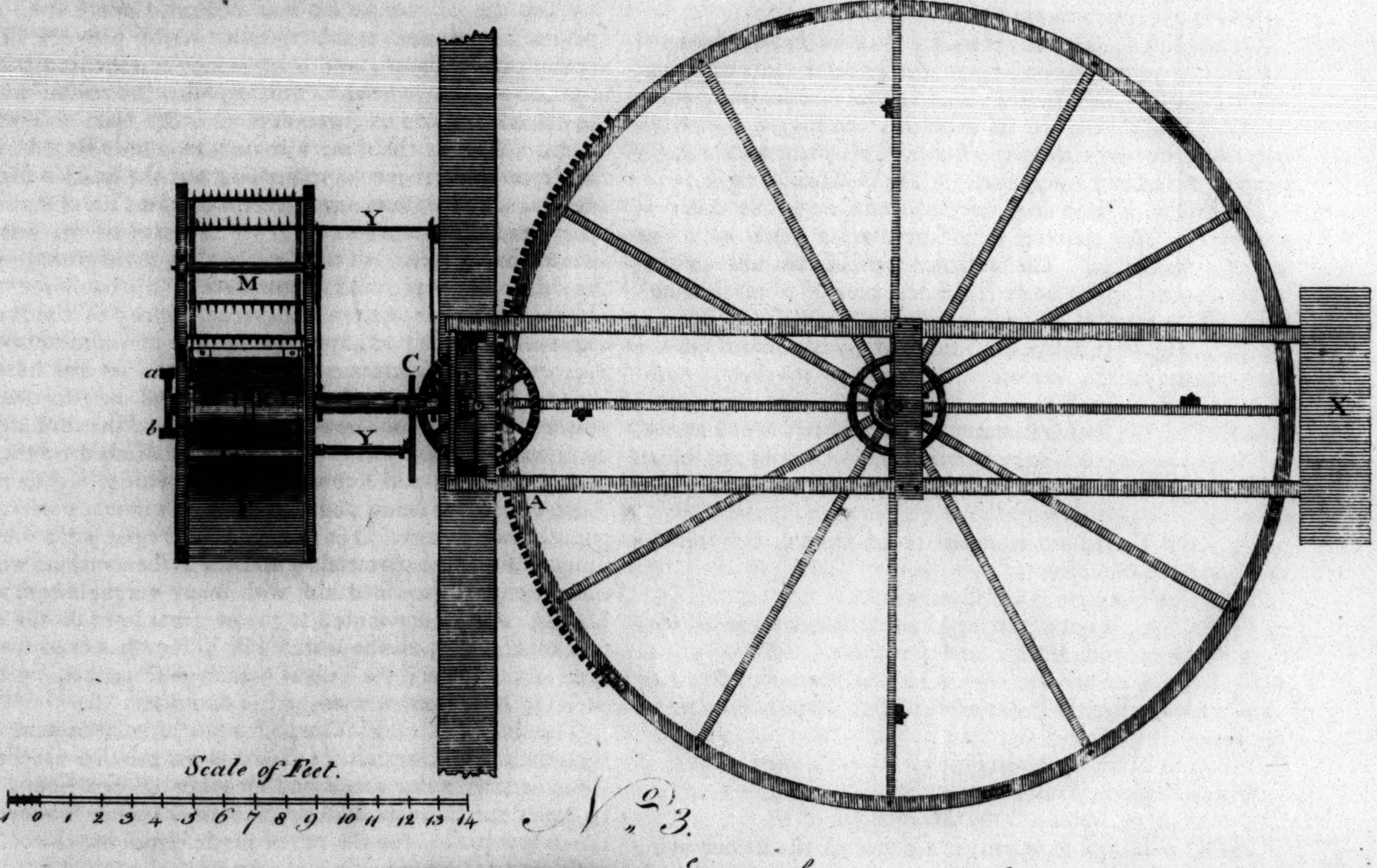
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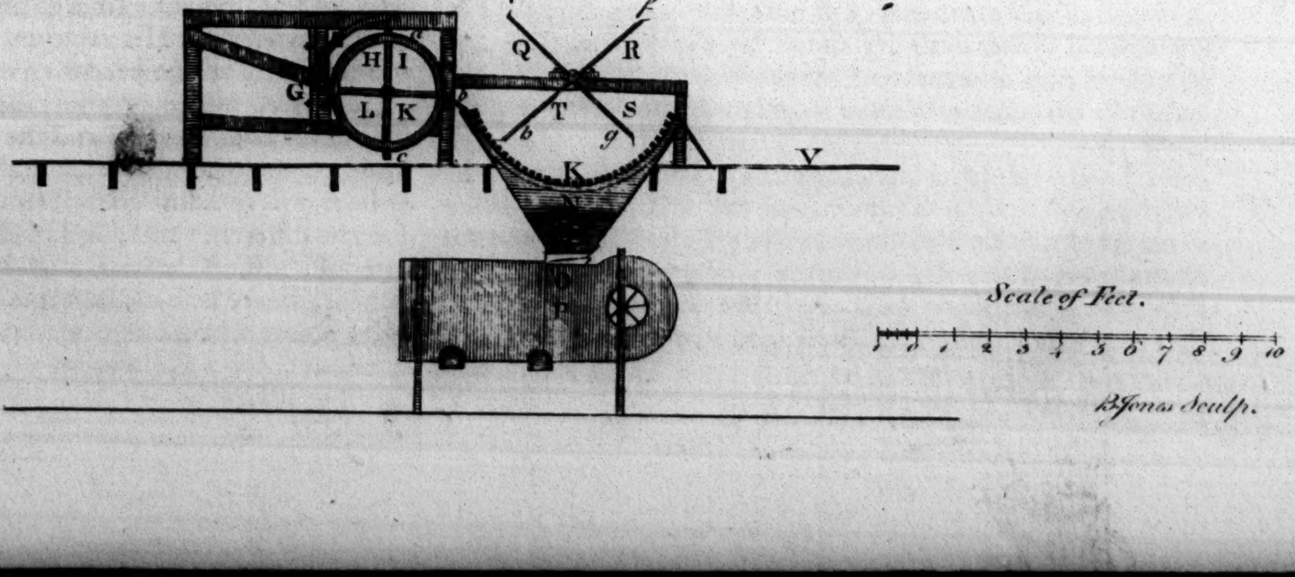
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B. Jones Sculp.

BRITISH
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The beſt edition of Thucydides is that of Oxford, publiſhed in 1696, folio, and that of Duker, publiſhed at Amſterdam in 1731, folio.

THUJA, the Arbor vitæ, in botany: A genus of plants belonging to the claſs of *monodelphia*, and order of *monœcia*; and in the natural ſyſtem ranging under the 51ſt order, *Coniferæ*. There are four ſpecies known; the orientalis, occidentalis, apylla, and dolabrata; of which the two firſt are moſt remarkable.

The *occidentalis*, or common arbor vitæ, grows naturally in Canada, Siberia, and other northern countries. In ſome of the Engliſh gardens a few of theſe trees are to be met with of a large ſize: it has a ſtrong woody trunk, which riſes to the height of 40 feet or more. The bark, while young, is ſmooth, and of a dark brown colour; but as the trees advance, the bark becomes cracked, and leſs ſmooth. The branches are produced irregularly on every ſide, ſtanding almoſt horizontal, and the young ſlender ſhoots frequently hang downward, thinly garniſhed with leaves; ſo that when the trees are grown large they make but an indifferent appearance. The young branches are flat, and their ſmall leaves lie imbricated over each other like the ſcales of a fiſh; the flowers are produced from the ſide of the young branches pretty near to the foot-ſtalk; the male flowers grow in oblong catkins, and between theſe the female flowers are collected in form of cones. When the former have ſhed their farina, they ſoon aſter drop off; but the female flowers are ſucceeded by oblong cones, having obtuſe ſmooth ſcales, containing one or two oblong ſeeds. The leaves of this tree have a rank oily ſcent when bruiſed.

2. The *orientalis*, or China arbor vitæ, grows naturally in the northern parts of China, where it riſes to a conſiderable height; but this has not been long enough in Europe to have any trees of large ſize. The ſeeds of this ſort were firſt ſent to Paris by ſome of the miſſionaries; and there are ſome of the trees growing in the gardens of the curious there, which are more than 20 feet high. The branches of this ſort grow cloſer together, are much better adorned with leaves, which are of a brighter green colour, ſo make a much better appearance than the other, and being very hardy, it is eſteemed preferable to moſt of the evergreen trees with ſmall leaves, for ornament in gardens. The branches of this tree croſs each other at right angles: the leaves are flat; but the ſingle diviſions of the leaves are ſlender, and the ſcales are ſmaller and lie cloſer over each other than thoſe of the firſt ſort. The cones are alſo much larger, and of a beautiful grey colour; their ſcales end in acute reflexed points.

Theſe trees are propagated by ſeeds, layers, or cuttings.

THULE, or Thylæ, (anc. geog.), an iſland in the moſt northern parts of the German Ocean. Its ſituation was never accurately aſcertained by the ancients, hence its preſent name is unknown by modern hiſtorians. Some ſuppoſe that it is the iſland now called Iceland, or part of Greenland, and others that it was *Foula*. See Foula.

THUMB, in anatomy, one of the extremities of the hand.

Thumb-Cap, an iſland in the South Sea, lies about ſeven leagues north-weſt of Lagoon-iſland; it is a low, woody iſland, of a circular form, and not much above a mile in compaſs. There was no appearance of inhabitants; the land was covered with verdure of many hues.

THUMMIM. See Urim.

THUNBERGIA, in botany; a genus of plants belonging to the claſs of *didynamia*, and order of *angioſpermia*. The calyx is double; the exterior one is diphyllous, and the interior one multipartite. The capſule is globoſe, beaked, and bilocular. There is only one ſpecies known, the *capenſis*.

THUNDER, the noiſe occaſioned by the exploſion of a flaſh of lightning echoed back from the inequalities on the ſurface of the earth, in like manner as the noiſe of a cannon is echoed, and in particular circumſtances forms a rolling lengthened ſound.

Although *thunder*, properly ſpeaking, is only a mere ſound, capable of producing very little effect, yet the word is generally ſuppoſed to include the phenomena of lightning alſo; and electrified clouds are by univerſal conſent call *thunder-clouds*, and the exploſions of many flaſhes of lightning proceeding from them are generally called *thunder-ſtorms*. Though the phenomena of lightning, therefore, have been at a great length explained and accounted for under the articles Electricity and Lightning, and though the immediate cauſe of electrical exploſions from clouds is explained under the article Rain; yet the ultimate cauſe remains ſtill to be ſhown, and properly belongs to the preſent article.

It is univerſally allowed, that the variation of the electricity in different parts of the atmoſphere is the cauſe of thunder. Under the article Electricity, it has been ſhown why lightning explodes after the thunder-clouds are charged. Under the article Lightning, it is ſhown why that meteor puts on the various forms in which we ſee it, why it ſometimes ſtrikes houſes or animals, and ſometimes not, &c.; and under the article Rain, why the atmoſphere in ſome caſes parts with the vapours which at other times it ſo obſtinately retains. It remains therefore only to mention the theory by which ſome philoſophers explain the reaſon why rains are ſometimes attended with thunder, and ſometimes not; which, to thoſe who attentively peruſe the articles above-mentioned, may be done in few words.

In this part of Great Britain, and for a conſiderable way along the eaſtern coaſt, although thunder may happen at any time of the year, yet the month of July is that in which it may almoſt certainly be expected. Its duration is of very uncertain continuance; ſometimes only a few peals will be heard at any particular place during the whole ſeaſon; at other times the ſtorm will return at the interval of three or four days for a month, ſix weeks, or even longer: not that we have violent thunder in this country directly vertical in any one place ſo frequently in any year, but in many ſeaſons it will be perceptible that thunder-clouds are formed in the neighbourhood even at theſe ſhort intervals. Hence it appears, that during this particular period there muſt be ſome natural cauſe operating for the production of this phenomenon, which does not take place at other times. This cannot be the mere heat of the weather, for we have often a long tract of hot weather without any thunder; and beſides, though not common, thunder is ſometimes heard in the winter alſo. As therefore the heat of the weather is common to the whole ſummer, whether there be thunder or not, we muſt look for the cauſes of it in thoſe phenomena, whatever they are, which are peculiar to the months of July, Auguſt, and the beginning of September. Now it is generally obſerved, in the tract of country of which we now ſpeak, that from the month of April an eaſt or ſouth-eaſt wind generally takes place, and continues with little interruption till towards the end of June. At that time, ſometimes ſooner and ſometimes later, a weſterly wind takes place; but as the cauſes producing the eaſt wind are not removed, the latter oppoſes the weſt wind with its whole force. At the place of meeting, there is naturally a moſt vehement preſſure of the atmoſphere, and friction of its parts againſt one another; a calm enſues, and the vapours brought by both winds begin to collect and form dark clouds, which can have little motion either way, becauſe they are preſſed almoſt equally on all ſides. For the moſt part, however, the weſt wind prevails, and what little motion the clouds have is towards the eaſt: whence the common remark in this country, that "thunder-clouds move againſt the wind." But this is by no means univerſally true: for if the weſt wind happens to be excited by any temporary cauſe before its natural period when it ſhould take place, the eaſt wind will very frequently get the better of it; and the clouds, even although thunder is produced, will move weſtward. Yet in either caſe the motion is ſo ſlow, that the moſt ſuperficial obſervers cannot help taking notice of a conſiderable reſiſtance in the atmoſphere.

That when two ſtreams of air are thus driven againſt each other, the ſpace where they meet muſt become highly electrified, is as plain as that an electric globe muſt be excited when friction is applied. It is true, as the ſubſtances here to be excited are both electrics *per ſe*, it may be objected, that no electricity could be produced; for we cannot excite one electric by rubbing it with another. Yet it is obſerved, that glaſs may be electrified by blowing ſtrongly upon it, or by the exploſion of cannon; and even when glaſs is ſtrongly preſſed upon glaſs, both pieces become electrified as ſoon as they are ſeparated. When glaſs is rubbed upon glaſs, no attraction nor repulſion can be perceived, nor is any ſign of electricity obſerved on bodies brought near to it; yet a very bright electric light always appears on the glaſſes, and a phoſphoreal ſmell is felt; which ſhows, that though the electricity does not fly out through the air in the uſual way, yet the fluid within the glaſs is agitated; and there is little reaſon to doubt that any conducting body incloſed within the ſubſtance of the glaſs would be electrified alſo. The vapours therefore, which are the conducting ſubſtances in the atmoſphere, become immediately electrified in conſequence of the preſſure above-mentioned, and all the phenomena deſcribed under the various articles already referred to take place.

In like manner, by the ſtruggle of two other winds as well as thoſe of the eaſt and weſt, may a thunder-ſtorm be produced; but it is always neceſſary that the reſiſtance of the air to the motion of the clouds ſhould be very great, and nearly equal all round. For if the vapour ſhould get off to a ſide, no thunder would take place; the electricity would then be carried off as faſt as it was collected, and rain would only be the conſequence, by reaſon of the electrified vapours parting with their latent heat, as is explained under the article RAIN. In fact, we very often obſerve, that in the time of rain the clouds evidently move acroſs the wind, and the nearer their motion is to a direct oppoſition, the heavier will the rain be; while, on the other hand, if they move briſkly before the wind, let the direction be what it will, the atmoſphere ſoon clears up.

That rattling in the noiſe of thunder which makes it ſeem as if it paſſed thro' arches, or were variouſly broken, is probably owing to the ſound being excited among clouds hanging over one another, and the agitated air paſſing irregularly between them. The exploſion, if high in the air, and remote from us, will do no miſchief; but when near, it may deſtroy trees, animals, &c. This proximity or ſmall diſtance may be eſtimated nearly by the interval of time between ſeeing the flaſh of lightning and hearing the report of the thunder, eſtimating the diſtance after the rate of 1142 feet *per* ſecond of time, or three two-third ſeconds to the mile. Dr Wallis obſerves, that commonly the difference between the two is about ſeven ſeconds, which, at the rate above-mentioned, gives the diſtance almoſt two miles. But ſometimes it comes in a ſecond or two, which argues the exploſion very near us, and even among us. And in ſuch caſes, the Doctor aſſures us, he has ſometimes foretold the miſchiefs that happened.

The noiſe of thunder and the flame of lightning are eaſily made by art. If a mixture of oil or ſpirit of vitriol be made with water, and ſome filings of ſteel added to it, there will immediately ariſe a thick ſmoke or vapour out of the mouth of the veſſel; and if a lighted candle be applied to this, it will take fire, and the flame will immediately deſcend into the veſſel, which will be burſt to pieces with a noiſe like that of a cannon.

This is ſo far analogous to thunder and lightning, that a great exploſion and fire are occaſioned by it; but in this they differ, that this matter when once fired is deſtroyed, and can give no more exploſions; whereas, in the heavens, one clap of thunder uſually follows another, and there is a continued ſucceſſion of them for a long time. Mr Homberg explained this by the lightneſs of the air above us in compariſon of that near, which therefore would not ſuffer all the matter ſo kindled to be diſſipated at once, but keeps it for ſeveral returns.

Reſpecting the phenomena of thunder, we have many obſervations to communicate; ſome of which, we flatter ourſelves, are new, and all of them valuable; but our bounds oblige us, though with great reluctance, to paſs them over.

THUNDERBOLT. When lightning acts with extraordinary violence, and breaks or ſhatters any thing, it is called a *thunderbolt*, which the vulgar, to fit it for ſuch effects, ſuppoſe to be a hard body, and even a ſtone. But that we need not have recourſe to a hard ſolid body to account for the effects commonly attributed to the thunderbolt, will be evident to any one who conſiders thoſe of the pulvis fulminans and of gunpowder; but more eſpecially the aſtoniſhing powers of electricity, when only collected and employed by human art, and much more when directed and exerciſed in the courſe of nature.

When we conſider the known effects of electrical exploſions, and thoſe produced by lightning, we ſhall be at no loſs to account for the extraordinary operations vulgarly aſcribed to thunderbolts. As ſtones and bricks ſtruck by lightning are often found in a vitrified ſtate, we may reaſonably ſuppoſe, with Beccaria, that ſome ſtones in the earth having been ſtruck in this manner, gave occaſion to the vulgar opinion of the thunderbolt.

THUNDER-Houſe. See ELECTRICITY, p. 474.

THURINGIA, a diviſion of the circle of Upper Saxony in Germany. It is a fruitful tract, abounding in corn, eſpecially wheat; in black cattle, ſheep, and horſes. It is about 73 miles in length, and as much in breadth. It contains 47 towns, 14 boroughs, betwixt 700 and 800 villages, 300 noble eſtates, 7 ſuperintendencies, and 5 underconſiſtories. Thuringia, the country of the ancient Thuringi, or Catti, a branch of the Vandals, mentioned by Tacitus, was formerly a kingdom, afterwards a county, then a landgravate, and was governed by its own princes for many ages, till 1124, when it devolved to the marquis of Miſnia, and, with that country, afterwards to the duke of Saxony. But the modern Thuringia is only a part of the ancient, nay, but a part of the ancient South Thuringia, which comprehends beſides, a large ſhare of the modern Franconia, Heſſe, &c. On the extinction of the male line of the ancient landgraves in 1247, it came to the margraves of Meiſſen, anceſtors to the preſent electoral family. The elector has no voice in the diet, on account of his ſhare in the landgravate or circle of Thuringia. Erfurt is the capital.

THURLOE (John), an Engliſh ſtateſman under Oliver Cromwell, was born at Abots Roding in Eſſex in 1616, of which pariſh his father was rector, and was educated to the ſtudy of the law. In 1648 he was made receiver or clerk of the curſitor fines; and though his attachments were entirely on the ſide of the parliament, he declares himſelf totally unconcerned in all counſels relative to the death of the king: however, on that event, and on the eſtabliſhment of the commonwealth, he was diverted from proſecuting his employments in the law by engaging in public buſineſs. When Cromwell aſſumed the protectorſhip, he became ſecretary of ſtate; in 1655, he had the care and charge both of foreign and inland poſtage committed to him by the protector; and was afterward ſworn one of his privy-council, according to "The humble petition and advice." He was continued in the ſame capacities under Richard Cromwell, and until meaſures were taken for the Reſtoration; when he made an offer of his ſervices to that end, which, however, were not accepted. May 15th 1660, he was committed to the cuſtody of the ſerjeant at arms on a charge of high treaſon; but being ſoon releaſed, he retired to Great Milton in Oxfordſhire: and though he was afterward often ſolicited by Charles II. to engage in the adminiſtration of public buſineſs, he thought proper to decline the offers. He died in 1668: and was a man of an amiable private character, who in the higheſt of his power exerciſed all poſſible moderation towards perſons of every party. The moſt authentic teſtimony of his abilities is that vaſt collection of ſtate-papers, ſeven volumes folio, now in the hands of the public; which place the affairs of Great Britain, and of Europe in general, during that remarkable period, in the cleareſt light.

THURSDAY, the fifth day of the Chriſtian week, but the ſixth of that of the Jews.

THUS, Frankincense, a ſolid brittle reſin, brought to us in little globes or maſſes, of a browniſh or yellowiſh colour on the outſide, internally whitiſh or variegated with whitiſh ſpecks. It is ſuppoſed to be the produce of the pine that yields the common turpentine, and to concrete upon the ſurface of the terebinthinate juice ſoon after it has iſſued from the tree. See Incense.

THUYA. See Thuja.

THYMUS, Thyme, in botany: A genus of plants belonging to the claſs of *didynamia*, and order of *gymnoſpermia;* and in the natural ſyſtem ranging under the 42d order, *Verticillatæ.* The calyx is bilabiate, and its throat cloſed with ſoft hairs. There are 11 ſpecies; of which two only are natives of Britain, the *ſerpyllum* and *acinas*.

1. The *ſerpyllum*, or mother of thyme, has pale red flowers growing on round heads, terminal; the ſtalks are procumbent, and the leaves plane, obtuſe, and ciliated at the baſe. 2. The *acinas*, or wild baſil, has flowers growing in whirls on ſingle footſtalks; the ſtalks are erect and branched; the leaves acute and ſerrated, The *thymus vulgaris*, or garden thyme, is a native of France, Spain, and Italy.—The attachment of bees to this and other aromatic plants is well known. In the experiments made at Upſal, ſheep and goats were obſerved to eat it, and ſwine to refuſe it.

Thymus, in anatomy. See Anatomy, n° 114.

THYRSUS, in antiquity, the ſceptre which the poets put into the hand of Bacchus, and wherewith they furniſhed the menades in their Bacchanalia.

Thyrsus, in botany, a mode of flowering reſembling the cone of a pine. It is, ſays Linnæus, a panicle contracted into an oval or egg-ſhaped form. The lower footſtalks, which are longer, extend horizontally, whilſt the upper ones are ſhorter and mount vertically. Lilac and butter-bur furniſh examples.

TIARA, an ornament or habit wherewith the ancient Perſians covered their heads; and with which the Armenians and kings of Pontus are repreſented on medals; theſe laſt, becauſe they were deſcended from the Perſians. Latin authors call it indifferently *tiara* and *cidaris*. Strabo ſays, the tiara was in form of a tower; and the ſcholiaſt on Ariſtophanes's comedy, Αχορνης, act 1. ſcene 2. affirms, that it was adorned with peacock's feathers.

Tiara is alſo the name of the pope's triple crown. The tiara and keys are the badges of the papal dignity; the tiara of his civil rank, and the keys of his juriſdiction: for as ſoon as the pope is dead, his arms are repreſented with the tiara alone, without the keys. The ancient tiara was a round high cap. John XXIII. firſt encompaſſed it with a crown. Boniface VIII. added a ſecond crown; and Benedict XII. a third.

TIARELLA, in botany: A genus of plants belonging to the claſs of *decandria*, and order of *digynia;* and in the natural ſyſtem ranging under the 13th order, *Succulentæ.* The calyx is quinquepartite; the corolla pentapetalous, and inſerted into the calyx; the petals are entire; the capſule is unilocular and bivalve, the one valve being leſs than the other. There are two ſpecies, the *cordifolia* and *trifoliata*.

TIBER, a great river of Italy, which runs through the pope's territories, paſſing by Perugia and Orvietto; and having viſited Rome, falls into the Tuſcan ſea at Oſtia, fifteen miles below that city.

TIBET, called by the Tartars *Barantola*, *Bootan*, or *Tangoot*, and by the Chineſe *Tſang*, is ſituated between 26° and 39° north latitude; and according to Abbé Groſier, is reckoned to be 640 leagues from eaſt to weſt, and 650 from north to ſouth. It is bounded on the north by the country of the Mongols and the deſert of Kobi; on the eaſt by China; on the weſt by Hindoſtan, and on the ſouth by the ſame country and the kingdom of Ava. In the valleys lying between the lower mountains are many tribes of Indian people; and a diſpute happening between the heirs of one of the rajahs or petty princes, one party called to their aſſiſtance the Boutaners, and the other the Britiſh. The latter prevailed; and the fame of Britiſh valour being carried to the court of Tibet, the Teeſhoo-Lama, who ruled the ſtate under the Delai-Lama, at that time in his minority, ſent a deputation to Bengal, deſiring peace for the prince who had been engaged in war with the Britiſh. This was readily granted by the governor; and Mr Bogle was ſent ambaſſador to the court of Tibet, where he reſided ſeveral months; and after an abſence of a year and a quarter, returned to Calcutta. The account of this gentleman's expedition hath not been publiſhed by himſelf; but from Mr Stewart's letter to Sir John Pringle, publiſhed in the Philoſophical Tranſactions, vol. 67. we learn the following particulars, collected from his papers.

"Mr Bogle divides the territories of the Delai-Lama into two different parts. That which lies immediately contiguous to Bengal, and which is called by the inhabitants *Doopo*, he diſtinguiſhes by the name of *Bootan;* and the other, which extends to the northward as far as the frontiers of Tartary, called by the natives *Pu*, he ſtyles *Tibet*. Bootan is ruled by the Dah Terriah, or Deb Rajah. It is a country of ſteep and inacceſſible mountains, whoſe ſummits are crowned with eternal ſnow; they are interſected with deep valleys, through which pour numberleſs torrents that increaſe in their courſe, and at laſt, gaining the plains, loſe themſelves in the great rivers of Bengal. Theſe mountains are covered down their ſides with foreſts of ſtately trees of various ſorts; ſome (ſuch as pines, &c.) which are known in Europe; others, ſuch as are peculiar to the country and climate. The valleys and ſides of the hills which admit of cultivation are not unfruitful, but produce crops of wheat, barley, and rice. The inhabitants are a ſtout and warlike people, of a copper complexion, in ſize rather above the middle European ſtature, haſty and quarrelſome in their temper, and addicted to the uſe of ſpirituous liquors; but honeſt in their dealings, robbery by violence being almoſt unknown among them. The chief city is Taſſey Seddein ſituated on the Patchoo. Tibet begins properly from the top of the great ridge of the Caucaſus, and extends from thence in breadth to the confines of Great Tartary, and perhaps to ſome of the dominions of the Ruſſian empire. The woods, which every where cover the mountains in Boutan, are here totally unknown; and, except a few ſtraggling trees near the villages, nothing of the ſort to be ſeen. The climate is extremely ſevere and rude. At Chamnanning, where he wintered, although it be in latitude 31° 39′, only 8° to the northward of Calcutta, he often found the thermometer in his room at 29° by Fahrenheit's ſcale; and in the middle of April the ſtanding waters were all frozen, and heavy ſhowers of ſnow perpetually fell. This, no doubt, muſt be owing to the great elevation of the country, and to the vaſt frozen ſpace over which the north wind blows uninterruptedly from the pole, through the vaſt deſerts of Siberia and Tartary, till it is ſtopped by this formidable wall.

“ The Tibetians are of a ſmaller ſize than their ſouthern neighbours, and of a leſs robuſt make. Their complexions are alſo fairer, and many of them have even a ruddineſs in their countenances unknown in the other climates of the eaſt. Thoſe whom Mr Bogle ſaw at Calcutta appeared to have quite the Tartar face. They are of a mild and cheerful temper; the higher ranks are polite and entertaining in converſation, in which they never mix either ſtrained compliments or flattery. The common people, both in Bootan and Tibet, are clothed in coarſe woollen ſtuffs of their own manufacture, lined with ſuch ſkins as they can procure; but the better orders of men are dreſſed in European cloth, or China ſilk, lined with the fineſt Siberian furs. The uſe of linen is totally unknown among them. The chief food of the inhabitants is the milk of their cattle, prepared into cheeſe, butter, or mixed with the flour of a coarſe barley or of peaſe, the only grain which their ſoil produces; and even theſe articles are in a ſcanty proportion; but they are furniſhed with rice and wheat from Bengal and other countries in their neighbourhood. They alſo are ſupplied with fiſh from the rivers in their own and the neighbouring provinces, ſalted and ſent into the interior parts. They have no want of animal food from the cattle, ſheep, and hogs, which are raiſed on their hills; and are not deſtitute of game. They have a ſingular method of preparing their mutton, by expoſing the carcaſe entire, after the bowels are taken out, to the ſun and bleak northern winds which blow in the months of Auguſt and September, without froſt, and ſo dry up the juices and parch the ſkin, that the meat will keep uncorrupted for the year round. This they generally eat raw, without any other preparation.

“ The religion and political conſtitution of this country, which are intimately blended together, would make a conſiderable chapter in its hiſtory. It ſuffices to ſay, that at preſent, and ever ſince the expulſion of the Eluth Tartars, the kingdom of Tibet is regarded as depending on the empire of China, which they call *Cathay*; and there actually reſide two mandarines, with a garriſon of a thouſand Chineſe, at Lahaſſa the capital, to ſupport the government; but their power does not extend far: and in fact the Lama, whoſe empire is founded on the ſureſt grounds, perſonal affection and religious reverence, governs every thing internally with unbounded authority. Every body knows that the Delai Lama is the great object of adoration for the various tribes of heathen Tartars, who roam through the vaſt tract of continent which ſtretches from the banks of the Volga to Correa on the ſea of Japan, the moſt extenſive religious dominion, perhaps, on the face of the globe. See LAMA.

“ It is an old notion, that the religion of Tibet is a corrupted Chriſtianity: and even Father Diſederii, a Jeſuit (but not of the Chineſe miſſion) who viſited the country about the beginning of this century, thinks he can reſolve all their myſteries into ours; and aſſerts, with a truly myſtical penetration, that they have certainly a good notion of the Trinity, ſince in their addreſs to the Deity, they ſay as often *konciok-oik* in the plural as *konciok* in the ſingular, and with their roſaries pronounce theſe words, *om, ha, hum*, The truth is, that the religion of Tibet, from whatever ſource it ſprung, is pure and ſimple in its ſource, conveying very exalted notions of the Deity, with no contemptible ſyſtem of morality: but in its progreſs it has been greatly altered and corrupted by the inventions of worldly men; a fate we can hardly regret in a ſyſtem of error, ſince we know that that of truth has been ſubject to the ſame. Polygamy, at leaſt in the ſenſe we commonly receive the word, is not in practice among them; but it exiſts in a manner ſtill more repugnant to European ideas; for there is a plurality of huſbands, which is firmly eſtabliſhed and highly reſpected there. In a country where the means of ſubſiſting a family are not eaſily found, it ſeems not impolitic to allow a ſet of brothers to agree in raiſing one, which is to be maintained by their joint efforts. In ſhort, it is uſual in Tibet for the brothers in the family to have a wife in common, and they generally live in great harmony and comfort with her; not but ſometimes little diſſenſions will ariſe (as may happen in families conſtituted upon different principles), an inſtance of which Mr Bogle mentions in the caſe of a modeſt and virtuous lady, the wife of half a dozen of the Teeſhoo Lama's nephews, who complained to the uncle that the two youngeſt of her huſbands did not furniſh that ſhare of love and benevolence to the common ſtock which duty and religion required of them. In ſhort, however ſtrange this cuſtom may appear to us, it is an undoubted fact that it prevails in Tibet.

“ The manner of beſtowing their dead is alſo ſingular: they neither put them in the ground like the Europeans, nor burn them like the Hindoos; but expoſe them on the bleak pinnacle of ſome neighbouring mountain, to be devoured by wild beaſts and birds of prey, or waſted away by time and the viciſſitudes of the weather in which they lie. The mangled carcaſes and bleached bones lie ſcattered about; and amidſt this ſcene of horror, ſome miſerable old wretch, man or woman, loſt to all feelings but thoſe of ſuperſtition, generally ſets up an abode, to perform the diſmal office of receiving the bodies, aſſigning each a place, and gathering up the remains when too widely diſperſed.”

To the account of Tibet which we have given from the communications of Mr Bogle, we may add the information which we have obtained from a later traveller, Mr Saunders[*], ſurgeon at Boglepoer in Bengal, who made a journey into Tibet in the year 1783. His obſervations chiefly reſpect the natural productions and diſeaſes of the country.

The plants which Mr Saunders found were almoſt all European plants, a great number of them being natives of Britain. From the appearance of the hills he concludes that they muſt contain many ores of metal and pyrites. There are inexhauſtible quantities of TINCAL (ſee that article), and rock ſalt is plentiful; gold-duſt is found in great quantities in the beds of rivers, and ſometimes in large maſſes, lumps, and irregular veins; lead, cinnabar, containing a large proportion of quickſilver, copper, and iron, he thinks, might eaſily be procured. But the inhabitants of Tibet have no better fuel than the dung of animals. A coal mine would be a valuable diſcovery. We are told, that in ſome parts of China bordering on Tibet coal is found and uſed as fuel.

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[*] Paper to the Phil. Tranſ. Vol. LXXIX.

It is remarkable that the ſame diſeaſe prevails at the foot of the mountains of Tibet as in Switzerland at the foot of the Alps, a glandular ſwelling in the throat commonly called *goitre*. This diſeaſe has been aſcribed to the uſe of ſnow-water, which flows down in ſtreams from the mountains in both countries. But in many countries where ſnow-water is abundant it does not prevail, and in other places far remote from ſnow it is not unfrequent, as in Sumatra. Mr Saunders thinks that it ariſes from the air peculiar to the vicinity of certain mountains; and finding the vegetable productions of the mountains of Tibet the ſame with thoſe of the Alps, that they alſo may have their influence. An analyſis of the water where this diſeaſe prevails might throw ſome light on the ſubject. We have heard it attributed to the impregnation of water with *tuſa*. This very extraordinary diſeaſe has been little attended to, from obvious reaſons; it is unaccompanied with pain, ſeldom fatal, and generally confined to the poorer ſort of people. The tumor is unſightly, and grows to a troubleſome ſize, being often as large as a perſon's head. It is certainly not exaggerating to ſay, that one in ſix of the Rungpore diſtrict, and country of Bootan, has the diſeaſe.

As thoſe who labour moſt, and are the leaſt protected from the changes of weather, are moſt ſubject to the diſeaſe, we univerſally find it in Bootan more common with the women than men. It generally appears in Bootan at the age of thirteen or fourteen, and in Bengal at the age of eleven or twelve; ſo that in both countries the diſeaſe ſhows itſelf about the age of puberty. I do not believe this diſeaſe has ever been removed, though a mercurial courſe ſeemed to check its progreſs, but did not prevent its advance after intermitting the uſe of mercury. An attention to the primary cauſe will firſt lead to a proper method of treating the diſeaſe; a change of ſituation for a ſhort while, at that particular period when it appears, might be the means of preventing it.

The venereal diſeaſe is not uncommon in Tibet; and what will perhaps ſurprize the phyſician, the inhabitants are acquainted with the effects of mercury, and with a method of preparing it ſo as to render it a ſafe and efficacious remedy. They know how to deprive it of its metallic form by mixing it with alum, nitre, and vermilion, and expoſing it to a certain degree of heat, which they judge of by weighing the fuel.

The language ſpoken in Tibet is different from that of the Tartars. The aſtronomers are acquainted with the motion of the heavenly bodies, and able to calculate eclipſes: but the lamas are generally ignorant; few of them can read, much leſs underſtand their ancient books.

TIBULLUS (Aulus Albius), a Roman knight, and a celebrated Latin poet, was born at Rome 43 B. C. He was the friend of Horace, Ovid, Macer, and other great men in the reign of Auguſtus. He accompanied Meſſala Corvinus in his expedition againſt the iſland of Corcyra: but falling ſick, and being unable to ſupport the fatigues of war on account of the weakneſs of his conſtitution, he quitted the profeſſion of arms, and returned to Rome, where he died before the year 17; when Ovid ſhowed his grief for his death by writing a fine elegy upon him. Tibullus wrote four books of elegies, which are ſtill extant: they are written in a tender and agreeable ſtyle, and in very elegant Latin. Muret and Joſeph Scaliger have written learned and curious commentaries on the works of this poet. The beſt edition of Tibullus is that of Janus Bronckhuſius, publiſhed at Amſterdam in 1708, in one volume quarto. We have an Engliſh poetical verſion by Mr Grainger.

TIBUR (anc. geog.) a town of Latium, pleaſantly ſituated on the Anio. Here Horace had his villa and houſe; and here he wiſhed to end his days. Here Adrian built an extraordinary villa called *Tiburtina*, inſcribed with the names of the provinces and of the moſt conſiderable places, (Spartian); near which Zenobia had a houſe called *Zenobia*, (Trebellius, Pollio). Hither Auguſtus often retreated on account of its ſalubrity, (Suetonius): for which it is greatly commended, (Martial). Anciently, when the Romans had far extended their territory, it was the utmoſt place of baniſhment, (Ovid). It had a temple of Hercules; and therefore called *Herculeum*. In the temple was a library, (A. Gellius). Now *Tivoli* in the Campagna di Roma on the Teverone.

TICINUS, (anc. geog.) a river in Inſubria, riſing in mount Adula, traverſing the Lacus Verbanus ſouthwards, and falling into the Po near Ticinum. Between this river and the Po Hannibal gained his firſt victory over the Romans under P. Scipio. The general himſelf eſcaped with the utmoſt difficulty, and that by the bravery of his ſon the firſt Scipio Africanus. Now the *Teſino*, riſing in mount Godard, running ſouth through the Lago Maggiore and Milan, by Pavia, into the Po.

TICK, in zoology. See Acarus.

TICKELL (Thomas), an excellent Engliſh poet, was the ſon of the Reverend Richard Tickell, and was born in 1686, at Bridekirk in Cumberland. He was educated at Queen's college, Oxford, of which he was made fellow; and while he continued at that univerſity, he addreſſed to Mr Addiſon a complimentary copy of verſes on his Opera of Roſamond, which introduced him to an acquaintance with that gentleman, who diſcovering his merit, became his ſincere friend. On Mr Addiſon's being made ſecretary of ſtate, he appointed Mr Tickell his under ſecretary; and on his being obliged to reſign that office on account of his ill health, he recommended him ſo effectually to Mr Craggs his ſucceſſor, that he was continued in his poſt till that gentleman's death. In 1724 Mr Tickell was appointed ſecretary to the lords juſtices in Ireland, and enjoyed that place as long as he lived. He wrote ſome poems, which, when ſeparately publiſhed, met with a favourable reception, and paſſed through ſeveral editions: they are now printed in the ſecond volume of The Minor Poets. After Mr Addiſon's death Mr Tickell had the care of the edition of his works printed in 4 vols 4to; to which he prefixed an account of Mr Addiſon's life, and a poem on his death. Mr Tickell died in the year 1740.

TICKERA, a conſiderable article of merchandiſe in Fezzan in Africa; it is valued by travellers as a portable and highly ſalubrious food. It is a preparation of pounded dates, and the meal of Indian corn, formed into a paſte, and highly dried in an oven.

TICKSEED, Sun-flower. See Coreopſis.

TICUNAS. See Poiſon, p. 266.

TIDE, is a word which expreſſes that riſing and falling of the waters which are obſerved on all maritime coaſts.

There is a certain depth of the waters of the ocean which would obtain if all were at reſt: but obſervation ſhows that they are continually varying from this level, and that ſome of theſe variations are regular and periodical.

1ſt, It is obſerved, that on the ſhores of the ocean, and in bays, creeks, and harbours, which communicate freely with the ocean, the waters riſe up above this mean height twice a day, and as often ſink below it, forming what is called a FLOOD and an EBB, a HIGH and a LOW WATER. The whole interval between high and low water is called a TIDE;

the water is ſaid to FLOW and to EBB; and the riſing is called the FLOOD-TIDE, and the falling is called the EBB-TIDE.

2*d*, It is obſerved that this riſe and fall of the waters is variable in quantity. At Plymouth, for inſtance, it is ſometimes 21 feet between the greateſt and leaſt depth of the water in one day, and ſometimes only 12 feet.

Theſe different heights of tide are obſerved to ſucceed each other in a regular ſeries, diminiſhing from the greateſt to the leaſt, and then increaſing from the leaſt to the greateſt. The greateſt is called a SPRING TIDE, and the leaſt is called a NEAP TIDE.

3*d*, This ſeries is completed in about 15 days. More careful obſervation ſhows the two ſerieſes are completed in the exact time of a lunation. For the ſpring tide in any place is obſerved to happen preciſely at a certain interval of time (generally between two and three days) after new or full moon, and the neap tide at a certain interval after half moon; or, more accurately ſpeaking, it is obſerved that the ſpring tide always happens when the moon has got a certain number of degrees eaſtward of the line of conjunction and oppoſition, and the neap tide happens when ſhe is a certain number of degrees from her firſt or laſt quadrature. Thus the whole ſeries of tides appears to be regulated by the moon.

4*th*, It is obſerved that high water happens at new and full moon when the moon has a certain determined poſition with reſpect to the meridian of the place of obſervation, preceding or following the moon's ſouthing a certain interval of time; which is conſtant with reſpect to that place, but very different in different places.

5*th*, The time of high water in any place appears to be regulated by the moon; for the interval between the time of high water and the moon's ſouthing never changes above three quarters of an hour, whereas the interval between the time of high water and noon changes ſix hours in the courſe of a fortnight.

6*th*, The interval between two ſucceeding high waters is variable. It is leaſt of all about new and full moon, and greateſt when the moon is in her quadratures. As two high waters happen every day, we may call the double of their interval a TIDE DAY, as we call the diurnal revolution of the moon a *lunar day*. The tide day is ſhorteſt about new and full moon, being then about $24^h\ 37'$; about the time of the moon's quadratures it is $25^h\ 27'$. Theſe values are taken from a mean of many obſervations made at Barbadoes by Dr Maſkelyne.

7*th*, The tides in ſimilar circumſtances are greateſt when the moon is at her ſmalleſt diſtance from the earth, or in her perigee, and gradually diminiſhing, are ſmalleſt when ſhe is in her apogee.

8*th*, The ſame remark is made with reſpect to the ſun's diſtance, and the greateſt tides are obſerved during the winter months of Europe.

9*th*, The tides in any part of the ocean increaſe as the moon, by changing her declination, approaches the zenith of that place.

10*th*, The tides which happen while the moon is above the horizon are greater than the tides of the ſame day when the moon is below the horizon.

Such are the regular phenomena of the tides. They are important to all commercial nations, and have therefore been much attended to. It is of the tides, in all probability, that the Bible ſpeaks, when God is ſaid to ſet bounds to the ſea, and to ſay "this far ſhall it go, and no farther."

Homer is the earlieſt profane author who ſpeaks of the tides. Indeed it is not very clear that it is of them that he ſpeaks (in the XIIth book of the Odyſſey) when he ſpeaks of Charybdis, which riſes and retires thrice in every day. Herodotus and Diodorus Siculus ſpeak more diſtinctly of the tides in the Red ſea. Pytheas of Marſeilles is the firſt who ſays any thing of their cauſe. According to Strabo he had been in Britain, where he muſt have obſerved the tides of the ocean. Plutarch ſays expreſsly that Pytheas aſcribed them to the moon. It is ſomewhat wonderful that Ariſtotle ſays ſo little about the tides. The army of Alexander, his pupil, were ſtartled at their firſt appearance to them near the Perſian Gulph; and we ſhould have thought that Ariſtotle would be well informed of all that had been obſerved there. But there are only three paſſages concerning them in all Ariſtotle's writings, and they are very trivial. In one place he ſpeaks of great tides obſerved in the north of Europe; in another he mentions their having been aſcribed by ſome to the moon; and in a third, he ſays, that the tide in a great ſea exceeds that in a ſmall one.

The Greeks had little opportunity of obſerving the tides. The conqueſts and the commerce of the Romans gave them more acquaintance with them. Cæſar ſpeaks of them in the 4th book of his Gallic war. Strabo, after Poſidonius, claſſes the phenomena into daily, monthly, and annual. He obſerves, that the ſea riſes as the moon gets near the meridian, whether above or below the horizon, and falls again as ſhe riſes or falls; alſo, that the tides increaſe at the time of new and full moon, and are greateſt at the ſummer ſolſtice. Pliny explains the phenomena at ſome length; and ſays, that both the ſun and moon are their cauſe, dragging the waters along with them (B. II. c. 97). Seneca (*Nat. Queſt.* III. 28.) ſpeaks of the tides with correctneſs; and Macrobius (*Somn. Scip.* I. 6.) gives a very accurate deſcription of their motions.

It is impoſſible that ſuch phenomena ſhould not exerciſe human curioſity as to their cauſe. Plutarch (*Plaut. Phil.* III. 17.) Galileo (*Syſt. Mund.* Dial. 4.), Riccioli in his *Almageſt*, ii. p. 374, and Gaſſendi, ii. p. 27, have collected moſt of the notions of their predeceſſors on the ſubject; but they are of ſo little importance, that they do not deſerve our notice. Kepler ſpeaks more like a philoſopher (*De Stella Martis*, and *Epit. Aſtron.* p. 555). He ſays that all bodies attract each other, and that the waters of the ocean would all go to the moon were they not retained by the attraction of the earth; and then goes on to explain their elevation under the moon and on the oppoſite ſide, becauſe the earth is leſs attracted by the moon than the nearer waters, but more than the waters which are more remote.

The honour of a complete explanation of the tides was reſerved for Sir Iſaac Newton. He laid hold of this claſs of phenomena as the moſt inconteſtible proof of univerſal gravitation, and has given a moſt beautiful and ſynoptical view of the whole ſubject; contenting himſelf, however, with merely exhibiting the chief conſequences of the general principle, and applying it to the phenomena with ſingular addreſs. But the wide ſteps taken by this great philoſopher in his inveſtigation leave ordinary readers frequently at fault: many of his aſſumptions require the greateſt mathematical knowledge to ſatiſfy us of their truth. The academy of Paris therefore propoſed to illuſtrate this among other parts of the principles of natural philoſophy, and publiſhed the theory of the tides as a prize problem. This produced three excellent diſſertations, by M'Laurin, Dan. Bernoulli, and Euler. Aided by theſe, and chiefly by the ſecond, we ſhall here give a phyſical theory, and accommodate it to the purpoſes of navigation, by giving the rules of calculation. We have demonſtrated in our diſſertations on the phyſical principles of the celeſtial motions, that it is an unexcepted fact, that every particle of matter in the ſolar ſyſtem is actually deflected toward every other particle; and that the deflection of a particle of matter toward any diſtant ſphere is proportional to the quantity of matter in that ſphere directly, and to the ſquare of the diſtance of the particle from the centre of that ſphere inverſely: and having found that the heavineſs of a piece of terreſtial matter is nothing but the ſuppoſed opponent to the force which we exert in carrying this piece of matter, we conceive it is poſſeſſing a property, that is, diſtinguiſhing quality, manifeſted by its being *gravis* or heavy. This is heavineſs, *gravitas*, gravity; and the manifeſtation of this quality, or the event in which it is ſeen, whether it be directly falling, or deflecting in a parabolic curve, or ſtretching a coiled ſpring, or breaking a rope, or ſimply preſſing on its ſupport, is *gravitatio*, gravitation; and the body is ſaid to gravitate. When all obſtacles are removed from the body, as when we cut the ſtring by which a ſtone is hung, it moves directly downwards, *tendit ad terram. Si diſcindatur funis, tenderet lapis ad terram. Dum vero funis integer perſtet, lapis terram verſus niti cenſetur.* By ſome metaphyſical proceſs, which it is needleſs at preſent to trace, this *niſus ad motum* has been called a *tendency* in our language. Indeed the word has now come to ſignify the energy of any active quality in thoſe caſes where its ſimpleſt and moſt immediate manifeſtation is prevented by ſome obſtacle. The ſtone is now ſaid to tend toward the earth, though it does not actually approach it, being withheld by the ſtring. The ſtretching the ſtring in a direction perpendicular to the horizon is conceived as a full manifeſtation of this tendency. This tendency, this inergy of its heavineſs, is therefore named by the word which diſtinguiſhes the quality; and it is called *gravitation*, and it is ſaid to *gravitate*.

But Sir Iſaac Newton diſcovered that this deflection of a heavy body differs in no reſpect from that general deflection obſerved in all the bodies of the ſolar ſyſtem. For 16 feet, which is the deflection of a ſtone in one ſecond, has the very ſame proportion to $\frac{1}{19}$th of an inch, which is the ſimultaneous deflection of the moon, that the ſquare of the moon's diſtance from the centre of the earth has to the ſquare of the ſtone's diſtance from it, namely, that of 3600 to 1.

Thus we are enabled to compare all the effects of the mutual tendencies of the heavenly bodies with the tendency of gravity, whoſe effects and meaſures are familiar to us.

If the earth were a ſphere covered to a great depth with water, the water would form a concentric ſpherical ſhell; for the gravitation of every particle of its ſurface would then be directed to the centre, and would be equal. The curvature of its ſurface therefore would be every where the ſame, that is, it would be the uniform curvature of a ſphere.

Plate DIX.

It has been demonſtrated in former articles, after Sir Iſaac Newton, that the gravitation of a particle C (fig. 1.) to the centre O, is to that of a particle E at the ſurface as CO to EO. In like manner the gravitation of o is to that of p as o O to p O. If therefore EO and O p are two communicating canals, of equal lengths, the water in both would be in equilibrio, becauſe each column would exert the ſame total preſſure at O. But if the gravitation of each particle in p O be diminiſhed by a certain proportion, ſuch as $\frac{1}{100}$th of its whole weight, it is plain that the total preſſure of the column p O will be $\frac{1}{100}$th part leſs than that of the column EO. Therefore they will no longer be in equilibrio. The weight of the column EO will prevail; and if a hollow tower P p be built at the mouth of the pit p o, the water will ſink in EO and riſe in O p, till both are again in equilibrio, exerting equal total preſſures at O. Or we may prevent the ſinking at E by pouring in more water into the tower Pp. The ſame thing muſt happen in the canal f c perpendicular to EO, if the gravitation of every particle be diminiſhed by a force acting in the direction CF, and proportional to the diſtance of the particle from C, and ſuch, that when c C is equal to o O, the force acting on c is equal to the force acting on o. In order that the former equilibrium may be reſtored after this diminution of the gravitation of the column f C, it is plain that more water muſt be poured into the oblique tower Ff. All this is evident when we conſider the matter hydroſtatically. The gravitation of the particle c may be repreſented by o O; but the diminution of the preſſure occaſioned by this at O is repreſented by Cc.

Hence we can collect this much, that the whole diminution of preſſure at C is to the whole diminution of preſſure at O as the ſum of all the lines c C to the ſum of all the lines o O, that is, as $f\mathrm{C}^2$ to p O^2. But the weight of the ſmall quantity of water added in each tower is diminiſhed in the ſame proportion; therefore the quantity added at F f muſt be to the quantity added at P p as fC to p O. Therefore we muſt have $\mathrm{F}f : \mathrm{P}p = f\mathrm{C} : p\,\mathrm{O}$, and the points F, F, P, muſt be in the circumference of an ellipſe, of which PO and EO are the tranſverſe and conjugate ſemiaxes.

What we have here ſuppoſed concerning the diminution of gravity in theſe canals is a thing which really obtains in nature. It was demonſtrated, when treating of the *Preceſſion of the Equinoxes*, that if the ſun or moon lie in the direction OP, at a very great diſtance, there reſults from the unequal gravitation of the different particles of the earth a diminution of the gravity of each particle; which diminution is in a direction parallel to OP, and proportional to the diſtance of the particle from a plain paſſige through the centre of the earth at right angles to the line OP.

Thus it happens that the waters of the ocean have their equilibrium diſturbed by the unequal gravitation of their different particles to the ſun or to the moon; and this equilibrium cannot be reſtored till the waters come in from all hands, and riſe up around the line joining the centres of the earth and of the luminary. The ſpherical ocean muſt acquire the form of a prolate ſpheroid generated by the revolution of an ellipſe round its tranſverſe axis. The waters will be higheſt in that place which has the luminary in its zenith, and in the antipodes to that place; and they will be moſt depreſſed in all thoſe places which have the luminary in their horizon. P and P′ will be the poles, and EOQ will be the equator of this prolate ſpheroid.

Mr Ferguſon, in his Aſtronomy, aſſigns another cauſe of this arrangement, *viz.* the difference of the centrifugal forces of the different particles of water, while the earth is turning round the common centre of gravity of the earth and moon. This, however, is a miſtake. It would be juſt if the earth and moon were attached to the ends of a rod, and the earth kept always the ſame face towards the moon.

It is evident that the accumulation at P and P′, and the depreſſion at the equator, muſt augment and diminiſh in the ſame proportion with the diſturbing force. It is alſo evident that its abſolute quantity may be diſcovered by our knowledge of the proportion of the diſturbing force to the force of gravity.—Now this proportion is known; for the proportion of the gravitation of the earth's centre to the ſun or moon, to the force of gravity at the earth's ſurface, is known; and the proportion of the gravitation of the earth's centre to the luminary, to the difference of the gravitations of the centre and of the ſurface, is alſo known, being very nearly the proportion of the diſtance of the luminary to twice the radius of the earth.

Although this reaſoning, by which we have aſcertained the ellipical form of the watery ſpheroid, be ſufficiently convincing, it is very imperfect, being accommodated to one condition only of equilibrium, *viz.* the equilibrium of the canals

canals fc and co. There are ſeveral other conditions equally neceſſary to which this lax reaſoning will not apply, ſuch as the direction of the whole remaining gravitation in any point F. This muſt be perpendicular to the ſurface, &c. &c. Nor will this mode of inveſtigation aſcertain the eccentricity of the ſpheroid without a moſt intricate proceſs. We muſt therefore take the ſubject more generally, and ſhow the proportion and directions of gravity in every point of the ſpheroid. We need not, however, again demonſtrate that the gravitation of a particle placed any where without a perfect ſpherical ſhell, or a ſphere conſiſting of concentric ſpherical ſhells, either of uniform denſity, or of denſities varying according to ſome function of the radius, is the ſame as if the whole matter of the ſhell or ſphere were collected in the centre. This has been demonſtrated in the article ASTRONOMY. We need only remind the reader of ſome conſequences of this theorem which are of continual uſe in the preſent inveſtigation.

1ſt, The gravitation to a ſphere is proportional to its quantity of matter directly, and to the ſquare of the diſtance of its centre from the gravitating particle inverſely.

2d, If the ſpheres be homogeneous and of the ſame denſity, the gravitations of particles placed on their ſurfaces, or at diſtances which are proportional to their diameters, are as the radii; for the quantities of matter are as the cubes of the radii, and the attractions are inverſely as the ſquares of the radii; and therefore the whole gravitations are as $\frac{r^3}{r^2}$, or as r.

3d, A particle placed within a ſphere has no tendency to the matter of the ſhell which lies without it, becauſe its tendency to any part is balanced by an oppoſite tendency to the oppoſite part. Therefore,

4th, A particle placed any where *within* a homogeneous ſphere gravitates to its centre with a force proportional to its diſtance from it.

It is a much more difficult problem to determine the gravitation of particles to a ſpheroid. To do this in general terms, and for every ſituation of the particle, would require a train of propoſitions which our limits will by no means admit; we muſt content ourſelves with as much as is neceſſary for merely aſcertaining the ratio of the axes. This will be obtained by knowing the ratio of the gravitation at the pole to that at the equator. Therefore

Let N m S q N (fig. 2) be a ſection through the axis of an oblate homogeneous ſpheroid, which differs very little from a ſphere. NS is the axis, mq is the equatorial diameter, O is the centre, and NMSQ is the ſection of the inſcribed ſphere. Let P be a particle ſituated at any diſtance without the ſphere in its axis produced; it is required to determine the gravitation of this particle to the whole matter of the ſpheroid?

Draw two lines PAC, PBD, very near to each other, cutting off two ſmall arches AB, CD; draw GA a, HB b, IC c, KD d, perpendicular to the axis; alſo draw OE and AL, perpendicular to PAC, and OF perpendicular to PD, cutting PC in f. Join OA.

Let OA, the radius of the inſcribed ſphere, be r, and OP the diſtance of the gravitating particle be d, and M m, the elevation of the equator of the ſpheroid, or the ellipticity, be e. Alſo make AE $= x$, and OE $= y, = \sqrt{r^2 - x^2}$. Then AE—BF $= \dot{x}$ and F$f = \dot{y}, = \frac{x\dot{x}}{\sqrt{r^2-x^2}}$

Suppoſe the whole figure to turn round the Axis OP. The little ſpace AB b a will generate a ring of the redundant matter; ſo will CD d c. This ring may be conſidered as conſiſting of a number of thin rings generated by the revolution of A a. The ring generated by A a is equal to a parallelogram whoſe baſe is the circumference deſcribed by A, and whoſe height is A a. Therefore let c be the circumference of a circle whoſe radius is 1. The ring will be A $a \times c \times$ AG. But becauſe m a N is an arch of an ellipſe, we have M m : A a = MO : AG $= r$: AG, and A a = M $m \times \frac{\text{AG}}{r}, = \frac{e}{r}$ AG. Therefore the ſurface of this ring is $= c\,\frac{e}{r}\text{AG}^2$.

We have ſuppoſed the ſpheroid to be very nearly ſpherical, that is, e exceedingly ſmall in compariſon of r. This being the caſe, all the particles in A a, and conſequently all the particles in the ring generated by the revolution of A a, will attract the remote particle P with the ſame force that A does very nearly. We may ſay the ſame thing of the whole matter of the ring generated by the revolution of AB b a. This attraction is exerted in the direction PA by each individual particle. But every action of a particle A is accompanied by the action of a particle A′ in the direction PA′. Theſe two compoſe an attraction in the direction PO. The whole attraction in the direction ſimilar to PA is $= c \times \frac{e\ \text{AG}^2}{r\ \text{PA}^2} \times$ GH, for GH meaſures the number of parallel plates of which the ſolid ring is compoſed. This being decompoſed in the direction PG is $= c \times \frac{e}{r} \times \frac{\text{AG}^2 . \text{PG}}{\text{PA}^3} \times$ GH. But $\frac{\text{AG}^2}{\text{PA}^2} = \frac{\text{OE}^2}{\text{PO}^2}$, and $\frac{\text{PG}}{\text{PA}} = \frac{\text{PE}}{\text{PO}}$. Therefore the attraction of the ring, eſtimated in the direction PO, is $= c \times \frac{e}{r} \times \frac{\text{OE}^2 . \text{PE}}{\text{PO}^3} \times$ GH.

Farther, by the nature of the circle, we have HG : AB = AG : AO; alſo AB : BL = AO : OE. But PA : AG = PO : OE, and OE $= \frac{\text{AG} \times \text{PO}}{\text{PA}}$. Therefore

AB : BL = AO : $\frac{\text{AG} . \text{PO}}{\text{PA}}$, = AO . PA : PO . AG

Alſo BL : L A = EO : EA,

And LA : Ff = PA : Pf, = ultimately PA : PE. Therefore, by equality, HG : Ff = AG . AO . PA . EO . PA : AO. PO. AG. EA. PE.

Or HG : Ff = EO . PA^2 : PO . EA . PE.

And HG = F$f \times \frac{\text{EO} . \text{PA}^2}{\text{PO} . \text{PE} . \text{EA}}$.

Now ſubſtitute this value of HG in the formula expreſſing the attraction of the ring. This changes it to $c\,\frac{e}{r} \times \frac{\text{OE}^2 . \text{PE}}{\text{PO}^3} \times \frac{\text{OE} . \text{PA}^2}{\text{PO} . \text{PE} . \text{EA}} \times$ Ff, or $c\,\frac{e}{r} \times \frac{\text{OE}^3 . \text{PA}^2}{\text{PO}^4 . \text{EA}} \times$ Ff. In like manner, the attraction of the ring generated by the revolution of CD d c is $c\,\frac{e}{r} \times \frac{\text{OE}^3 . \text{PC}^2}{\text{PO}^4 . \text{EA}} \times$ Ff. Therefore the attraction of both is $= c\,\frac{e}{r} \times \text{F}f \times \frac{\text{OE}^3}{\text{PO}^4 . \text{EA}} \times \overline{\text{PA}^2 + \text{PC}^2}, = c\,\frac{e}{r} \times \text{F}f\,\frac{y^3}{d^4 . x} \times \overline{\text{PA}^2 + \text{PC}^2}$. But PA^2 + PC^2 = 2 PE^2 + 2 EA^2, = 2 PE^2 + 2 x^2. Therefore the attraction is $2\,c\,\frac{e}{r\,d^4} \times \text{F}f\,\frac{y^3}{x} \times \overline{\text{PE}^2 + x^2}$. But F$f$ $= \dot{y}, = \frac{x}{y}\dot{x}$. Therefore F$f\,\frac{y^3}{x} = \frac{x}{y}\dot{x} \times \frac{y^3}{x}, = y^2\ \dot{x}$,

=

$=\overline{r^2-x^2}\,\dot{x}$. Therefore the attraction of the two rings is $2c\frac{e}{rd^4}\times\overline{r^2-x^2}\times\overline{PE^2+x^2}\times\dot{x}$. But $PE^2=PO^2-OE^2,=d^2-(r^2-x^2)=d^2-r^2+x^2$. Therefore the attraction of the two rings is

$$2c\frac{e}{rd^4}\times\overline{r^2-x^2}\times\overline{d^2-r^2+2x^2}\,\dot{x},=2c\frac{e}{rd^4}\times$$

$$\overline{\underset{*}{r^2d^2\dot{x}}-r^4\dot{x}+\underset{*}{2r^2x^2\dot{x}}-d^2x^2\dot{x}+\underset{*}{r^2x^2\dot{x}}-2x^4\dot{x}}=2c\frac{e}{rd^4}$$

$$\times\overline{r^2d^2\dot{x}+3r^2x^2\dot{x}-r^4\dot{x}-d^2x^2\dot{x}-2x^4\dot{x}}.$$

The attraction of the whole ſhell of redundant matter will be had by taking the fluent of this formula, which is $2c\frac{e}{rd^4}\times\left(r^2d^2x+\frac{3r^2x^3}{3}-r^4x-\frac{d^2x^3}{3}-\frac{2x^5}{5}\right)$, and then make $x=r$. This gives $2c\frac{e}{rd^4}(d^2r^3+r^5-r^5-\frac{1}{3}d^2r^3-\frac{2}{5}r^5)$, which is $=2c\frac{e}{rd^4}(\frac{2}{3}d^2r^3-\frac{2}{5}r^5)$, $=\frac{4cer^2}{3d^2}-\frac{4r^4}{5d^4}$. To this add the attraction of the inſcribed ſphere, which is $\frac{2}{3}\frac{cr^3}{d^2}$, and we have the attraction of the whole ſpheroid

$$=\frac{2}{3}\frac{cr^3}{d^2}+\frac{4}{3}\frac{cer^2}{d^2}-\frac{4}{5}\frac{cer^4}{d^4}$$

Cor. 1. If the particle P is ſituated preciſely in N, the pole of the ſpheroid, the attraction of the ſpheroid, is $\frac{2}{3}cr+\frac{8}{15}ce$.

If the ſpheroid is not oblate, but oblong, and if the greater ſemiaxis be r, and the depreſſion at the equator be e, the analyſis is the ſame, taking e negatively. Therefore the attraction for a particle in the pole, or the gravitation of a particle in the pole, is $\frac{2}{3}cr-\frac{8}{15}ce$.

But if the polar ſemiaxis be $r+e$, and the equatorial radius be r, ſo that this oblong ſpheroid has the ſame axis with the former oblate one, the gravitation of a particle in the pole is $\frac{2}{3}cr+\frac{2}{15}ce$.

Cor. 2. If a number of parallel planes are drawn perpendicular to the equator of an oblong ſpheroid, whoſe longer ſemiaxis is $r+e$, and equatorial radius r, they will divide the ſpheroid into a number of ſimilar ellipſes; and ſince the ellipſe through the axis has $r+e$ and r for its two ſemiaxes, and the radius of a circle of equal area with this ellipſe is a mean proportional between r and $r+e$, and therefore very nearly $=r+\frac{1}{2}e$, when e is very ſmall in compariſon of r, a particle on the equator of the oblong ſpheroid will be as much attracted by theſe circles of equal areas, with their correſponding ellipſes, as by the ellipſes. Now the attraction at the pole of an oblate ſpheroid was $\frac{2}{3}cr+\frac{8}{15}ce$. Therefore putting $\frac{1}{2}e$ in place of e, the attraction on the equator of the oblong ſpheroid will be equal to $\frac{2}{3}cr+\frac{4}{15}ce$.

Thus we have aſcertained the gravitations of a particle ſituated in the pole, and of one ſituated in the equator, of a homogeneous oblong ſpheroid. This will enable us to ſolve the following problem:

If the particles of a homogeneous oblong fluid ſpheroid attract each other with a force inverſely as the ſquares of their diſtances, and if they are attracted by a very diſtant body by the ſame law, and if the ratio of the equatorial gravity to this external force be given; to find what muſt be the proportion of the ſemiaxis, ſo that all may be in equilibrio, and the ſpheroid preſerve its form?

Let r be the equatorial radius, and $r+e$ be the polar ſemiaxis. Then the gravitation at the pole m is $\frac{2}{3}cr+\frac{2}{15}ce$, and the gravitation at the equator is $\frac{2}{3}cr+\frac{4}{15}ce$. Now by the gravitation towards the diſtant body placed in the direction of the polar axis, the polar gravitation is diminiſhed, and the equatorial gravitation is increaſed; and the increaſe of the equatorial gravitation is to the diminution of the polar gravitation as NO to 2 *m* O. Therefore if the whole attraction of the oblong ſpheroid for a particle on its equator be to the force which the diſtant body exerts there, as G to P, and if the ſpheroid is very nearly ſpherical, the abſolute weight at the equator will be $\frac{2}{3}cr+\frac{4}{15}ce+\frac{2}{3}cr\frac{P}{G}$. And the abſolute weight at the pole will be $\frac{2}{3}cr+\frac{2}{15}ce-\frac{2}{3}cr\frac{2P}{G}$. Their difference is $\frac{2}{15}ce+2cr\frac{P}{G}$.

Now if we ſuppoſe this ſpheroid to be compoſed of ſimilar concentric ſhells, all the forces will decreaſe in the ſame ratio. Therefore the weight of a particle in a column reaching from the equator to the centre will be to the weight of a ſimilarly ſituated particle of a column reaching from the pole to the centre, as the weight of a particle at the equator to the weight of a particle at the pole. But the whole weights of the two columns muſt be equal, that they may balance each other at the centre. Their lengths muſt therefore be reciprocally as the weights of ſimilarly ſituated particles; that is, the polar ſemiaxis muſt be to the equatorial radius, as the weight of a particle at the equator to the weight of a particle at the pole. Therefore we muſt have $\frac{2}{15}ce+2cr\frac{P}{G}:\frac{2}{3}cr+\frac{2}{15}ce-\frac{4}{3}cr\frac{P}{G}=e:r$.

Hence we derive $2r\frac{P}{G}=\frac{8}{15}e$, or $4\,G:15\,P=r:e$. This determines the form of the fluid ſpheroid when the ratio of G to P is given.

It is well known that the gravitation of the moon to the earth is to the diſturbing force of the ſun as 178,725 to 1 very nearly. The lunar gravitation is increaſed as ſhe approaches the earth in the reciprocal duplicate ratio of the diſtances. The diſturbing force of the ſun diminiſhes in the ſimple ratio of the diſtances; therefore the weight of a body on the ſurface of the earth is to the diſturbing force of the ſun on the ſame body, in a ratio compounded of the ratio of 178,725 to 1, the ratio of 3600 to 1, and the ratio of 60 to 1; that is, in the ratio of 38604600 to 1. If the mean radius of the earth be 20934500 feet, the difference of the axis, or the elevation of the pole of the watery ſpheroid produced by the gravitation to the ſun, will be $\frac{15}{4}\times\frac{20934500}{38604600}$ feet, or very nearly $24\frac{1}{2}$ inches. This is the tide produced by the ſun on a homogeneous fluid ſphere.

It is plain, that if the earth conſiſts of a ſolid nucleus of the ſame denſity with the water, the form of the ſolar tide will be the ſame. But if the denſity of the nucleus be different, the form of the tide will be different, and will depend both on the denſity and on the figure of the nucleus.

If the nucleus be of the ſame form as the ſurrounding fluid, the whole will ſtill maintain its form with the ſame proportion of the axis. If the nucleus be ſpherical, its action on the ſurrounding fluid will be the ſame as if all the matter of the nucleus by which it exceeds an equal bulk of the fluid were collected at the centre. In this caſe, the ocean cannot maintain the ſame form: for the action of this central body being proportional to the ſquare of the diſtance inverſely, will augment the gravity of the equatorial fluid more than it augments that of the circumpolar fluid; and the ocean, which was in equilibrio (by ſuppoſition), muſt now become more protuberant at the poles. It may, however,

ever be again balanced in an elliptical form, when it has acquired a juſt proportion of the axes. The proceſs for determining this is tedious, but preciſely ſimilar to the preceding.

If the denſity of the nucleus exceed that of the fluid about $\frac{1}{5\frac{1}{2}}$, we ſhall have $r : e = \text{G} : 3\,\text{P}$, which is nearly the form which has been determined for the earth, by the menſuration of degrees of the meridian, and by the vibration of pendulums. The curious reader will do well to conſult the excellent diſſertations by Clairaut and Boſcovich on the Figure of the earth, where this curious problem is treated in the moſt complete manner. Mr Bernoulli, in his diſſertation on the Tides, has committed a great miſtake in this particular. On the other hand, if the nucleus be leſs denſe than the waters, or if there be a great central hollow, the elevation produced by the ſun will exceed 24½ inches.

It is needleſs to examine this any farther. We have collected enough for explaining the chief affections of the tides.

It is known that the earth is not a ſphere, but ſwelled out at the equator by the diurnal rotation. But the change of form is ſo very ſmall in proportion to the whole bulk, that it cannot ſenſibly affect the change of form afterwards induced by the ſun on the waters of the ocean. For the diſturbing force of the ſun would produce a certain protuberance on a fluid ſphere; and this protuberance depends on the ratio of the diſturbing force to the force of gravity at the ſurface of this ſphere. If the gravity be changed in any proportion, the protuberance will change in the ſame proportion. Therefore if the body be a ſpheroid, the protuberance produced at any point by the ſun will increaſe or diminiſh in the ſame proportion that the gravity at this point has been changed by the change of form. Now the change of gravity, even at the pole of the terreſtrial ſpheroid, is extremely ſmall in compariſon with the whole gravity. Therefore the change produced on the ſpheroid will not ſenſibly differ from that produced on the ſphere; and the elevations of the waters above the ſurface, which they would have aſſumed independent of the ſun's action, will be the ſame on the ſpheroid as on the ſphere. For the ſame reaſon, the moon will change the ſurface already changed by the ſun, in the ſame manner as ſhe would have changed the ſurface of the undiſturbed ocean. Therefore the change produced by both theſe luminaries in any place will be the ſame when acting together as when acting ſeparately; and it will be equal to the ſum, or the difference of their ſeparate changes, according as theſe would have been in the ſame or in oppoſite directions.

Let us now conſider the moſt intereſting circumſtances of the form of an elliptical tide, which differs very little from a ſphere.

Let T (fig. 2.) be a point in the ſurface of the inſcribed ſphere, and let Z expreſs the angular diſtance TOQ from the longer axis of the ſurrounding ſpheroid S *m* N *q*. Let TR, TW be perpendicular to the equatorial diameter and to the axis, ſo that they are the coſine and the ſine of TOQ to the radius TO or QO. Let S′ *q* N′ be a ſection of the circumſcribed ſphere. Draw OT cutting the ſpheroid in Z and the circumſcribed ſphere in *t*. Alſo let *s o n* be a ſection of a ſphere which has the ſame capacity with the ſpheroid, and let it cut the radius in *r*. Then,

1. The elevation TZ of the point Z of the ſpheroid above the inſcribed ſphere is $= \text{Q}q \times \text{coſ.}^2\text{Z}$, and the depreſſion tZ below the circumſcribed ſphere is $= \text{Q}q \times \text{ſine}^2\,\text{Z}$. Produce RT till it meet the ſurface of the ſpheroid in V. The minute triangle VTZ may be conſidered as a rectilineal, right-angled at Z, and therefore ſimilar to OTR. Therefore OT : TR = TV : TZ. But in the ellipſe OQ, or OT : TR = Q*q* : TV. Therefore $\text{OT}^2 : \text{TR}^2 = \text{Q}q : \text{TZ}$, and $\text{TZ} = \frac{\text{Q}q \cdot \text{TR}^2}{\text{OT}^2}, = \text{Q}q : \frac{\text{Q}q \times \text{coſ.}^2\text{Z},}{1} = \text{Q}q \times \text{coſ.}^2\text{Z}$.

And in the very ſame manner it may be ſhewn, that $t\text{Z} = \text{Q}q \times \text{ſin.}^2\text{Z}$.

2. The elevation of the point T above another point T′ whoſe angular diſtance TOT′ from the point T is 90°, is $= \text{Q}q \times \overline{\text{coſ.}^2\text{Z} - \text{ſin.}^2\,\text{Z}}$. Call the angle QOT′ Z′. Then $\text{T}'\text{Z}' = \text{Q}q \times \text{coſ.}^2\,\text{Z}'$, and $\text{TZ} - \text{T}',\text{Z}', = \text{Q}q \times \overline{\text{coſ.}^2\text{Z} - \text{coſ.}^2\,\text{Z}'}$. But the arch QT′ is the complement of QT, and therefore $\text{coſ.}^2\text{Z}' = \text{ſin.}^2\text{Z}$. Therefore $\text{TZ} - \text{T}', \text{Z}' = \text{Q}q \times \overline{\text{coſ.}^2\text{Z} - \text{ſin.}^2\,\text{Z}}$.

3. $\text{Q}o = \frac{1}{3}\text{Q}q$. For the inſcribed ſphere is to the ſpheroid as OQ to O *q*. But the inſcribed ſphere is to the ſphere *s o n* as OQ^3 to $\text{O}o^3$. Therefore becauſe the ſphere *s o n* is equal to the ſpheroid S *q* N, we have $\text{OQ} : \text{O}q = \text{OQ}^3 : \text{O}o^3$, and O *o* is the firſt of two mean proportionals between OQ and O *q*. But Q *q* is very ſmall in compariſon with OQ. Therefore Q *o* is very nearly ⅓ of Q *q*.

Since *s o n* is the ſphere of equal capacity, it is the form of the undiſturbed ocean. The beſt way therefore of conceiving the changes of form produced by the ſun or moon, or by both together, is to conſider the elevations or depreſſions which they produce above or below this ſurface. Therefore,

4. The elevation rZ of the point Z above the equicapacious ſphere is evidently $= \text{Q}q \times \text{coſ.}^2\text{Z} - \frac{1}{3}\text{Q}q$. Alſo the depreſſion r'Z′ of the point Z′ is $= \text{Q}q \times \text{ſin.}^2\text{Z}' - \frac{2}{3}\text{Q}q$.

N. B. Either of theſe formulæ will anſwer for either the elevation above, or the depreſſion below, the natural ocean: For if $\text{coſ.}^2\,\text{Z}$ is leſs than ⅓, the elevation given by the formula will be negative; that is, the point is below the natural ſurface. In like manner, when $\text{ſin.}^2\,\text{Z}'$ is leſs than ⅔, the depreſſion is negative, and the point is above the ſurface. But if $\text{coſ.}^2\,\text{Z}$ be = ⅓, or $\text{ſin.}^2\text{Z}$ be = ⅔, the point is in the natural ſurface. This marks the place where the ſpheroid and the equal ſphere interſect each other, viz. in P′, the arch P′ *o* being 54° 44′ very nearly, and PS = 35° 16′.

Let S repreſent the whole elevation of the pole of the ſolar tide above its equator, or the difference between high and low water produced by the ſun; and let M repreſent the whole elevation produced by the moon. Let *x* and *y* repreſent the zenith diſtances of the ſun and moon with reſpect to any point whatever on the ocean. Then *x* and *y* will be the arches intercepted between that point and the ſummits of the ſolar and lunar tides. Then the elevation produced by both luminaries in that plane is $\text{S} \cdot \text{coſ.}^2\,x - \frac{1}{3}\text{S} + \text{M} \cdot \text{coſ.}^2 y - \frac{1}{3}\text{M}$; or, more conciſely, $\text{S} \cdot \text{coſ.}^2\,x + \text{M} \cdot \text{coſ.}^2\,y - \frac{1}{3}\overline{\text{S} + \text{M}}$, and the depreſſion is $\text{S} \cdot \text{ſin.}^2\,x + \text{M} \cdot \text{ſin.}^2 y - \frac{1}{3}\,\text{S} + \text{M}$.

Let the ſun and moon be in the ſame point of the heavens. The ſolar and lunar tides will have the ſame axis; the coſines of *x* and *y* will each be 1, and the elevation at the compound pole will be $\text{S} + \text{M} - \frac{1}{3}\overline{\text{S} + \text{M}} = \frac{2}{3}\overline{\text{S} + \text{M}}$. The depreſſion at any point 90° from this pole will be $\frac{1}{3}\,\overline{\text{S} + \text{M}}$, and the whole tide is S + M.

Let the moon be in quadrature, as in *a* (fig. 3). The appearance at *s* will be known, by conſidering that in this place the coſine of *x* is 1, and the coſine of *y* is 0. Therefore the elevation at $s = \text{S} - \frac{1}{3}\overline{\text{S} + \text{M}}, = \frac{2}{3}\,\text{S} - \frac{1}{3}\,\text{M}$.
The depreſſion at $a = \text{S} - \frac{1}{3}\,\overline{\text{S} + \text{M}} = \frac{1}{3}\,\text{S} - \frac{2}{3}\,\text{M}$.
The difference or whole tide = $\overline{\text{S} - \text{M}}$.

In like manner, the whole elevation at a above the inſcribed ſphere is $M - S$.

Hence we ſee that the whole tide, when the moon is in quadrature, is the difference of S and M. We alſo ſee, that if M exceeds S, the water will be higher at a than at s. Now it is a matter of obſervation, that in the quadratures it is high water under the moon, and low water under the ſun. It is alſo a matter of obſervation, that in the free ocean, the ebb tide, or the water at s, immediately under the ſun, is below the natural ſurface of the ocean. Hence we muſt conclude, that $\frac{2}{3}$ S is leſs than $\frac{1}{3}$ M, or that M is more than double of S. This agrees with the phenomena of nutation and preceſſion, which ſeem to make $S = \frac{2}{5}$ of M.

In all other poſitions of the ſun and moon, the place of high water will be different. It is high water where the ſum of the elevations produced by both luminaries above the natural ocean is greateſt; and the place of low water is where the depreſſion below the natural ocean is greateſt. Therefore, in order that it may be high water, we muſt have $S \cdot \text{coſ.}^2\, x + M \cdot \text{coſ.}^2\, y - \frac{1}{3}\, \overline{S + M}$ a maximum; or, neglecting the conſtant quantity $\frac{S + M}{3}$, we muſt have $S \cdot \text{coſ.}^2\, x + M \cdot \text{coſ.}^2\, y$ a maximum.

In like manner, to have low water in a place where the zenith diſtances of the ſun and moon are v and w, we muſt have $S \cdot \text{ſin.}^2\, v + M \cdot \text{ſin.}^2\, w$ a maximum.

Lemma 1. If we conſider the ſines and coſines of angles as numeral fractions of the radius 1, then we have $\text{coſ.}^2\, Z = \frac{1}{2} + \frac{1}{2}\, \text{coſ.}^2\, Z$, and $\text{ſin.}^2\, Z = \frac{1}{2} - \frac{1}{2}\, \text{coſ.}\ \ Z$.

Let $a\,m\,s$ (fig. 3.) be a quadrant of a circle of which O is the centre, and O s is the radius. On O s deſcribe the ſemicircle OMS, cutting O m in M. Draw s M, and produce it till it cut the quadrant in n. Alſo draw MC to the centre of the ſemicircle, and MD and $n\,d$ perpendicular to O s.

It is plain that s M is perpendicular to OM; and if O s be radius, s M is the ſine of the angle s OM, which we may call Z; OM is its coſine; and becauſe $O\,s : OM = OM : OD$, and $O\,s : OD = O\,s^2 : OM^2$, and OD may repreſent $\text{coſ.}^2 Z$. Now $OD = OC + CD$. If $O\,s = 1$, then $OC = \frac{1}{2}$. $CD = CM \cdot \text{coſ.}\ MCD, = CM \cdot \text{coſ.}\ 2\ MOD, = \frac{1}{2} \cdot \text{coſ.}\ 2\, Z$. Therefore $\text{coſ.}^2\, Z = \frac{1}{2} + \frac{1}{2}\, \text{coſ.}\ 2\, Z$.

In like manner, becauſe $O\,s : s\,M = s\,M : s\,D$, $s\,D$ is $= \text{ſin.}^2 Z$. This is evidently $= \frac{1}{2} - \frac{1}{2}\, \text{coſ.}\ 2\, Z$.

Lemma 2. $\text{Coſ.}^2\, Z - \text{ſin.}^2\, Z = \text{coſ.}\ 2\, Z$. For, becauſe s M is perpendicular to OM, the arch $s\,n$ is double of the arch $s\,m$, and becauſe MD is parallel to $n\,d$, $s\,d$ is $= 2\, s\, D$, and $d\, D = \text{ſin.}^2\, Z$. Therefore $O\, d = \text{coſ.}^2\, Z - \text{ſin.}^2\, Z$. But O d is the coſine of $n\,s$, $=$ coſ. 2 Z, and $\text{coſ.}^2\, Z, - \text{ſin.}^2 Z = \text{coſ.}\ 2 Z$.

By the firſt Lemma we ſee, that in order that there may be high water at any place, when the zenith diſtances of the ſun and moon are x and y, we muſt have $S \cdot \text{coſ.}\ 2\, x + M \cdot \text{coſ.}\ 2\, y$ a maximum.

That this may be the caſe, the fluxion of this formula muſt be $= 0$. Now we know that the fluxions of the coſines of two arches are as the ſines of thoſe arches. Therefore we muſt have $S \cdot \text{ſin.}\ 2\, x + M \cdot \text{ſin.}\ 2\, y = 0$, or $S \cdot \text{ſin.}\ 2\, x = - M \cdot \text{ſin.}\ 2\, y$, which gives us $\text{ſin.}\ 2\, x : \text{ſin.}\ 2\, y = M : S$.

In like manner, the place of low water requires $\text{ſin.}\ 2\, v : \text{ſin.}\ 2\, w = M : S$.

From this laſt circumſtance we learn, that the place of low water is 0, removed 90° from the place of high water; whereas we might have expected, that the ſpheroid would have been moſt protuberant on that ſide on which the moon is: For the ſines of $2\, v$ and of $2\, w$ have the ſame proportion with the ſines of $2\, x$ and of $2\, y$. Now we know that the ſine of the double of any arch is the ſame with the ſine of the double of its complement. Therefore if low water be really diſtant 90° from high water, we ſhall have $\text{ſin.}\ 2\, x : \text{ſin.}\ 2\, y = \text{ſin.}\ 2\, v : \text{ſin.}\ 2\, w$. But if it is at any other place, the ſines cannot have this proportion.

Now let s be the point of the earth's ſurface which has the ſun in the zenith, and m the point which has the moon in the zenith. Let h be any other point. Draw O h cutting the ſemicircle OM s in H. Make CM to CS as the diſturbing force of the moon to that of the ſun; and draw S v parallel, and S t, M r perpendicular to HH′. Join MH and MH′. The angle H C s is double of the angle HOs, and MCH is double of MH′H, or of its equal MOH. Becauſe H′MH is a ſemicircle, HM is perpendicular to MO. Therefore if HH′ be conſidered as radius, HM is the ſine, and H′M is the coſine of MH′H. And C r is $= MC \cdot \text{coſ.}\ 2\, y, = M \cdot \text{coſ.}\ 2\, y$. And C t is $SC \cdot \text{coſ.}\ 2\, x$. Therefore $t\,r$ or S′ v is $= S \cdot \text{coſ.}\ 2\, x + M \cdot \text{coſ.}\ 2\, y$. Therefore $t\,r$ or S v will expreſs the whole difference of elevation between h and the points that are 90 degrees from it on either ſide (by *Lemma* 2.); and if h be the place of high water, it will expreſs the whole tide, becauſe the high and low waters were ſhown to be 90° aſunder. But when h is the place of high water, S v is a maximum. Becauſe the place of the moon, and therefore the point M, is given, S v will be a maximum when it coincides with SM, and CH is parallel to SM.

This ſuggeſted to us the following new, and not inelegant, ſolution of the problem for determining the place of high water.

Let s Q $o\,q\,s$ (fig. 4. and 5.) be a ſection of the terraqueous globe, by a plane paſſing through the ſun and moon, and let O be its centre. Let s be the point which is immediately under the ſun, and m the place immediately under the moon. Biſect O s in C, and deſcribe round C the circle OM s LO, cutting O m in M. Take C s to repreſent the diſturbing force of the moon, and make C s to CS as the force of the moon to that of the ſun (ſuppoſing this ratio to be known). Join MS, and draw CH parallel to it. Draw OH h, and l OL l perpendicular to it. And laſtly, draw CI perpendicular to SM. Then we ſay that m and its oppoſite m' are the places of high water, l and l' are the places of low water, MS is the height of the tide, and MI, SI are the portion of this tide produced by the moon and ſun.

For it is plain, that in this caſe the line S v of the laſt propoſition coincides with MS, and is a maximum. We may alſo obſerve, that $MC : CS = \text{ſin.}\ MSC : \text{ſin.}\ SMC, = \text{ſin.}\ HCS : \text{ſin.}\ MCH, = \text{ſin.}\ 2\, h\, O\, s : \text{ſin.}\ 2\, h\, O\, m, = \text{ſin.}\ 2\, x : \text{ſin.}\ 2\, y$, or $M : S = \text{ſin.}\ 2\, x : \text{ſin.}\ 2\, y$, agreeably to what was required for the maximum.

It is alſo evident, that $MI = MC \cdot \text{coſ.}\ CMI, = M \cdot \text{coſ.}\ 2\, y$, and $SI = SC \cdot \text{coſ.}\ ISC, = S \cdot \text{coſ.}\ 2\, x$; and therefore MS is the difference of elevation between h and the points l and l', which are 90° from it, and is therefore the place of low water; that is, MS is the whole tide.

The elevation of every other point may be determined in the ſame way, and thus may the form of the ſpheroid be completely determined.

If we ſuppoſe the figure to repreſent a ſection through the earth's equator (which is the caſe when the ſun and moon are in the equator), and farther ſuppoſe the two luminaries to be in conjunction, the ocean is an oblong ſpheroid, whoſe axis is in the line of the ſyzigies, and whoſe equator coincides with the ſix hour circle. But if the moon be in any other point of the equator, the figure of the ocean will be very complicated. It will not be any figure of revolution; becauſe neither its equator (or moſt depreſſed part)

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part), nor its meridians, are circles. The moſt depreſſed part of its equator will be in that ſection through the axis which is perpendicular to the plane in which the luminaries are ſituated. And this greateſt depreſſion, and its ſhorteſt equatorial diameter, will be conſtant, while its other dimenſions vary with the moon's place. We need not inquire more minutely into its form; and it is ſufficient to know, that all the ſections perpendicular to the plane paſſing thro' the ſun and moon are ellipſes.

This conſtruction will afford us a very ſimple, and, we hope, a very perſpicuous explanation of the chief phenomena of the tides. The well informed reader will be pleaſed with obſerving its coincidence with the algebraic ſolution of the problem given by Daniel Bernoulli, in his excellent diſſertation on the Tides, which ſhared with M'Laurin and Euler the prize given by the Academy of Sciences at Paris, and with the eaſe and perſpicuity with which the phenomena are deducible from it, being in ſome ſort exhibited to the eye.

In our application, we ſhall begin with the ſimpleſt caſes, and gradually introduce the complicating circumſtances which accommodate the theory to the true ſtate of things.

We begin, therefore, by ſuppoſing the earth covered, to a proper depth, with water, forming an ocean concentric with its ſolid nucleus.

In the next place, we ſuppoſe that this ocean adopts in an inſtant the form which is conſiſtent with the equilibrium of gravity and the diſturbing forces.

Thirdly, We ſuppoſe the ſun ſtationary, and the moon to move eaſtward from him above 12½° every day.

Fourthly, We ſuppoſe that the ſolid nucleus turns round its proper axis to the eaſtward, making a rotation in 24 ſolar hours. Thus any place of obſervation will ſucceſſively experience all the different depths of water.

Thus we ſhall obtain a certain SUCCESSION of phenomena, preciſely ſimilar to the ſucceſſion obſerved in nature, with this ſole difference, that they do not correſpond to the contemporaneous ſituations of the ſun and moon. When we ſhall have accounted for this difference, we ſhall preſume to think that we have given a juſt theory of the tides.

We begin with the ſimpleſt caſe, ſuppoſing the ſun and moon to be always in the equator. Let the ſeries begin with the ſun and moon in conjunction in the line O s. In this caſe the points s, m, and h coincide, and we have high water at 12 o'clock noon and midnight.

While the moon moves from s to Q, O m cuts the upper ſemicircle in M; and therefore CH, which is always parallel to MS, lies between MC and C s. Therefore h is between m and s, and we have high water after 12 o'clock, but before the moon's ſouthing. The ſame thing happens while the moon moves from o to q, during her third quarter.

But while the moon moves from her firſt quadrature in Q to oppoſition in o (as in fig. 5.), the line m O drawn from the moon's place, cuts the lower ſemicircle in M and CH, parallel to SM, again lies between M and s, and therefore h lies between m and o. The place of high water is to the eaſtward of the moon, and we have high water after the moon's ſouthing. The ſame thing happens while the moon is moving from her laſt quadrature in q to the next ſyzygy. In ſhort, the point H is always between M and s, and the place of high water is always between the moon and the *neareſt* ſyzygy. The place of high water overtakes the moon in each quadrature, and is overtaken by the moon in each ſyzygy. Therefore during the firſt and third quarters, the place of high water gradually falls behind the moon for ſome time, and then gains upon her again, ſo as to overtake her in the next quadrature. But during the ſecond and fourth quarters, the place of high water advances before the moon to a certain diſtance, and then the moon gains upon it, and overtakes it in the next ſyzygy.

If therefore we ſuppoſe the moon to advance uniformly along the equator, the place of high water moves unequally, ſloweſt in the times of new and full moon, and ſwifteſt in the time of the quadratures. There muſt be ſome intermediate ſituations where the place of high water neither gains nor loſes upon the moon, but moves with the ſame velocity.

The rate of motion of the point h may be determined as follows: Draw C i, S n, making very ſmall and equal angles with HC and MS. Draw n C, and about S, with the diſtance S n, deſcribe the arch $n\,v$, which may be conſidered as a ſtraight line perpendicular to n S, or to MS.

Then, becauſe SM and S n are parallel to CH and C i, the points n and i are contemporaneous ſituations of M and H, and the arches n M, i H, are in the ratio of the angular motions of m and h. Alſo, becauſe $n\,v$ and n M are perpendicular to n S and n C, the angle $v\,n$ M is equal to the angle S n C, or SMC. Alſo, becauſe the angles $n\,v$ M and MIC are right angles, and the angles $v\,n$ M, CMI, are alſo equal, the triangles $v\,n$ M, CMI, are ſimilar. Therefore

$n\mathrm{M} : n\,v = \mathrm{MC} : \mathrm{MI}$. And
$n\,v : i\mathrm{H} = n\,\mathrm{S} : i\,\mathrm{C}$, or $= \mathrm{MS} : \mathrm{MC}$; therefore
$n\mathrm{M} : i\mathrm{H} = \mathrm{MS} : \mathrm{MI}$. Therefore the angular motion of the moon is to the angular motion of the place of high water as MS to MI.

Therefore, when M'S is perpendicular to SC, and the point I coincides with S, the motion of high water is equal to that of the moon. But when M'S is perpendicular to SC, H'C is alſo perpendicular to C s, and the angle h' O s is 45, and the high water is in the octant. While the moon paſſes from s to m', or the high water from s to h', the point I falls between M and S, and the motion of high water is ſlower than that of the moon. The contrary obtains while the moon moves from m' to Q, or the high water from the octant to the quadrature.

It is evident, that the motion of h in the third quarter of the lunation, that is, in paſſing from o to q, is ſimilar to its motion from s to Q. Alſo, that its motion from Q to o muſt retard by the ſame degrees as it accelerated in paſſing from s to Q, and that its motion in the laſt quarter from q to s is ſimilar to its motion from Q to o.

At new and full moon the point I coincides with C, and the point M coincides with s. Therefore the motion of the high water at full and change is to the motion of the moon as s C to s S. But when the moon is in quadrature, I coincides with C, and M with o. Therefore the motion of the moon is to that of high water as OS to OC or s C. Therefore the motion of high water at full and change is to its motion in the quadratures as OS to S s, or as the difference of the diſturbing forces to their ſum. The motion of the tide is therefore ſloweſt in the ſyzigies and ſwifteſt in the quadratures; yet even in the ſyzigies it paſſes the ſun along with the moon, but more ſlowly.

Let the interval between the morning tide of one day and that of the next day be called a *tide-day*. This is always greater than a ſolar day, or 24 hours, becauſe the place of high water is moving faſter to the eaſtward than the ſun. It is leſs than a lunar day, or 24h. 50′, while the high water paſſes from the ſecond to the third octant, or from the fourth to the firſt. It is equal to a lunar day when high water is in the octants, and it exceeds a lunar day while high water paſſes from the firſt to the ſecond octant, or from the third to the fourth.

The difference between a ſolar day and a tide-day is called,

called the PRIMING or the RETARDATION of the tides. This is evidently equal to the time of the earth's deſcribing in its rotation an angle equal to the motion of the high water in a day from the ſun. The ſmalleſt of theſe retardations is to the greateſt as the difference of the diſturbing forces to their ſum. Of all the phenomena of the tides, this ſeems liable to the feweſt and moſt inconſiderable derangements from local and accidental circumſtances. It therefore affords the beſt means for determining the proportion of the diſturbing forces. By a compariſon of a great number of obſervations made by Dr Maſkelyne at St Helena and at Barbadoes (places ſituated in the open ſea), it appears that the ſhorteſt tide-day is 24h. 37′, and the longeſt is 25h. 27′. This gives $M - S : M + S = 37 : 87$, and $S : M = 2 : 4{,}96$; which differs only 1 part in 124 from the proportion of 2 to 5, which Daniel Bernoulli collected from a variety of different obſervations. We ſhall therefore adopt the proportion of 2 to 5 as abundantly exact. It alſo agrees exactly with the phenomena of the nutation of the earth's axis and the preceſſion of the equinoxes; and the aſtronomers affect to have deduced this proportion from theſe phenomena. But an intelligent reader of their writings will perceive more fineſſe than juſtice in this aſſertion. The nutation and preceſſion *do not* afford phenomena of which we can aſſign the ſhare to each luminary with ſufficient preciſion for determining the proportion of their diſturbing forces; and it is by means of many arbitrary combinations, and without neceſſity, that D'Alembert has made out this ratio. We cannot help being of opinion, that D'Alembert has accommodated his diſtribution of the phenomena to this ratio of 2 to 5, which Daniel Bernoulli (the beſt philoſopher and the moſt candid man of that illuſtrious family of mathematicians) had, with ſo much ſagacity and juſtneſs of inference, deduced from the phenomena of the tides. D'Alembert could not but ſee the value of this inference; but he wanted to ſhow his own addreſs in deducing it *proprio marte* forſooth from the nutation and preceſſion. His procedure in this reſembles that of his no leſs vain countryman De la Place, who affects to be highly pleaſed with finding that Mr Bode's diſcovery that Meyer had ſeen the Georgium Sidus in 1756, perfectly agreed with the theory of its motions which he (De la Place) had deduced from his own doctrines. Any well informed mathematician will ſee, that De la Place's data afforded no ſuch preciſion; and the book on the Elliptical Motions of the Planets, to which he alludes, contains no grounds for his inference. This obſervation we owe to the author of a paper on that ſubject in the Tranſactions of the Royal Society of Edinburgh. We hope that our readers will excuſe this occaſional obſervation, by which we wiſh to do juſtice to the merit of a modeſt man, and one of the greateſt philoſophers of his time. Our only claim in the preſent diſſertation is the making his excellent performance on the tides acceſſible to an Engliſh reader not much verſant in mathematical reſearches; and we are ſorry that our limits do not admit any thing more than a ſketch of it. But to proceed.

Aſſuming 2 : 5 as the ratio of SC to CM′, we have the angle $CM'S = 23^\circ\ 34'$ nearly, and $m'\,o\,b' = 11^\circ\ 47'$; and this is the greateſt difference between the moon's place and the place of high water. And when this obtains, the moon's elongation $m'\,o\,s$ is 56° 47′ from the neareſt ſyzigy. Hence it follows, that while the moon moves uniformly from 56° 47′ weſt elongation to 56° 47′ eaſt, or from 123° 13′ eaſt to 123° 13′ weſt, the tide day is ſhorter than the lunar day; and while ſhe moves from 56° 47′ eaſt to 123° 13′, or from 123° 13′ weſt to 56° 47′, the tide-day is longer than the lunar-day.

We now ſee the reaſon why

——The ſwelling tides obey the moon.

The time of high water, when the ſun and moon are in the equator, is never more than 47 minutes different from that of the moon's ſouthing (+ or — a certain fixed quantity, to be determined once for all by obſervation.)

It is now an eaſy matter to determine the hour of high water correſponding to any poſition of the ſun and moon in the equator. Suppoſe that on the noon of a certain day the moon's diſtance from the ſun is $m\,s$. The conſtruction of this problem gives us $s\,b$, and the length of the tide day. Call this T. Then ſay $360^\circ : s\,m = T : t$, and t is the hour of high water.

Or, if we chooſe to refer the time of high water to the moon's ſouthing, we muſt find the value of $m\,b$ at the time of the moon's ſouthing, and the difference d between the tide day and a mean lunar day L, and ſay $360 : m\,b = d : s$, the time of high water before the moon's ſouthing in the firſt and third quarters, but after it in the ſecond and fourth. The following table by Daniel Bernoulli exhibits theſe times for every 10th degree of the moon's elongation from the ſun. The firſt or leading column is the moon's elongation from the ſun or from the point of oppoſition. The ſecond column is the minutes of time between the moon's ſouthing and the place of high water. The marks — and + diſtinguiſh whether the high water is before or after the moon's ſouthing. The third column is the hour and minute of high water. But we muſt remark, that the firſt column exhibits the elongation, not on the noon of any day, but at the very time of high water. The two remaining columns expreſs the heights of the tides and their daily variations.

m s.	*m b.*	*s b.*	M S.	M *v.*
°	′	h. ′		
0	0	0. 0	1000	
	—			13
10	11½	0.28½	987	38
20	22 —	0.58	949	62
30	31½—	1.28½	887	81
40	40 —	2.—	806	91
50	45 —	2.35	715	105
60	46½—	3.13½	610	92
70	40½—	3.59½	518	65
80	25 —	4.55	453	24
90	0	6.—	429	—
	+			24
100	25 +	7. 5	453	65
110	40½+	8. 0½	518	92
120	46½+	8.46½	610	105
130	45 +	9.25	715	91
140	40 +	10.—	806	81
150	31½+	10.31½	887	62
160	22 +	11. 2	949	38
170	11½+	11.31½	987	13
180	0	12.—	1000	

The height of high water above the low water conſtitutes what is uſually called the tide. This is the intereſting circumſtance in practice. Many circumſtances render it almoſt impoſſible to ſay what is the elevation of high water above the natural ſurface of the ocean. In many places the ſurface at low water is above the natural ſurface of the ocean. This is the caſe in rivers at a great diſtance from their mouths. This may appear abſurd, and is certainly very paradoxical; but it is a fact eſtabliſhed on the moſt unexceptionable authority. One inſtance fell under our own obſervation. The low water mark at ſpring tide in the harbour of Alloa was found by accurate levelling to be three feet higher than the top of the ſtone pier at Leith, which is ſeveral feet above the high water mark of this harbour. A little attention to the motion of running waters will explain this completely. Whatever checks the motion of water in a canal muſt raiſe its ſurface. Water in a canal runs only in conſequence of the declivity of this ſurface: (See River). Therefore a flood tide coming to the mouth of a river checks the current of its waters, and they accumulate at the mouth. This checks the current farther up, and therefore the waters accumulate there alſo: and this checking of the ſtream, and conſequent riſing of the waters, is gradually communicated up the river to a great diſtance. The water riſes every where, though its ſurface ſtill has a ſlope. In the mean time, the flood tide at the mouth paſſes by, and an ebb ſucceeds. This muſt accelerate even the ordinary courſe of the river. It will more remarkably accelerate the river now raiſed above its ordinary level, becauſe the declivity at the mouth will be ſo much greater. Therefore the waters near the mouth, by accelerating, will ſink in their channel, and increaſe the declivity of the canal beyond them. This will accelerate the waters beyond them; and thus a ſtream more rapid than ordinary will be produced along the whole river, and the waters will ſink below their ordinary level. Thus there will be an ebb below the ordinary ſurface as well as a flood above it, however ſloping that ſurface may be.

Hence it follows, that we cannot tell what is the natural ſurface of the ocean by any obſervations made in a river, even though near its mouth. Yet even in rivers we have regular tides, ſubjected to all the varieties deduced from this theory.

We have ſeen that the tide is always proportional to M S. It is greateſt therefore when the moon is in conjunction or oppoſition, being then S *s*, the ſum of the ſeparate tides produced by the ſun and moon. It gradually decreaſes as the moon approaches to quadrature; and when ſhe is at Q or *q*, it is SO, or the difference of the ſeparate tides. Suppoſing S *s* divided into 1000 equal parts, the length of MS. is expreſſed in theſe parts in the fourth column of the foregoing table, and their differences are expreſſed in the fifth column.

We may here obſerve, that the variations of the tides in equal ſmall times are proportional to the ſine of twice the diſtance of the place of high water from the moon. For ſince M *n* is a conſtant quantity, on the ſuppoſition of the moon's uniform motion, M *v* is proportional to the variation of MS. Now $\text{M}n : \text{M}v = \text{MC} : \text{CI} = 1 : \text{ſin. } 2y$, and M *n* and MC are conſtant quantities.

Thus we have ſeen with what eaſe the geometrical conſtruction of this problem not only explains all the intereſting circumſtances of the tides, but alſo points them out, almoſt without employing the judgment, and exhibits to the eye the gradual progreſs of each phenomenon. In theſe reſpects it has great advantages over the very elegant algebraic analyſis of Mr Bernoulli. In that proceſs we advance almoſt without ideas, and obtain our ſolutions as detached facts, without perceiving their regular ſeries. This is the uſual pre-eminence of geometrical analyſis; and we regret that Mr Bernoulli, who was eminent in this branch, did not rather employ it. We doubt not but that he would have ſhown ſtill more clearly the connection and gradual progreſs of every particular. His aim, however, being to inſtruct thoſe who were to calculate tables of the different affections of the tides, he adhered to the algebraic method. Unfortunately it did not preſent him with the eaſieſt formulæ for practice. But the geometrical conſtruction which we have given ſuggeſts ſeveral formulæ which are exceedingly ſimple, and afford a very ready mode of calculation.

The fundamental problems are to determine the angle *s* O *b* or *m* O *b*, having *m* O *s* given; and to determine M S.

Let the given angle *m* O *s* be called *a*; and, to avoid the ambiguity of algebraic ſigns, let it always be reckoned from the neareſt ſyzigy, ſo that we may always have *a* equal to the ſum of *x* and *y*. Alſo make $d^2 = \frac{S^2 \times \text{ſin.}^2 2a}{M^2 + S^2 + 2M \times S \times \text{coſ. } 2a}$, which repreſents the $\frac{\text{S}c^2}{\text{SM}^2}$ of fig. 4. or $\text{ſin.}^2 2y$, and make $p = \frac{S \times \text{ſin. } 2a}{M + S \times \text{coſ. } 2a}$, which is the expreſſion of $\frac{\text{S}c}{\text{M}c}$ of that figure, or of tan. $2y$. Then we ſhall have,

1. $\text{Sin.}\, y = \sqrt{\frac{1 - \sqrt{1 - d^2}}{2}}$. For we ſhall have $\text{coſ. } 2y = \sqrt{1 - d^2}$. But $\text{ſin.}^2 y = \frac{1}{2} - \frac{1}{2}\text{coſ. } 2y = \frac{1 - \sqrt{1 - d^2}}{2}$, and $\text{ſin.}\, y = \sqrt{\frac{1 - \sqrt{1 - d^2}}{2}}$.

2. $\text{Tan.}\, y = \frac{p}{1 + \sqrt{1 + p^2}}$. For becauſe p is $=$ tan. $2y$, $\sqrt{1 + p^2}$ is the ſecant of $2y$, and $1 + \sqrt{1 + p^2} : 1 = p : \text{tan.}\, y$.

Theſe proceſſes for obtaining *y* directly are abundantly ſimple. But it will be much more expeditious and eaſy to content ourſelves with obtaining 2 *y* by means of the value of its tangent, viz. $\frac{S \cdot \text{ſin. } 2a}{M + S \cdot \text{coſ. } 2a}$. Or, we may find *x* by means of the ſimilar value of its tangent $\frac{\text{M}d}{\text{S}d}$ of fig. 4.

There is ſtill an eaſier method of finding both 2 *x* and 2 *y*, as follows.

Make $M + S : M - S = \text{tan. } a : \text{tan. } b$. Then *b* is the difference of *x* and *y*, as *a* is their ſum. For this analogy evidently gives the tangent of half the difference of the angles CSM and CMS of fig. 4. or of 2 *x* and 2 *y*. Therefore to *a*, which is half of the ſum of $2x + 2y$, add *b*, and we have $2x = a + b$, or $x = \frac{a + b}{2}$, and $y = \frac{a - b}{2}$.

By either of theſe methods a table may be readily computed of the value of *x* or *y* for every value of *a*.

But we muſt recollect that the values of S and M are by no means conſtant, but vary in the inverſe triplicate ratio of the earth's diſtance from the ſun and moon; and the ratio of 2 to 5 obtains only when theſe luminaries are at their mean diſtances from the earth. The forces correſponding to the perigean medium and apogean diſtances are as follow.

	Sun.	Moon.
Apogean - -	1,901	4,258
Medium - -	2,	5,
Perigean - -	2,105	5,925

Hence we ſee that the ratio of S to M may vary from 1,901 : 5,925 to 2,105 : 4,258, that is, nearly from 1 : 3 to 1 : 2, or from 2 : 6 to 2 : 4. The ſolar force does not vary much, and may be retained as conſtant without any great error. But the change of the moon's force has great effects on the tides both as to their time and their quantity.

I. In

I. In reſpect of their Time.

1. The tide day following a ſpring tide is 24h. 27′ when the moon is in perigee, but 24h. 33′ when ſhe is in apogee.

2. The tide day following neap tide is 25h. 15′, and 25h. 40′ in theſe two ſituations of the moon.

3. The greateſt interval of time between high water and the moon's ſouthing is 39′ and 61′; the angle y being 9° 45′ in the firſt caſe, and 15° 15′ in the ſecond.

II. In reſpect of their Heights.

1. If the moon is in perigee when new or full, the ſpring tide will be 8 feet inſtead of 7, which correſponds to her mean diſtance. The very next ſpring tide happens when ſhe is near her apogee, and will be 6 feet inſtead of 7. The neap tides happen when ſhe is at her mean diſtance, and will therefore be 3 feet.

But if the moon be at her mean diſtance when new or full, the two ſucceeding ſpring tides will be regular or 7 feet, and one of the neap tides will be 4 feet and the other only 2 feet.

Mr Bernoulli has given us the following table of the time of high water for theſe three chief ſituations of the moon, namely, her perigee, mean diſtance, and apogee. It may be had by interpolation for all intermediate poſitions with as great accuracy as can be hoped for in phenomena which are ſubject to ſuch a complication of diſturbances. The firſt column contains the moon's elongation from the ſun. The columns P, M, A, contain the minutes of time which elapſe between the moon's ſouthing and high water, according as ſhe is in perigee, at her mean diſtance, or in apogee. The ſign— indicates the priority, and + the poſteriority, of high water to the moon's ſouthing.

☽ and ☉	P	M	A
0	0	0	0
	—	—	—
10	9½	11½	14
20	18	22	27½
30	26	31½	39½
40	33	40	50
50	37½	45	56
60	38½	46½	58
70	33½	40½	50½
80	22	25	31
90	0	0	0
	+	+	+
100	21	25	31
110	33½	40½	50½
120	38½	46½	58
130	37½	45	56
140	33	40	50
150	26	31½	39½
160	18	22	27½
170	9½	11½	14
180	0	0	0

The reader will undoubtedly be making ſome compariſon in his own mind of the deductions from this theory with the actual ſtate of things. He will find ſome conſiderable reſemblances; but he will alſo find ſuch great differences as will make him very doubtful of its juſtneſs. In very few places does the high water happen within ¾ths of an hour of the moon's ſouthing, as the theory leads him to expect; and in no place whatever does the ſpring tide fall on the day of new and full moon, nor the neap tide on the day of her quadrature. Theſe always happen two or three days later. By comparing the difference of high water and the moon's ſouthing in different places, he will hardly find any connecting principle. This ſhows evidently that the cauſe of this irregularity is local, and that the juſtneſs of the theory is not affected by it. By conſidering the phenomena in a navigable river, he will learn the real cauſe of the deviation. A flood tide arrives at the mouth of a river. The true theoretical tide differs in no reſpect from a wave. Suppoſe a ſpring tide actually formed on a fluid ſphere, and the ſun and moon then annihilated. The elevation muſt ſink, preſſing the under waters aſide, and cauſing them to riſe where they were depreſſed. The motion will not ſtop when the ſurface comes to a level; for the waters arrived at that poſition with a motion continually accelerated. They will therefore paſs this poſition as a pendulum paſſes the perpendicular, and will riſe as far on the other ſide, forming a high water where it was low water, and a low water where it was high water; and this would go on for ever, oſcillating in a time which mathematicans can determine, if it were not for the viſcidity, or ſomething like friction, of the waters. If the ſphere is not fluid to the centre, the motion of this wave will be different. The elevated waters cannot ſink without diffuſing themſelves ſidewiſe, and occaſioning a great horizontal motion, in order to fill up the hollow at the place of low water. This motion will be greateſt about half way between the places of high and low water. The ſhallower we ſuppoſe the ocean the greater muſt this horizontal motion be. The reſiſtance of the bottom (tho' perfectly ſmooth and even) will greatly retard it all the way to the ſurface. Still, however, it will move till all be level, and will even move a little farther, and produce a ſmall flood and ebb where the ebb and flood had been. Then a contrary motion will obtain; and after a few oſcillations, which can be calculated, it will be inſenſible. If the bottom of the ocean (which we ſtill ſuppoſe to cover the whole earth) be uneven, with long extended valleys running in various directions, and with elevations reaching near the ſurface, it is evident that this muſt occaſion great irregularities in the motion of the undermoſt waters, both in reſpect of velocity and direction, and even occaſion ſmall inequalities on the ſurface, as we ſee in a river with a rugged bottom and rapid current. The deviations of the under currents will drag with them the contiguous incumbent waters, and thus occaſion greater ſuperficial irregularities.

Now a flood arriving at the mouth of a river, muſt act preciſely as this great wave does. It muſt be propagated up the river (or along it, even though perfectly level) in a certain time, and we ſhall have high water at all the different places in ſucceſſion. This is diſtinctly ſeen in all rivers. It is high water at the mouth of the Thames at three o'clock, and later as we go up the river, till at London bridge we have not high water till three o'clock in the morning, at which time it is again high water at the Nore. But in the mean time, there has been low water at the Nore, and high water about half way to London; and while the high water is proceeding to London, it is ebbing at this intermediate place, and is low water there when it is high water at London and at the Nore. Did the tide extend as far beyond London as London is from the Nore, we ſhould have three high waters with two low waters interpoſed. The moſt remarkable inſtance of this kind is the Maragnon or Amazon river in South America. It appears by the obſervations of Condamine and others, that between Para, at the mouth of the river, and the conflux of the Madera

dera and Maragnon, there are ſeven coexiſtent high waters, with ſix low waters between them. Nothing can more evidently ſhow that the tides in theſe places are nothing but the propagation of a wave. The velocity of its ſuperficial motion, and the diſtance to which it will ſenſibly go, muſt depend on many circumſtances. A deep channel and gentle acclivity will allow it to proceed much farther up the river, and the diſtance between the ſucceſſive ſummits will be greater than when the channel is ſhallow and ſteep. If we apply the ingenious theory of Chevalier Buat, delivered in the article **River**, we may tell both the velocity of the motion and the interval of the ſucceſſive high waters. It may be imitated in artificial canals, and experiments of this kind would be very inſtructive. We have ſaid enough at preſent for our purpoſe of explaining the irregularity of the times of high water in different places, with reſpect to the moon's ſouthing. For we now ſee clearly, that ſomething of the ſame kind muſt happen in all great arms of the ſea which are of an oblong ſhape, and communicate by one end with the open ocean. The general tide in this ocean muſt proceed along this channel, and the high water will happen on its ſhores in ſucceſſion. This alſo is diſtinctly ſeen. The tide in the Atlantic ocean produces high water at new and full moon at a later and later hour along the ſouth coaſt of Great Britain in proportion as we proceed from Scilly iſlands to Dover. In the ſame manner it is later and later as we come along the eaſt coaſt from Orkney to Dover. Yet even in this progreſs there are conſiderable irregularities owing to the ſinuoſities of the ſhores, deep indented bays, prominent capes, and extenſive ridges and valleys in the channel. A ſimilar progreſs is obſerved along the coaſts of Spain and France, the tide advancing gradually from the ſouth, turning round Cape Finiſterre, ranging along the north coaſt of Spain, and along the weſt and north coaſts of France.

The attentive conſideration of theſe facts will not only ſatisfy us with reſpect to this difficulty, but will enable us to trace a principle of connection amidſt all the irregularities that we obſerve.

We now add, that if we note the difference between the time of high water of ſpring tide, as given by theory, for any place, and the *obſerved time* of high water, we ſhall find this interval to be very nearly conſtant thro' the whole ſeries of tides during a lunation. Suppoſe this interval to be forty hours. We ſhall find every other phenomenon ſucceed after the ſame interval. And if we ſuppoſe the moon to be in the place where ſhe was 40 hours before, the obſervation will agree pretty well with the theory, as to the ſucceſſion of tides, the length of tide day, the retardations of the tides, and their gradual diminution from ſpring to neap tide. We ſay pretty well; for there ſtill remain ſeveral ſmall irregularities, different in different places, and not following any obſervable law. Theſe are therefore local, and owing to local cauſes. Some of theſe we ſhall afterwards point out. There is alſo a general deviation of the theory from the real ſeries of tides. The neap tides, and thoſe adjoining, happen a little earlier than the corrected theory points out. Thus at Breſt (where more numerous and accurate obſervations have been made than at any other place in Europe), when the moon changes preciſely at noon, it is high water at 3h. 28′. When the moon enters her ſecond quarter at noon, it is high water at 8h. 40′, inſtead of 9h. 48′, which theory aſſigns.

Something ſimilar, and within a very few minutes equal, to this is obſerved in *every* place on the ſea-coaſt. This is therefore ſomething general, and indicates a real defect in the theory.

But this ariſes from the ſame cauſe with the other general deviation, viz. that the greateſt and leaſt tides do not happen on the days of full and half moon, but a certain time after. We ſhall attempt to explain this.

We ſet out with the ſuppoſition, that the water acquired in an inſtant the elevation competent to its equilibrium. But this is not true. No motion is inſtantaneous, however great the force; and every motion and change of motion produced by a ſenſible or finite force increaſes from nothing to a ſenſible quantity by infinitely ſmall degrees. Time elapſes before the body can acquire any ſenſible velocity; and in order to acquire the ſame ſenſible velocity by the action of different forces acting ſimilarly, a time muſt elapſe inverſely proportional to the force. An infinitely ſmall force requires a finite time for communicating even an infinitely ſmall velocity; and a finite force, in an infinitely ſmall time, communicates only an infinitely ſmall velocity; and if there be any kind of motion which changes by inſenſible degrees, it requires a finite force to prevent this change. Thus a bucket of water, hanging by a cord lapped round a light and eaſily moveable cylinder, will run down with a motion uniformly accelerated; but this motion will be prevented by hanging an equal bucket on the other ſide, ſo as to act with a finite force. This force prevents only infinitely ſmall accelerations.

Now let ALKF (fig. 6.) be the ſolid nucleus of the earth, ſurrounded by the ſpherical ocean $b\,b\,d\,g$. Let this be raiſed to a ſpheroid BHDG by the action of the moon at M, or in the direction of the axis CM. If all be at reſt, this ſpheroid may have the form preciſely competent to its equilibrium. But let the nucleus, with its ſpheroidal ocean, have a motion round C in the direction AFKL from weſt to eaſt. When the line of water BA is carried into the ſituation $s\,q$ infinitely near to BA, it is no longer in equilibrio; for s is too elevated, and the part now come to B is too much depreſſed. There is a force tending to depreſs the waters at s, and to raiſe thoſe now at B; but this force is infinitely ſmall. It cannot therefore reſtore the ſhape competent to equilibrium till a ſenſible time has elapſed; therefore the diſturbing force of the moon cannot keep the ſummit of the ocean in the line MC. The force muſt be of a certain determinate magnitude before it can in an inſtant undo the inſtantaneous effect of the rotation of the waters and keep the ſummit of the ocean in the ſame place. But this effect is poſſible; for the depreſſion at s neceſſary for this purpoſe is nearly as the diſtance from B, being a depreſſion, not from a ſtraight line, but from a circle deſcribed with the radius CB. It is therefore an infiniteſimal of the firſt order, and may be reſtored in an inſtant, or the continuation of the depreſſion prevented by a certain finite force. Therefore there is ſome diſtance, ſuch as By, where the diſturbing force of the moon may have the neceſſary intenſity. Therefore the ſpherical ocean, inſtead of being kept continually accumulated at B and D, as the waters turn round, will be kept accumulated at y and y', but at a height ſomewhat ſmaller. It is much in this way that we keep melted pitch or other clammy matter from running off from a bruſh, by continually turning it round, and it hangs protuberant, not from the loweſt point, but from a point beyond it, in the direction of its motion. The facts are very ſimilar. The following experiment will illuſtrate this completely, and is quite a parallel fact. Conceive GDH, the lower half of the ellipſe, to be a ſupple heavy rope or chain hanging from a roller with a handle. The weight of the rope makes it hang in an oblong curve, juſt as the force of the moon raiſes the waters of the ocean. Turn the roller very ſlowly, and the rope, unwinding at one ſide and winding up on the other ſide of the roller, will continue to form the ſame curve: but turn the roller very briſkly in the direction FKL, and the rope will now hang like the curve $u\,y'\,v$, conſiderably advanced from the perpendicular, ſo far, to wit, that the force of gravity may be able in an inſtant to undo the infinitely ſmall elevation produced by the turning.

We are very anxious to have this circumſtance clearly conceived, and its truth firmly eſtabliſhed; becauſe we have obſerved it to puzzle many perſons not unaccuſtomed to ſuch diſcuſſions: we therefore hope that our readers, who have got over the difficulty, will indulge us while we give yet another view of this matter, which leads to the ſame concluſion.

It is certain that the interval between high and low water is not ſufficient for producing all the accumulation neceſſary for equilibrium in an ocean ſo very ſhallow. The horizontal motion neceſſary for gathering together ſo much water along a ſhallow ſea would be prodigious. Therefore it never attains its full height; and when the waters, already raiſed to a certain degree, have paſſed the ſituation immediately under the moon, they are ſtill under the action of accumulating forces, although theſe forces are now diminiſhed. They will continue riſing till they have ſo far paſt the moon that their ſituation ſubjects them to depreſſing forces. If they have acquired this ſituation with an accelerated motion, they will riſe ſtill farther by their inherent motion, till the depreſſing forces have deſtroyed all their acceleration, and then they will begin to ſink again. It is in this way that the nutation of the earth's axis produces the greateſt inclination, not when the inclining forces are greateſt, but three months after. It is thus that the warmeſt time of the day is a conſiderable while after noon, and that the warmeſt ſeaſon is conſiderably after midſummer. The warmth increaſes till the momentary waſte of heat exceeds the momentary ſupply. We conclude by ſaying, that it may be demonſtrated, that, in a ſphere, fluid to the centre, the time of high water cannot be leſs, and may be more, than three lunar hours after the moon's ſouthing. As the depth of the ocean diminiſhes, this interval alſo diminiſhes.

It is perhaps impoſſible to aſſign the diſtance By at which the ſummit of the ocean may be kept while the earth turns round its axis. We can only ſee, that it muſt be leſs when the accumulating force is greater, and therefore leſs in ſpring tides than in neap tides; but the difference may be inſenſible. All this depends on circumſtances which we are little acquainted with: many of theſe circumſtances are local; and the ſituation of the ſummit of the ocean, with reſpect to the moon, may be different in different places.

Nor have we been able to determine theoretically what will be the height of the ſummit. It will certainly be leſs than the height neceſſary for perfect equilibrium. Daniel Bernoulli ſays, that, after very attentive conſideration, he is convinced that the height at new or full moon will be to the theoretical height as the coſine of the angle BCy to radius, or that the height at y will be $\mathrm{B}b \times \frac{\mathrm{C}\alpha}{\mathrm{C}b}$.

The reſult of all this reaſoning is, that we muſt always ſuppoſe the ſummit of the tide is at a certain diſtance eaſtward from the place aſſigned by the theory. Mr Bernoulli concludes, from a very copious compariſon of obſervations at different places, that the place of high water is about 20 degrees to the eaſtward of the place aſſigned by the theory. Therefore the table formerly given will correſpond with obſervation, if the leading column of the moon's elongation from the ſun be altered accordingly. We have inſerted it again in this place, with this alteration, and added three columns for the times of high water. Thus changed it will be of great uſe.

We have now an explanation of the acceleration of the neap tides, which ſhould happen 6 hours later than the ſpring tides. They are in fact tides correſponding to poſitions of the moon, which are 20° more, and not the real ſpring and neap tides. Theſe do not happen till two days after; and if the really greateſt and leaſt tides be obſerved, the leaſt will be found 6 hours later than the firſt.

Elong. of Moon.	High Water before or after Moon's Southing.			Time of High Water.		
	Perigee.	M. Diſt.	Apogee.	Perigee.	M. Diſt.	Apogee.
0	18 after	22 after	27½ after	0.18	0.22	0.27½
10	9½ do.	11½	14	0.49½	0.51½	0.54
20	0 do.	0	0	1.20	1.20	1.20
30	9½ bef.	11½ bef.	14 bef.	1.50½	1 48	1.46
40	18 do.	22	27½	2.22	2.18	2.12
50	26	31½	39½	2.54	2.48	2.40
60	33	40	50	3.27	3.20	3.10
70	37½	45	56	4.02½	3.55	3 44
80	38½	46½	58	4.41½	4.33	4.22
90	33½	40½	50½	5.26½	5.19	5.09
100	22	25	31	6. 9	6.15	6.09
110	0	0	0	7.20	7.20	7.20
120	22 after	25 after	31 after	8.21	8.25	8.31
130	33½ after	40½	50½	9.13½	9 20	9.30
140	38½	46½	58	9.58½	10.06	10.18
150	37½	45	56	10.37½	10.45	10 56
160	33	40	50	11 13	11.20	11.30
170	26	31½	29½	11.46	11.51	11.59
180	18	22	27½	0.18	0 22	0 27

This table is general; and exhibits the time of high water, and their difference from thoſe of the moon's ſouthing, in the open ſea, free from all local obſtructions. If therefore the time of high water in any place on the earth's equator (for we have hitherto conſidered no other) be different from this table (ſuppoſed correct), we muſt attribute the difference to the diſtinguiſhing circumſtances of the ſituation. Thus every place in the equator ſhould have high water on the day that the moon, ſituated at her mean diſtance, changes preciſely at noon, at 22 minutes paſt noon; becauſe the moon paſſes the meridian along with the ſun by ſuppoſition. Therefore, to make uſe of this table, we muſt take the difference between the firſt number of the column, intitled time of high water, from the time of high water at full and change peculiar to any place, and add this to all the other numbers of that column. This adapts the table to the given place. Thus to know the time of high water at Leith when the moon is 50° eaſt of the ſun, at her mean diſtance from the earth, take 22′ from 4h 30′, there remains 4.08. Add this to 2h. 48′, and we have 6h. 56′ for the hour of high water. (The hour of high water at new and full moon for Edinburgh is marked 4h. 30 in Maſkelyne's tables, but we do not pretend to give it as the exact determination. This would require a ſeries of accurate obſervations.)

It is by no means an eaſy matter to aſcertain the time of high water with preciſion. It changes ſo very ſlowly, that we may eaſily miſtake the exact minute. The beſt method is to have a pipe with a ſmall hole near its bottom, and a float with a long graduated rod The water gets in by the ſmall hole and raiſes the float, and the ſmallneſs of the hole prevents the ſudden and irregular ſtarts which waves would occaſion. Inſtead of obſerving the moment of high water, obſerve the height of the rod about half an hour before, and wait after high water till the rod comes again to that height: take the middle between them. The water riſes ſenſibly half an hour before the top of the tide, and quickly changes the height of the rod, ſo that we cannot make a great miſtake in the time.

Mr Bernoulli has made a very careful compariſon of the theory thus corrected, with the great collection of obſervations preſerved in the *Depot de la Marine* at Breſt and Rochefort *; and finds the coincidence very great, and far exceeding any rule which he had ever ſeen. Indeed we have no rules but what are purely empirical, or which ſuppoſe a uniform progreſſion of the tides.

The heights of the tides are much more affected by local circumſtances than the regular ſeries of their times. The regular ſpring tide ſhould be to the neap tide in the ſame proportion in all places; but nothing is more different than this proportion. In ſome places the ſpring tide is not double of the neap tide, and in other places it is more than quadruple. This prevented Bernoulli from attempting to fix the proportion of M to S by means of the heights of the tides. Newton had, however, done it by the tides at Briſtol, and made the lunar force almoſt five times greater than the ſolar force. But this was very ill-founded, for the reaſon now given.

Yet Bernoulli ſaw, that in all places the tides gradually decreaſed from the ſyzigies to the quadratures. He therefore preſumed, that they decreaſed by a ſimilar law with the theoretical tides, and has given a very ingenious method of accommodating the theory to any tides which may be obſerved. Let A be the ſpring tide, and B the neap tide in any place. Then form an M and an S from theſe, by making $M = \frac{A+B}{2}$, and $S = \frac{A-B}{2}$; ſo that $M + S$ may be $= A$, and $M - S = B$ agreeable to theory. Then with this M and S compoſe the general tide T, agreeable to the conſtruction of the problem. We may be perſuaded that the reſult cannot be far from the truth. The following table is calculated for the three chief diſtances of the moon from the earth.

Elong. ☽ & ☉	Height of the Tide.		
	Moon in Perigee.	Moon in M. Diſt.	Moon in Apogee.
0	0,99A+0,15B	0,88A+0,12B	0,79A+0,08B
10	1,10A+0,04B	0,97A+0,03B	0,87A+0,02B
20	1,14A+0,00B	1,00A+0,00B	0,90A+0,00B
30	1,10A+0,04B	0,97A+0,03B	0,87A+0,02B
40	0,99A+0,15B	0,88A+0,12B	0,79A+0,08B
50	0,85A+0,32B	0,75A+0,25B	0,68A+0,18B
60	0,67A+0,53B	0,59A+0,41B	0,53A+0,29B
70	0,46A+0,75B	0,41A+0,59B	0,37A+0,41B
80	0,28A+0,96B	0,25A+0,75B	0,23A+0,53B
90	0,13A+1,13B	0,12A+0,88B	0,11A+0,62B
100	0,03A+1,24B	0,03A+0,97B	0,03A+0,68B
110	0,00A+1,28B	0,00A+1,00B	0,00A+0,70B
120	0,03A+1,24B	0,03A+0,97B	0,03A+0,68B
130	0,13A+1,13B	0,12A+0,88B	0,11A+0,62B
140	0,28A+0,96B	0,25A+0,75B	0,23A+0,53B
150	0,46A+0,75B	0,41A+0,59B	0,37A+0,41B
160	0,67A+0,53B	0,59A+0,41B	0,53A+0,29B
170	0,85A+0,32B	0,75A+0,25B	0,68A+0,18B
180	0,99A+0,15B	0,88A+0,12B	0,79A+0,08B

Obſerve that this table is corrected for the retardation ariſing from the inertia of the waters. Thus when the moon is 20 degrees from the ſun, the mean diſtance tide is 1,00A+0,00B, which is the theoretical tide correſponding to conjunction or oppoſition.

We have now given in ſufficient detail the phenomena of the tides along the equator, when the ſun and moon are both in the equator, ſhewing both their times and their magnitude. When we recollect that all the ſections of an oblong ſpheroid by a plane paſſing through an equatorial diameter are ellipſes, and that the compound tide is a combination of two ſuch ſpheroids, we perceive that every ſection of it through the centre, and perpendicular to the plane in which the ſun and moon are ſituated, is alſo an ellipſe, whoſe ſhorter axis is the equatorial diameter of a ſpring tide. This is the greateſt depreſſion in all ſituations of the luminaries; and the points of greateſt depreſſion are the lower poles of every compound tide. When the luminaries are in the equator, theſe lower poles coincide with the poles of the earth. The equator, therefore, of every compound tide is alſo an ellipſe; the whole circumference of which is lower than any other ſection of this tide, and gives the place of low water in every part of the earth. In like manner, the ſection through the four poles, upper and lower, gives the place of high water. Theſe two ſections are terreſtrial meridians or hour circles, when the luminaries are in the equator.

Hence it follows, that all that we have already ſaid as to the times of high and low water may be applied to every place on the ſurface of the earth, when the ſun and moon are in the equator. But the heights of tide will diminiſh as we recede from the equator. The heights muſt be reduced in the proportion of radius to the coſine of the latitude of the place. But in every other ſituation of the ſun and moon all the circumſtances vary exceedingly. It is very true, that the determination of the elevation of the waters in any place whatever is equally eaſy. The difficulty is, to exhibit for that place a connected view of the whole tide, with the hours of flood and ebb, and the difference between high and low water. This is not indeed difficult; but the proceſs by the ordinary rules of ſpherical trigonometry is tedious. When the ſun and moon are not near conjunction or oppoſition, the ſhape of the ocean reſembles a turnip, which is flat and not round in its broadeſt part. Before we can determine with preciſion the different phenomena in connection, we muſt aſcertain the poſition or attitude of this turnip; marking on the ſurface of the earth both its elliptical equators. One of theſe is the plane paſſing thro' the ſun and moon, and the other is perpendicular to it, and marks the place of low water. And we muſt mark in like manner its firſt meridian, which paſſes through all the four poles, and marks on the ſurface of the earth the place of high water. The poſition of the greateſt ſection of this compound ſpheroid is frequently much inclined to the earth's equator; nay, ſometimes is at right angles to it, when the moon has the ſame right aſcenſion with the ſun, but a different declination. In theſe caſes the ebb tide on the equator is the greateſt poſſible; for the lower poles of the compound ſpheroid are in the equator. Such ſituations occaſion a very complicated calculus. We muſt therefore content ourſelves with a good approximation.

And firſt, with reſpect to the times of high water. It will be ſufficient to conceive the ſun and moon as always in one plane, *viz.* the ecliptic. The orbits of the ſun and moon are never more inclined than $5\frac{1}{2}$ degrees. This will make very little difference; for when the luminaries are ſo ſituated that the great circle through them is much inclined to the equator, they are then very near to each other, and the form of the ſpheroid is little different from what it would be if they were really in conjunction or oppoſition. It will therefore be ſufficient to conſider the moon in three different ſituations.

1. In the equator. The point of higheſt water is never farther

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* See Mr Caſſini. Mem. Acad. Paris, 1734.

ther from the moon than 15°, when ſhe is in apogee and the ſun in perigee. Therefore if a meridian be drawn thro' the point of higheſt water to the equator, the arch $m b$ of fig. 4. will be repreſented on the equator by another arch about $\frac{92}{100}$ of this by reaſon of the inclination of the equator and ecliptic. Therefore, to have the time of high water, multiply the numbers of the columns which expreſs the difference of high water and the moon's ſouthing by $\frac{92}{100}$, and the products give the real difference.

2. Let the moon be in her greateſt declination. The arch of right aſcenſion correſponding to $m b$ will be had by multiplying $m b$, or the time correſponding to it in the table, by $\frac{102}{92}$.

3. When the moon is in a middle ſituation between theſe two extremes, the numbers of the table will give the right aſcenſion correſponding to $m b$ without any correction, the diſtance from the equator compenſating for the obliquity of the ecliptic arch $m b$.

The time of low water is not ſo eaſily found; and we muſt either go through the whole trigonometrical proceſs, or content ourſelves with a leſs perfect approximation. The trigonometrical proceſs is not indeed difficult: We muſt find the poſition of the plane through the ſun and moon. A great circle through the moon perpendicular to this is the line of high water; and another perpendicular circle cutting this at right angles is the circle of low water.

But it will be abundantly exact to conſider the tide as accompanying the moon only.

Let NQSE (fig. 7.) be a ſection of the terraqueous globe, of which N and S are the north and ſouth poles and EOQ the equator. Let the moon be in the direction OM, having the declination BQ. Let D be any place on the earth's ſurface. Draw the parallel LDC of latitude. Let $B'Fb'f$ be the ocean, formed into a ſpheroid, of which Bb is the axis and fF the equator.

As the place D is carried along the parallel CDL by the rotation of the earth, it will paſs in ſucceſſion through different depths of the watery ſpheroid. It will have high water when at C and L, and low water when it croſſes the circle fOF. Draw the meridian NdG, and the great circle B$d$$b$. The arch GQ, when converted into lunar hours (each about 62 minutes), gives the duration of the flood dc and of the ſubſequent ebb $c\,d$, which happen while the moon is above the horizon; and the arch EG will give the durations of the flood and of the ebb which happen when the moon is below the horizon. It is evident, that theſe two floods and two ebbs have unequal durations. When D is at C it has high water; and the height of the tide is CC′. For the ſpheroid is ſuppoſed to touch the ſphere on the equator fOF, ſo that of CC′ is the difference between high and low water. At L the height of the tide is LL′; and if we deſcribe the circle L′Nq, C′q is the difference of theſe high waters, or of theſe tides.

Hence it appears, that the two tides of one lunar day may be conſiderably different, and it is proper to diſtinguiſh them by different names. We ſhall call that a *ſuperior tide* which happens when the moon is above the horizon during high water. The other may be called the *inferior tide*. The duration of the ſuperior tide is meaſured by 2 GQ, and that of the inferior tide by 2 EG, and 4 GO meaſures the difference between the whole duration of a ſuperior and of an inferior tide.

From this conſtruction we may learn in general, 1. When the moon has no declination, the durations and alſo the heights of the ſuperior and inferior tides are equal in all parts of the world. For in this caſe the tide equator fF coincides with the meridian NOS, and the poles B′ b' of the watery ſpheroid are on the earth's equator.

2. When the moon has declination, the duration and alſo the height of a ſuperior tide at any place is greater than that of the inferior; or is leſs than it, according as the moon's declination and the latitude of the place are of the ſame or oppoſite names.

This is an important circumſtance. It frequently happens that the inferior tide is found the greateſt when it ſhould be the leaſt; which is particularly the caſe at the Nore. This ſhows, without further reaſoning, that the tide at the Nore is only a branch of the regular tide. The regular tide comes in between Scotland and the continent; and after travelling along the coaſt reaches the Thames, while the regular tide is juſt coming in again between Scotland and the continent.

3. If the moon's declination is equal to the colatitude of the place, or exceeds it, there will be only one tide in a lunar day. It will be a ſuperior or an inferior tide, according as the declination of the moon and the latitude of the place are of the ſame or oppoſite kinds. For the equator of the tide cuts the meridian in f and F. Therefore a place which moves in the parallel $c\,f$ has high water when at c, and 12 lunar hours afterwards, has low water when at f. And any place k which is ſtill nearer to the pole N has high water when at k, and 12 lunar hours afterwards has low water at m. Therefore, as the moon's declination extends to 30°, all places farther north or ſouth than the latitude 60° will ſometimes have only one tide in a lunar day.

4. The ſine of the arch GO, which meaſures $\frac{1}{4}$ of the difference between the duration of a ſuperior and inferior tide, is = tan. lat. × tan. decl. For in the ſpherical triangle dOG

Rad : cotan. dOG = tan. dG : ſin. GO, and

Sin. GO = tan. dOQ × tan. dG, = tan. decl. × tan. lat.

Hence we ſee, that the difference of the durations of the ſuperior and inferior tides of the ſame day increaſe both with the moon's declination and with the latitude of the place.

The different ſituations of the moon and of the place of obſervation affect the heights of the tides no leſs remarkably. When the point D comes under the meridian NBQ in which the moon is ſituated, there is a ſuperior high water, and the height of the tide above the low water of that day is CC′. When D is at L, the height of the inferior tide is LL′. The elevation above the inſcribed ſphere is M × coſ.^{2} y, y being the zenith diſtance of the moon at the place of obſervation. Therefore at high water, which by the theory is in the place directly under the moon, the height of the tide is as the ſquare of the coſine of the moon's zenith or nadir diſtance.

Hence we derive a conſtruction which ſolves all queſtions relating to the height of the tides with great facility, free from all the intricacy and ambiguities of the algebraic analyſis employed by Bernoulli.

With the radius CQ = M (the elevation produced by the moon above the inſcribed ſphere) deſcribe the circle pQPE (fig. 8.) to repreſent a meridian, of which P and p are the poles, and EQ the equator. Biſect CP in O; and round O deſcribe the circle PBCD. Let M be the place over which the moon is vertical, and Z be the place of obſervation. MQ is the moon's declination, and ZQ is the latitude of the place. Draw MCm, ZCN, cutting the ſmall circle in A and B. Draw AGI perpendicular to CP, and draw CIμ, which will cut off an arch Eμ = QM. MZ and μN are the moon's zenith and nadir diſtances. Draw the diameter BD, and the perpendiculars IK, GH, and AF. Alſo draw OA, PA, AB, ID.

Then DF is the ſuperior tide, DK is the inferior tide, and DH is the arithmetical mean tide.

For the angles BCA, BDA, ſtanding on BA, are equal. Alſo the angles IDB, μCN, are equal, being ſupplements of the angle ICB. Therefore, if BD be made radius, DA and DI are the ſines of the zenith and nadir diſtances of the moon.

But BD : DA = DA : DF. Therefore DF = M × coſ.^{2} y, = the height Zz of the ſuperior tide. Alſo DK = M coſ.^{2} y', = the height nn' of the inferior tide.

Alſo, becauſe IA is biſected in G, KF is biſected in H, and $DH = \frac{DK + DF}{2}$, = the medium tide.

Let us trace the relation of the conſequences of the various poſitions of Z and M, as we formerly conſidered the reſults of the various ſituations of the ſun and moon.

Firſt, then, let Z retain its place, and let M gradually approach it from the equator. When M is in the equator, A and I coincide with C, and the three points F, K, and H, coincide in i.

As M approaches to Z, A and I approach to B and D; DF increaſes, and DK diminiſhes. The ſuperior or inferior tide is greateſt when the moon is in M or in N; and DF is then = M. As the moon paſſes to the northward of the place, the ſuperior and inferior tides both diminiſh till I comes to D; at which time MQ is equal to ZP, and there is no inferior tide. This however cannot happen if zP is greater than 30°, becauſe the moon never goes farther from the equator. M ſtill going north, we have again a perpendicular from I on BD, but below I, indicating that the inferior tide, now meaſured by DK, belongs to the hemiſpheriod next the moon. Alſo, as M advances from the equator northward, DH diminiſhes continually. Firſt, while H lies between O and B, becauſe G approaches O; and afterwards, when G is above O and H lies between O and D. It is otherwiſe, however, if ZQ is greater than 45°; for then DB is inclined to EQ the other way, and DH increaſes as the point G riſes.

In the next place, let M retain its poſition, and Z proceed along the meridian.

Let us begin at the equator, or ſuppoſe Q the place of obſervation. BD then coincides with CP, and the three lines DF, DK, and DH, all coincide with PG, denoting the two equal tides Qq and Ee and their medium, equal to either. As Z goes northward from Q, BOD detaches itſelf from COP; the line DF increaſes, while DK and DH diminiſh. When Z has come to M, F and B coincide with A, and DK and DH are ſtill more diminiſhed. When Z paſſes M, all the three lines DF, DK, and DH, continue to diminiſh. When Z comes to latitude 45°, DB is parallel to IA and EQ, and the point H coincides with O. This ſituation of Z has the peculiar property that DH (now DO) is the ſame, whatever be the declination of the moon. For IA being always parallel to DB, OK and OF will be equal, and DO will be half of DK and DF however they may vary. When Z gets ſo far north that ZP is = MQ, the diameter bd falls on I; ſo that dk vaniſhes, and we have only df. And when Z goes ſtill farther north, dk appears on the other ſide of I. When Z arrives at the pole, BD again coincides with PC, D with C, and DF, DK, and DH, coincide with CG.

Theſe variations of the points F, K, and H, indicate the following phenomena.

1. The greateſt tides happen when the moon is in the zenith or nadir of the place of obſervation; for then the point B coincides with A, and DF becomes DB; that is, =M, indicating the full tide BB.

2. When the moon is in the equator, the ſuperior and inferior tides have equal heights, = M. coſ.^{2} lat. For then A and I coincide with C, and the points F and K coincide in i, and Di is = DB coſ.^{2} BDC, = M· coſ.^{2} lat.

3. If the place of obſervation is in the equator, the inferior and ſuperior tides are again equal, whatever is the moon's declination: For then B coincides with C, and the points F, K, and H, coincide with G; and PG = PC· coſ.^{2} APG, = M· coſ.^{2} decl. moon.

4. The ſuperior tides are greater or leſs than the inferior tides according as the latitude and declination are of the ſame or of oppoſite names. For by making Qζ = QZ, and drawing ζCn, cutting the ſmall circle in β, we ſee that the figure is reverſed. The difference between the ſuperior and inferior tides is KF, or IA × coſin. of the angle formed by IA and DB; that is, of the angle BDδ, which is the complement of twice ZQ; becauſe BOC = 2 ZCQ. Now IA is 2 GA, = 2 OA·ſin. 2 MQ = PC·ſin. 2 MQ, = M · ſin. 2 decl. Therefore the difference of the ſuperior and inferior tides is M · ſin. 2 declin. ſin. 2 lat.

5. If the colatitude be equal to the declination, or leſs than it, there will be no inferior tide, or no ſuperior tide, according as the latitude of the place and declination of the moon are of the ſame or oppoſite names.

For when PZ = MQ, D coincides with I, and IK vaniſhes. When PZ is leſs than MQ, the point D is between C and I, and the point Z never paſſes through the equator of the watery ſpheroid; and the low water of its only tide is really the ſummit of the inferior tide.

6. At the pole there is no daily tide; but there are two monthly tides = M · ſin.^{2} declin. and it is low water when the moon is in the equator.

7. The medium tide, repreſented by DH, is $= M \times \frac{1 + \text{coſ. 2 lat.} \times \text{coſ. 2 declin.}}{2}$. For DH = DO + OH. Now OH is equal to OG × coſ. GOH = OG · coſ. 2 ZQ. And OG = OA · coſ. GOA, = OA· coſ. 2 MQ. Therefore OH = OA · coſ. 2 ZQ· coſ. 2 MQ. Therefore DH = OA + OA · coſ. 2 ZQ · coſ. 2 MQ = $M \times \frac{1 + \text{coſ. 2 ZQ} \cdot \text{coſ. 2 MQ.}}{2}$. Let this for the future be called m.

N. B. The moon's declination never exceeds 30°. Therefore coſ. 2 MQ is always a poſitive quantity, and never leſs than $\frac{1}{2}$, which is the coſine of 60°. While the latitude is leſs than 45°, coſ. 2 lat. is alſo a poſitive quantity. When it is preciſely 45° the coſine of its double is *o*; and when it is greater than 45, the coſine of its double is negative. Hence we ſee,

1. That the medium tides are equally affected by the northern and ſouthern declinations of the moon.

2. If the latitude of the place is 45°, the medium tide is always $\frac{1}{2}$ M. This is the reaſon why the tides along the coaſts of France and Spain are ſo little affected by the declination of the moon.

3. If the latitude is leſs than 45°, the mean tides increaſe as the moon's declination diminiſhes. The contrary happens if ZQ is greater than 45°. For DH increaſes or diminiſhes while the point G ſeparates from C according as the angle COD is greater or leſs than COB; that is, according as PCZ is greater or leſs than ZCQ.

4. When Z is in the equator, H coincides with G, and the effect of the moon's declination on the height of the tides is the moſt ſenſible. The mean tide is then $= M \frac{1 + \text{coſ. 2 MQ}}{2}$.

All that we have now ſaid may be ſaid of the ſolar tide, putting S in place of M.

Alſo the ſame things hold true of ſpring tides, putting M + S in place of M.

Fig. 1.

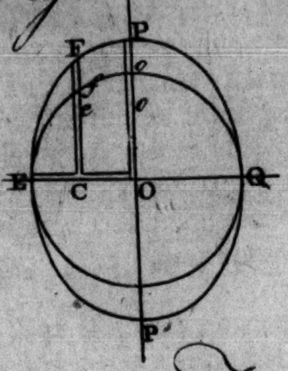

Fig. 2.

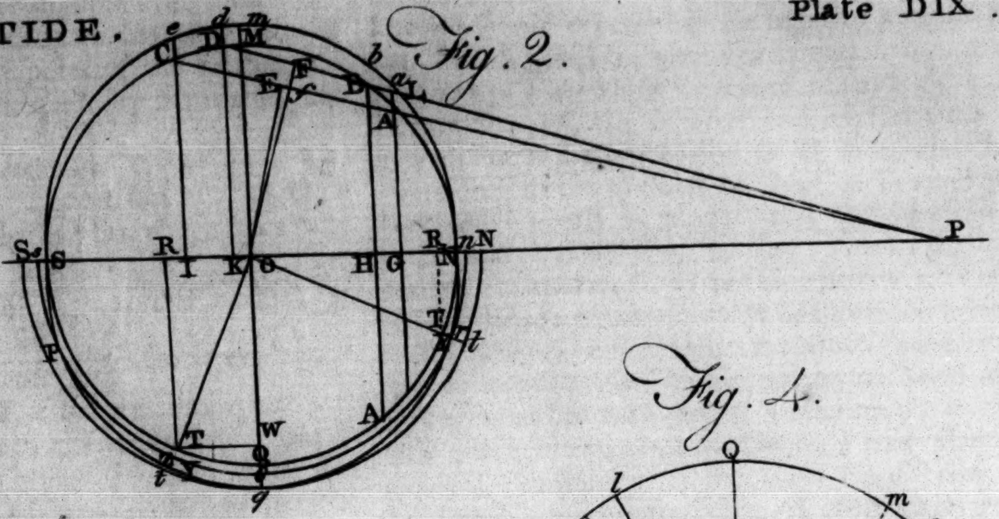
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Fig. 3.

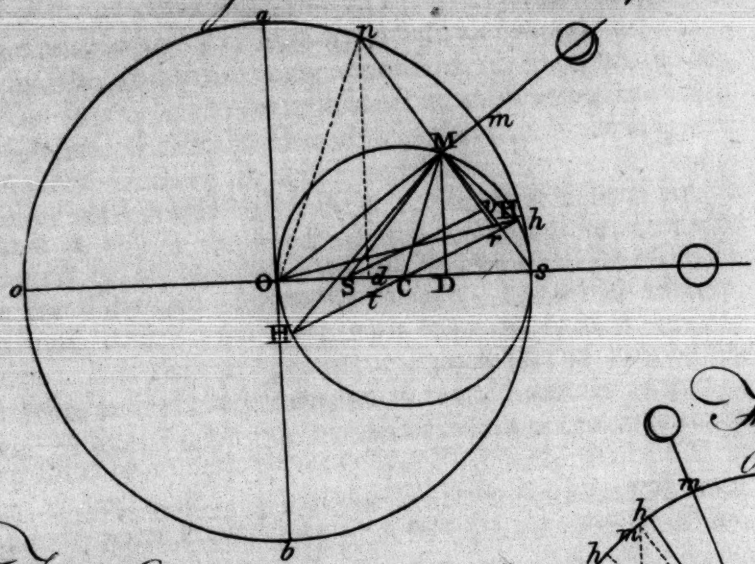
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Fig. 4.

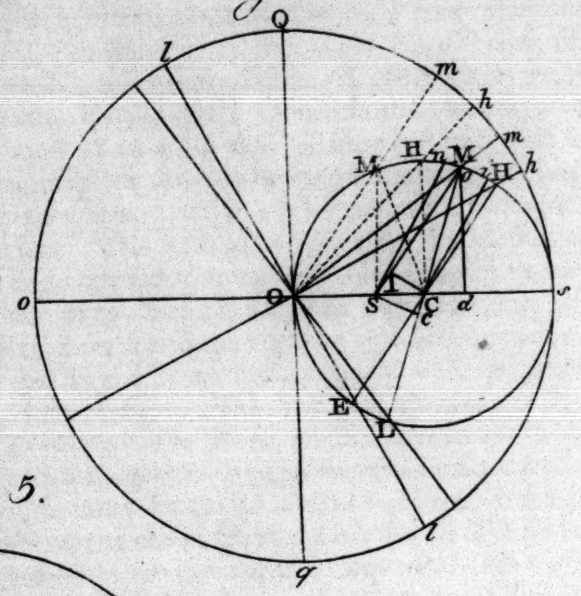
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Fig. 5.

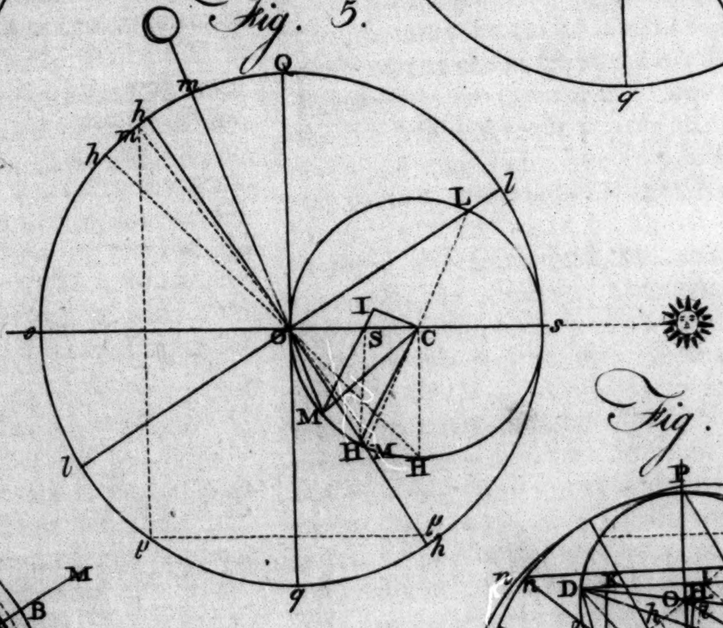
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Fig. 6.

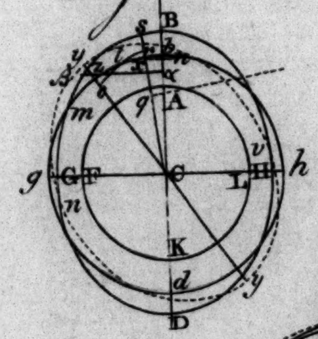
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Fig. 7.

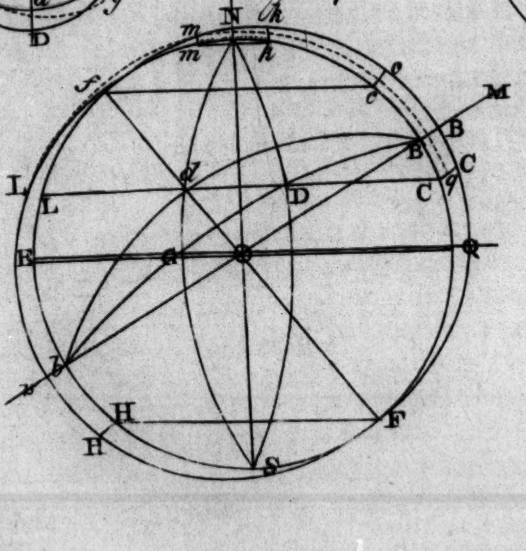
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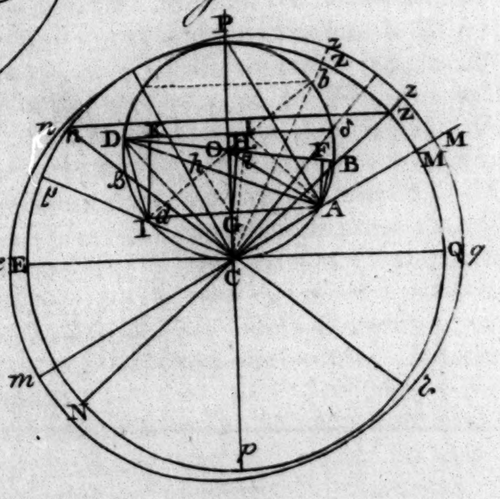
Fig. 8.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But in order to aſcertain the effects of declination and latitude on other tides, we muſt make a much more complicated conſtruction, even tho' we ſuppoſe both luminaries in the ecliptic. For in this caſe the two depreſſed poles of the watery ſpheroid are not in the poles of the earth; and therefore the ſections of the ocean, made by meridians, are by no means ellipſes.

In a neap tide, the moon is vertical at B (fig. 7. or 8.), and the ſun at ſome point of *f*F, 90° from B. If O be this point, the conſtruction for the heights of the tides may be made by adding to both the ſuperior and inferior tides for any point D, the quantity $\overline{M + S - D'F \text{ or } DK} \times \text{ſin.}^2\, dO, = \overline{M + S - \text{tide}} \times \frac{\text{ſin.}^2\, 2Q}{\text{coſ.}^2\, MQ}$, as is evident.

But if the ſun be vertical at *d*, *d* will be the higheſt part of the circle *f*OF, and no correction is neceſſary. But in this caſe the circle of high water will be inclined to the meridian in an angle equal to *d*BO (fig. 7.), and neither the times nor elevations of high water will be properly aſcertained, and the error in time may be conſiderable in high latitudes.

The inaccuracies are not ſo great in intermediate tides, and reſpect chiefly the time of high water and the height of low water.

The exact computation is very tedious and peculiar, ſo that it is hardly poſſible to give any account of a regular progreſs of phenomena; and all we can do is, to aſcertain the preciſe heights of detached points. For which reaſons, we muſt content ourſelves with the conſtruction already given. It is the exact geométrical expreſſion of Bernoulli's analyſis, and its conſequences now related contain all that he has inveſtigated. We may accommodate it very nearly to the real ſtate of things, by ſuppoſing PC equal, not to CO of fig. 4. but to MS, exhibiting the whole compound tide. And the point B, inſtead of repreſenting the moon's place, muſt repreſent the place of high water.

Thus have we obtained a general, though not very accurate, view of the phenomena which muſt take place in different latitudes and in different declinations of the ſun and moon, provided that the phyſical theory which determines the form and poſition of the watery ſpheroid be juſt. We have only to compute, by a very ſimple proceſs of ſpherical trigonometry, the place of the pole of this ſpheroid. The ſecond conſtruction, in fig. 8. ſhows us all the circumſtances of the time and height of high water at any point. It will be recollected, that in computing this place of the pole, the anticipation of 20 degrees, ariſing from the inertia of the waters, muſt be attended to.

Were we to inſtitute a compariſon of this theory with obſervation, without farther conſideration, we ſhould ſtill find it unfavourable, partly in reſpect of the heights of the tides, and more remarkably in reſpect of the time of low water. We muſt again conſider the effects of the inertia of the waters, and recollect, that a regular theoretical tide differs very little in its progreſs from the motion of a wave. Even along the free ocean, its motion much reſembles that of any other wave. All waves are propagated by an oſcillatory motion of the waters, preciſely ſimilar to that of a pendulum. It is well known, that if a pendulum receive a ſmall impulſe in the time of every deſcent, its vibrations may be increaſed to infinity. Did the ſucceſſive actions of the ſun or moon juſt keep time with the natural propagation of the tides, or the natural oſcillations of the waters, the tides would alſo augment to infinity: But there is an infinite odds againſt this exact adjuſtment. It is much more probable that the action of to-day interrupts or checks the oſcillation produced by yeſterday's action, and that the motion which we perceive in this day's tide is what remains, and is compounded with the action of to-day. This being the caſe, we ſhould expect that the nature of any tide will depend much on the nature of the preceding tide. Therefore we ſhould expect that the ſuperior and inferior tides of the ſame day will be more nearly equal than the theory determines. The whole courſe of obſervation confirms this. In latitude 45°, the ſuperior and inferior tides of one day may differ in the proportion of $2\frac{1}{2}$ to 1, and the tides correſponding to the greateſt and leaſt declinations of the moon may differ nearly as much. But the difference of the ſuperior and inferior tides, as they occur in the liſt of Obſervations at Rochefort, is not the third part of this, and the changes made by the moon's declination is not above one-half. Therefore we ſhall come much nearer the true meaſure of a ſpring tide, by taking the arithmetical mean, than by taking either the ſuperior or inferior.

We ſhould expect leſs deviation from the theory in the gradual diminution of the tides from ſpring tide to neap tide, and in the gradual changes of the medium tide by the declination of the moon; becauſe the ſucceſſive changes are very ſmall; and when they change in kind, that is, diminiſh after having for ſome time augmented, the change is by inſenſible degrees. This is moſt accurately confirmed by obſervation. The vaſt collection made by Caſſini of the Obſervations at Breſt being examined by Bernoulli, and the medium of the two tides in one day being taken for the tide of that day, he found ſuch an agreement between the progreſſion of theſe medium tides and the progreſſion of the lines MS of fig. 4. that the one ſeemed to be calculated by the other. He found no leſs agreement in the changes of the medium tides by the moon's declination.

In like manner, the changes produced by the different diſtances of the moon from the earth, were found abundantly conformable to the theory, although not ſo exact as the other. This difference or inferiority is eaſily accounted for: When the moon changes in her mean diſtance, one of the neap tides is uncommonly ſmall, and therefore the ſucceſſive diminutions are very great, and one tide ſenſibly affects another. The ſame circumſtance operates when ſhe changes in apogee, by reaſon of a very large ſpring tide. And the changes correſponding both to the ſun's diſtance from the earth and his declination agreed almoſt exactly.

All theſe things conſidered together, we have abundant reaſon to conclude, that not only the theory itſelf is juſt in principle (a thing which no intelligent naturaliſt can doubt), but alſo that the data which are aſſumed in the application are properly choſen; that is, that the proportion of 2 to 5 is very nearly the true proportion of the mean ſolar and lunar forces. If we now compute the medium tide for any place in ſucceſſion, from ſpring tide to neap tide, and ſtill more, if we compute the ſeries of times of their occurrence, we ſhall find as great an agreement as can be deſired. Not but that there are many irregularities; but theſe are evidently ſo anomalous, that we can aſcribe them to nothing but circumſtances which are purely local.

This general rule of computation muſt be formed in the following manner:

The ſpring tide, according to theory, being called A, and the neap tide B, recollect that the ſpring tide, according to the regular theory, is meaſured by M + S. Recollect alſo, that when the lunar tide only is conſidered, the ſuperior ſpring tide is $M \times \text{ſin.}^2$, ZM (fig. 8). But when we conſider the action of two adjoining tides on each other, we find it ſafer to take the medium of the ſuperior and inferior tides for the meaſure; and this is $M \times \frac{1 + \text{coſ.}^2\, 2ZQ \times \text{coſ.}\, 2MQ}{2}$. Let this be called M. This being totally the effect of M as modified by latitude and declination, may be taken as its proper meaſure, by which we are to calculate the other tides of the monthly ſeries from ſpring tide to neap tide.

In like manner, we muſt compute a value for S, as modified by declination and latitude; call this s. Then ſay,

$$M+S:A=m+s:A\times\frac{m+s}{M+S}.$$

This fourth proportional will give the ſpring tide as modified for the given declination of the luminaries, and the latitude of the place.

Now recollect, that the medium tide, when the luminaries are in the equator, is A × coſ.^{2} lat. Therefore let F be the ſpring tide *obſerved* at any place when the luminaries are in the equator; and let this be the medium of a great many obſervations made in theſe circumſtances. This gives A : coſ.^{2} lat. (as modified by the peculiar circumſtances of the place) = F. Therefore the fourth proportional now given changes to $F\times\frac{m+s}{M+S\cdot\text{coſ.}^2\text{ lat.}}$ And a ſimilar ſubſtitute for B is $G\times\frac{m-s}{M-S\cdot\text{coſ.}^2\text{ lat.}}$

Laſtly, To accommodate our formulæ to every diſtance of the earth from the ſun and moon, let D and Δ be the mean diſtances of the ſun and moon, and *d* and δ their diſtances at the given time; and then the two ſubſtitutes become

$$\frac{\Delta^3d^3M+\delta^3D^3S}{d^3\delta^3(M+S)}\times F\times\frac{m+s}{(M+S)\,\text{coſ.}^2\text{ lat.}}$$

$$\frac{\Delta^3d^3M-\delta^3D^3S}{d^3\delta^3(M-S)}\times G\times\frac{m+s}{(M-S)\,\text{coſ.}^2\text{ lat.}}$$

The half ſum of theſe two quantities will be the MC, and their half difference will be the SC, of fig. 4. with which we may now operate, in order to find the tide for any other day of the menſtrual ſeries, by means of the elongation *a* of the moon from the ſun; that is, we muſt ſay MC + CS : MC — CS = tan. *a* : tan. *b*; then $x=\frac{a+b}{2}$, and $y=\frac{a-b}{2}$. And MS, the height of the tide, is MC × coſ. $2y$ + CS × coſ. $2x$.

Such is the general theory of the tides, deduced from the principle of univerſal gravitation, and adjuſted to that proportion of the ſolar and lunar forces which is moſt conſiſtent with other celeſtial phenomena. The compariſon of the greateſt and leaſt daily retardations of the tides was with great judgment preferred to the proportion of ſpring and neap tides, ſelected by Sir Iſaac Newton for this purpoſe. This proportion muſt depend on many local circumſtances. When a wave or tide comes to the mouths of two rivers, and ſends a tide up each, and another tide of half the magnitude comes a fortnight after; the proportion of tides ſent up to any given places of theſe rivers may be extremely different. Nay, the proportion of tides ſent up to two diſtant places of the ſame river can hardly be the ſame; nor are they the ſame in any river that we know. It can be demonſtrated, in the ſtricteſt manner, that the farther we go up the river, where the declivity is greater, the neap tide will be ſmaller in proportion to the ſpring tide. But it does not appear that the time of ſucceſſion of the different tides will be much affected by local circumſtances. The tide of the ſecond day of the moon being very little leſs than that of the firſt, will be nearly as much retarded, and the intervals between their arrivals cannot be very different from the real intervals of the undiſturbed tides; accordingly, the ſucceſſion of the higheſt to the higheſt but one is found to be the ſame in all places, when not diſturbed by *different* winds. In like manner, the ſucceſſion of the loweſt and the loweſt but one is found equally invariable; and the higheſt and the loweſt tides obſerved in any place *muſt* be accounted the ſpring and neap tides of that place, whether they happen on the day of full and half moon or not. Nay, we can ſee here the explanation of a general deviation of the theory which we formerly noticed. A low tide, being leſs able to overcome obſtructions, will be ſooner ſtopped, and the neap tides ſhould happen a little earlier than by the undiſturbed theory.

With all theſe corrections, the theory now delivered will be found to correſpond, with obſervation, with all the exactneſs that we can reaſonably expect. We had an opportunity of comparing it with the phenomena in a place where they are very ſingular, viz. in the harbour of Biſſeſtedt in Iceland. The equator of the watery ſpheroid frequently paſſes through the neighbourhood of this place, in a variety of poſitions with reſpect to its parallel of diurnal revolution, and the differences of ſuperior and inferior tides are moſt remarkable and various. We found a wonderful conformity to the moſt diverſified circumſtances of the theory.

There is a period of 18 years, reſpecting the tides in Iceland, taken notice of by the ancient Saxons; but it is not diſtinctly deſcribed. Now this is the period of the moon's nodes, and of the greateſt and leaſt inclination of her orbit to the equator. It is therefore the period of the poſitions of the equator of the tides which ranges round this iſland, and very ſenſibly affects them.

Hitherto we have ſuppoſed the tides to be formed on an ocean completely covering the earth. Let us ſee how thoſe may be determined which happen in a ſmall and confined ſea, ſuch as the Caſpian or the Black Sea. The determination in this caſe is very ſimple. As no ſupply of water is ſuppoſed to come into the baſon, it is ſuſceptible of a tide only by ſinking at one end and riſing at the other. This may be illuſtrated by fig. 6. where C *s*, C *y*, are two perpendicular planes bounding a ſmall portion of the natural ocean. The water will ſink at *z* and riſe at *x*, and form a ſurface *o t r* parallel to the equilibrated ſurface *y s*. It is evident that there will be high water, or the greateſt poſſible riſe at *r*, when the baſon comes to that poſition where the tangent is moſt of all inclined to the diameter. This will be when the angle *t* CB is 45° nearly, and therefore three lunar hours after the moon's ſouthing; at the ſame time, it will be low water at the other end. It is plain that the riſe and fall muſt be exceedingly ſmall, and that there will be no change in the middle. The tides of this kind in the Caſpian Sea, in latitude 45°, whoſe extent in longitude does not exceed eight degrees, are not above ſeven inches; a quantity ſo ſmall, that a ſlight breeze of wind is ſufficient to check it, and even to produce a riſe of the waters in the oppoſite direction. We have not met with any accounts of a tide being obſerved in this ſea.

It ſhould be much greater, though ſtill very ſmall, in the Mediterranean Sea. Accordingly, tides are obſerved there, but ſtill more remarkably in the Adriatic, for a reaſon which will be given by and by. We do not know that tides have been obſerved in the great lakes of North America. Theſe tides, though ſmall, ſhould be very regular.

Should there be another great baſon in the neighbourhood of *z x*, lying eaſt or weſt of it, we ſhould obſerve a curious phenomenon. It would be low water on one ſide of the ſhore *z* when it is high water on the other ſide of this partition. If the tides in the Euxine and Caſpian Seas, or in the American lakes which are near each other, could be obſerved, this phenomenon ſhould appear, and would be one of the prettieſt examples of univerſal gravitation that can be conceived. Something like it is to be ſeen at Gibraltar. It is high water on the eaſt ſide of the rock about 10 o'clock at full and change, and it is high water on the weſt ſide, not a mile diſtant, at 12. This difference is perhaps the chief cauſe of the ſingular current which is obſerved in the Straits mouth. There are three currents obſerved at the ſame time, which change their directions every 12 hours. The ſmall tide of the Mediterranean proceeds along the Barbary ſhore, which is very uniform all the way from Egypt, with tolerable regularity. But along the northern ſide, where it is greatly obſtructed by Italy, the iſlands, and the eaſt coaſt of Spain, it ſets very irregularly; and the perceptible high water on the Spaniſh coaſt differs four hours from that of the ſouthern coaſt. Thus it happens, that one tide ranges round Europa point, and another along the ſhore near Ceuta, and there is a third current in the middle different from both. Its general direction is from the Atlantic Ocean into the Mediterranean Sea, but it ſometimes comes out when the ebb tide in the Atlantic is conſiderable.

Suppoſe the moon over the middle of the Mediterranean. The ſurface of the ſea will be level, and it will be half tide at both ends, and therefore within the Straits of Gibraltar. But without the Straits it is within half an hour of high water. Therefore there will be a current ſetting *in* from the Atlantic. About three and an half hours after, it is high water within and half ebb without. The current now ſets out from the Mediterranean. Three hours later, it is low water without the Straits and half ebb within; therefore the current has been ſetting out all this while. Three hours later, it is half flood without the Straits and low water within, and the current is again ſetting in, &c.

Were the earth fluid to the centre, the only ſenſible motion of the waters would be up and down, like the waves on the open ocean, which are not bruſhed along by ſtrong gales. But the ſhallowneſs of the channel makes a horizontal motion neceſſary, that water may be ſupplied to form the accumulation of the tide. When this is formed on a flat ſhelving coaſt, the water muſt flow in and out, on the flats and ſands, while it riſes and falls. Theſe horizontal motions muſt be greatly modified by the channel or bed along which they move. When the channel contracts along the line of flowing water, the wave, as it moves up the channel, and is checked by the narrowing ſhores, muſt be reflected back, and keep a-top of the waters ſtill flowing in underneath. Thus it may riſe higher in theſe narrow ſeas than in the open ocean. This may ſerve to explain a little the great tides which happen on ſome coaſts, ſuch as the coaſt of Normandy. At St Malo the flood frequently riſes 50 feet. But we cannot give any thing like a full or ſatisfactory account of theſe ſingularities. In the Bay of Fundy, and particularly at Annapolis Royal, the water ſometimes riſes above 100 feet. This ſeems quite inexplicable by any force of the ſun and moon, which cannot raiſe the waters of the free ocean more that eight feet. Theſe great floods are unqueſtionably owing to the proper timing of certain oſcillations or currents adjoining, by which they unite, and from one of great force. Such violent motions of water are frequently ſeen on a ſmall ſcale in the motions of brooks and rivers; but we are too little acquainted with hydraulics to explain them with any preciſion.

We have ſeen that there is an oſcillation of waters formed under the ſun and moon; and that in conſequence of the rotation of the earth, the inertia and the want of perfect fluidity of the waters, and obſtructions in the channel, this accumulation never reaches the place where it would finally ſettle if the earth did not turn round its axis. The conſequence of this muſt be a general current of the waters from eaſt to weſt. This may be ſeen in another way. The moon in her orbit round the earth has her gravity to the earth diminiſhed by the ſun's diſturbing force, and therefore moves in an orbit leſs incurvated than ſhe would deſcribe independent of the ſun's action. She therefore employs a longer time. If the moon were ſo near the earth as almoſt to touch it, the ſame thing would happen. Therefore ſuppoſe the moon turning round the earth, almoſt in contact with the equator, with her natural undiſturbed periodic time, and that the earth is revolving round its axis in the ſame time, the moon would remain continually above the ſame ſpot of the earth's ſurface (ſuppoſe the city of Quito), and a ſpectator in another planet would ſee the moon always covering the ſame ſpot. Now let the ſun act. This will not affect the rotation of the earth, becauſe the action on one part is exactly balanced by the action on another. But it will affect the moon. It will move more ſlowly round the earth's centre, and at a greater diſtance. It will be left behind by the city of Quito, which it formerly covered. And as the earth moves round from weſt to eaſt, the moon, moving more ſlowly, will have a motion to the weſt with reſpect to Quito. In like manner, every particle of water has its gravity diminiſhed, and its diurnal motion retarded; and hence ariſes a general motion or current from eaſt to weſt. This is very diſtinctly perceived in the Atlantic and Pacific Oceans. It comes round the Cape of Good Hope, ranges along the coaſt of Africa, and then ſets directly over to America, where it meets a ſimilar ſtream which comes in by the north of Europe. Meeting the ſhores of America, it is deflected both to the ſouth along the coaſt of Brazil, and to the north along the North American ſhores, where it forms what is called the *Gulf Stream*, becauſe it comes from the Gulf of Mexico. This motion is indeed very ſlow, this being ſufficient for the accumulation of ſeven or eight feet on the deep ocean; but it is not altogether inſenſible.

We may expect differences in the appearances on the weſtern ſhores of Europe and Africa, and on the weſtern ſhore of America, from the appearances on the eaſtern coaſts of America and of Aſia, for the general current obſtructs the waters from the weſtern ſhores, and ſends them to the eaſtern ſhores. Alſo when we compare the wide opening of the northern extremity of the Atlantic Ocean with the narrow opening between Kamtſchatka and America, we ſhould expect differences between the appearances on the weſt coaſts of Europe and of America. The obſervations made during the circumnavigations of Captain Cook and others ſhow a remarkable difference. All along the weſt coaſt of North America the inferior tide is very trifling, and frequently is not perceived.

In the very ſame manner, the diſturbing forces of the ſun and moon form a tide in the fluid air which ſurrounds this globe, conſiſting of an elevation and depreſſion, which move gradually from eaſt to weſt. Neither does this tide ever attain that poſition with reſpect to the diſturbing planets which it would do were the earth at reſt on its axis. Hence ariſes a motion of the whole air from eaſt to weſt; and this is the principal cauſe of the trade winds. They are a little accelerated by being heated, and therefore expanding. They expand more to the weſtward than in the oppoſite direction, becauſe the air expands on that ſide into air, which is now cooling and contracting. Theſe winds very evidently follow the ſun's motion, tending more to the ſouth or north as he goes ſouth or north. Were this motion conſiderably affected by the expanſion of heated air, we ſhould find the air rather coming northward and ſouthward from the torrid zone, in conſequence of its expanſion in that climate. We repeat it, it is almoſt ſolely produced by the aerial tide, and is neceſſary for the very formation of this tide. We cannot perceive the accumulation. It cannot affect the barometer, as many think, becauſe, though the air becomes deeper, it becomes deeper only becauſe it is made lighter by the gravitation to the ſun. Inſtead of preſſing more on the ciſtern of the barometer, we imagine that it preſſes leſs; becauſe, like the ocean, it never attains the height to which it tends. It remains always too low for equilibrium, and therefore it ſhould preſs with leſs force on the ciſtern of a barometer.

There is an appearance preciſely ſimilar to this in the planet Jupiter. He is ſurrounded by an atmoſphere which is arranged in zones or belts, probably owing to climate differences of the different latitudes, by which each ſeems to have a different kind of ſky. Something like this will appear to a ſpectator in the moon looking at this earth. The general weather and appearance of the ſky is conſiderably different in the torrid and temperate zones. Jupiter's belts are not of a conſtant ſhape and colour; but there often appear large ſpots or tracts of cloud, which retain their ſhape during ſeveral revolutions of Jupiter round his axis. To judge of his rotation by one of theſe, we ſhould ſay that he turns round in 9.55. There is alſo a brighter ſpot which is frequently ſeen, occupying one certain ſituation on the body of Jupiter. This is ſurely adherent to his body, and is either a bright coloured country, or perhaps a tract of clouds hovering over ſome volcano. This ſpot turns round in 9.51½. And thus there is a general current in his atmoſphere from eaſt to weſt.

Both the motion of the air and of the water tend to diminiſh the rotation of the earth round its axis: for they move ſlower than the earth, becauſe they are retarded by the luminaries. They muſt communicate this retardation to the earth, and muſt take from it a quantity of motion preciſely equal to what they want, in order to make up the equilibrated tide. In all probability this retardation is compenſated by other cauſes; for no retardation can be obſerved. This would have altered the length of the year ſince the time of Hipparchus, giving it a ſmaller number of days. We ſee cauſes of compenſation. The continual waſhing down of ſoil from the elevated parts of the earth muſt produce this effect, by communicating to the valley on which it is brought to reſt the exceſs of diurnal velocity which it had on the mountain top.

While we were employed on this article, a book was put into our hands called *Studies of Nature*, by a Mr Saint Pierre. This author ſcouts the Newtonian theory of the tides, as erroneous in principle, and as quite inſufficient for explaining the phenomena; and he aſcribes all phenomena of the tides to the liquefaction of the ices and ſnows of the circumpolar regions, and the greater length of the polar than of the equatorial axis of the earth. He is a man of whom we wiſh to ſpeak with reſpect, for his conſtant attention to final cauſes, and the proof thence reſulting of the wiſdom and goodneſs of God. For this he is entitled to the greater praiſe, that it required no ſmall degree of fortitude to reſiſt the influence of national example, and to retain his piety in the midſt of a people who have drunk the very dregs of the atheiſm of ancient Greece. This is a ſpecies of merit rarely to be met with in a Frenchman of the preſent day; but as a philoſopher, M. de St Pierre can lay claim to no other merit except that of having collected many important facts. The argument which he employs to prove that the earth is a prolate ſpheroid, is a direct demonſtration of the truth of the contrary opinion; and the melting of the ice and ſnows at the poles cannot produce the ſmalleſt motion in the waters. Were there even 10 times more ice and ſnow floating on the northern ſea than there is, and were it all to melt in one minute, there would be no flux from it; for it would only fill up the ſpace which it formerly occupied in the water. Of this any perſon will be convinced, who ſhall put a handful of ſnow ſqueezed hard into a jar of water, and note the exact height of the water. Let the ſnow melt, and he will find the water of the ſame height as before.

Tide-Waiters, or *Tideſmen*, are inferior officers belonging to the cuſtomhouſe, whoſe employment is to watch or attend upon ſhips until the cuſtoms be paid; they get this name from their going on board ſhips on their arrival in the mouth of the Thames or other ports, and ſo come up with the tide.

TIEND, in Scots law. See TEIND.

TIERCE, or TEIRCE, a meaſure of liquid things, as wine, oil, &c. containing the third part of a pipe, or 42 gallons.

TIERCED, in heraldry, denotes the ſhield to be divided by any part of the partition-lines, as party, coupy, tranchy, or tailly, into three equal parts of different colours or metals.

TIGER, in zoology. See FELIS.

TIGER-Wolf, the name by which the hyæna is called at the Cape of Good Hope. See HYÆNA.

TIGRIS, a river of Aſia, which has its ſource near that of the Euphrates in the mountain Tchildir in Turkomania: afterwards it ſeparates Diarbeck from Erzerum, and Khuſiſtan from Irac-Arabia; and uniting with the Euphrates at Gorno, it falls into the gulf of Baſſorah, under the name of *Schat el-Arab*. This river paſſes by Diarbekar, Gezira, Mouſul, Bagdad, Gorno, and Baſſorah.

TILIA, LIME or LINDEN-TREE, in botany: A genus of plants belonging to the claſs of *polyandria*, and order of *monogynia*; and in the natural ſyſtem ranging under the *Columniferæ*. The calyx is quinquepartite; the corolla pentapetalous; the berry is dry, globoſe, quinquelocular, quinquevalve, and opening at the baſe. There are four ſpecies; the europæa and americana, pubeſcens and alba.

The *europæa*, or common lime tree, is generally ſuppoſed to be a native of Britain; but we are informed by Mr Coxe, that Mr Pennant told him (on what authority is not mentioned), that it was imported into England before the year 1652.

Cox's Travels in Switzerland, vol. ii. p. 64.

The leaves are heart-ſhaped, with the apex produced, and ſerrated on the edges; the flowers grow in a thin umbel, from three to nine together, of a whitiſh colour and a fragrant ſmell; very grateful to bees. The wood is light, ſmooth, and of a ſpongy texture, uſed for making laſts and tables for ſhoemakers, &c. Ropes and bandages are made of the bark, and mats and ruſtic garments of the inner rind, in Carniola and ſome other countries.—The lime-tree contains a gummy juice, which being repeatedly boiled and clarified produces a ſubſtance like ſugar.

TILLEMONT (Sebaſtian le Nain de). See NAIN.

TILLER *of a Ship*, a ſtrong piece of wood faſtened in the head of the rudder, and in ſmall ſhips and boats called the *helm*.

TILLŒA, in botany: A genius of plants belonging to the claſs of *tetrandria*, the order of *tetragynia*, and in the natural ſyſtem ranging under the 13th order, *Succulentæ*. The calyx has three or four diviſions; the petals are three or four, and equal; the capſules three or four, and polyſpermous. There are four ſpecies; of which one only, the muſcoſa, is a native of England, and is not mentioned among the Scotch plants.

The *muſcoſa*, or procumbent tillœa, has proſtrate ſtems, almoſt erect, generally red, and grow longer after flowering. The parts of fructification are always three. The leaves grow in pairs, and are fleſhy. It is found on dry heaths in Norfolk and Suffolk, and flowers in May and June.

TILLOTSON (John), a celebrated archbiſhop of Canterbury, was the ſon of Robert Tillotſon of Sowerby, in the pariſh of Hallifax in Yorkſhire, clothier; and was born there in the year 1630. He ſtudied in Clarehall, Cambridge; and in 1656 left this college, in order to become tutor to the ſon of Edmund Prideaux, Eſq; of Ford-abbey in Devonſhire. He was afterwards curate to Dr Hacket, vicar of Cheſhunt, in Hertfordſhire. In 1663, he was preſented by Sir Thomas Barnardiſton to the rectory of Ketton or Keddington in the county of Suffolk; but was the next year choſen preacher to Lincoln's-Inn, when he procured Ketton to be beſtowed on his curate. He was greatly admired in London for his ſermons; and in the ſame year was choſen Tueſday lecturer at St Lawrence's church, London, where his lectures were frequented by all the divines of the city, and by many perſons of quality and diſtinction. In 1666, he took the degree of Doctor of Divinity at Cambridge; in 1669, was made prebendary of Canterbury; in 1672, was admitted dean of that cathedral; and three years after, was made a prebendary of St Paul's cathedral, London. In 1679, he became acquainted with Charles earl of Shrewſbury, whom he converted from Popery; and the next year refuſed to ſign the clergy of London's addreſs of thanks to king Charles II. for not agreeing to the bill of excluſion of the duke of York. In 1683, he viſited the unhappy Lord Ruſſel when under condemnation; and attended him in his laſt moments on the ſcaffold. In 1689, he was inſtalled dean of St Paul's; made clerk of the cloſet to King William and Queen Mary; and appointed one of the commiſſioners to prepare matters to be laid before the convocation, in order to a comprehenſion of all Proteſtants, as well diſſenters as churchmen; but this attempt was fruſtrated by the zeal of thoſe members of that body, who refuſed to admit of any alteration in things confeſſedly indifferent. In 1691, Dr Tillotſon was, notwithſtanding the warmeſt remonſtrances and intreaties on his part, conſecrated archbiſhop of Canterbury, and four days after was ſworn one of the privy council; their majeſties always repoſing an entire confidence in his prudence, moderation, and integrity. In 1694, he was ſeized with a dead palſy, of which he died in the 65th year of his age. He was interred in the church of St Lawrence Jury, London, where a handſome monument is erected to his memory. This learned and pious divine, while living, was greatly inveighed againſt by the enemies of the revolution. After his death there was found a bundle of bitter libels which had been publiſhed againſt him, on which he had written with his own hand, "I forgive the authors of theſe books, and pray God that he may alſo forgive them." It is remarkable, that while this truly great man was in a private ſtation, he always laid aſide two-tenths of his income for charitable uſes. One volume in folio of Dr Tillotſon's ſermons was publiſhed in his life-time, and corrected by his own hand; theſe Barbeyrac tranſlated into French. Thoſe which came abroad after his death, from his chaplain Dr Barker, made two volumes in folio, the copy of which was ſold for 2500l. and this was the only legacy he left to his family, his extenſive charity having conſumed his yearly revenues as conſtantly as they came to his hands. However, King William gave two grants to his widow; the firſt of which was an annuity of 400l. during the term of her natural life, and the ſecond of 200l. as an addition to the former annuity. Dr Tillotſon wrote ſome other works beſides his Sermons; and alſo publiſhed Dr Barrow's works, and Dr Wilkins's Treatiſe of the Principles and Duties of Natural Religion, and a volume of that divine's Sermons.

TIMBER, wood fit for building, &c. See Tree, and *Strength of Materials*.

TIMBERS, the ribs of a ſhip, or the incurvated pieces of wood, branching outward from the keel in a vertical direction, ſo as to give ſtrength, figure, and ſolidity, to the whole fabric. See Ship building, book i. ch. ii.

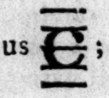
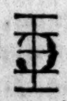
TIME, a ſucceſſion of phenomena in the univerſe, or a mode of duration marked by certain periods or meaſures, chiefly by the motion and revolution of the ſun.

The general idea which time gives in every thing to which it is applied, is that of limited duration. Thus we cannot ſay of the Deity, that he exiſts in time; becauſe eternity, which he inhabits, is abſolutely uniform, neither admitting limitation nor ſucceſſion. See Metaphysics, n° 209.

Time, in muſic, is an affection of ſound, by which it is ſaid to be long or ſhort, with regard to its continuance in the ſame tone or degree of tune.

Muſical time is diſtinguiſhed into *common* or *duple* time, and *triple* time.

Double, *duple*, or *common* time, is when the notes are in a duple duration of each other, *viz.* a ſemibreve equal to two minims, a minim to two crotchets, a crotchet to two quavers, &c.

Common or double time is of two kinds. The firſt when every bar or meaſure is equal to a ſemibreve, or its value in any combination of notes of a leſs quantity. The ſecond is where every bar is equal to a minim, or its value in leſs notes. The movements of this kind of meaſure are various, but there are three common diſtinctions; the firſt *ſlow*, denoted at the beginning of the line by the mark C; the ſecond *briſk*, marked thus ; and the third *very briſk*, thus marked 

Triple time is when the durations of the notes are triple of each other, that is, when the ſemibreve is equal to three minims, the minim to three crotchets, &c. and it is marked T.

Time-Keepers, or *Inſtruments for meaſuring Time.* See Clock, Dial, Watch, &c.

Harriſon's Time-Keeper. See Harrison and Longitude.

TIMOLEON, a celebrated Corinthian general, who reſtored the Syracuſians to their liberty, and drove the Carthaginians out of Sicily. See Syracuse, n° 50—54.

TIMON the *Sceptic*, who is not to be confounded with Timon the *Miſanthrope*, was a Phliaſian, a diſciple of Pyrrho, and lived in the time of Ptolemy Philadelphus. He took ſo little pains to invite diſciples to his ſchool, that it has been ſaid of him, that as the Scythians ſhot flying, Timon gained pupils by running from them. He was fond of rural retirement; and was ſo much addicted to wine, that he held a ſucceſsful conteſt with ſeveral celebrated champions in drinking. Like Lucian, he wrote with ſarcaſtic humour againſt the whole body of philoſophers. The fragments of his ſatirical poem *Silli*, often quoted by the ancients, have been carefully collected by Henry Stephens, in his *Poeſis Philoſophica*. Timon lived to the age of 90 years.

Timon, ſurnamed *Miſanthropos*, or the *Man-hater*, a famous Athenian, who lived about 420 B. C. He was one day aſked, why he loved the young Alcibiades while he deteſted all the reſt of the human race? on which he replied, "It is becauſe I foreſee that he will be the ruin of the Athenians."

nians." He carefully avoided all ſorts of company; yet went one day to an aſſembly of the people, and cried with a loud voice, "That he had a fig-tree on which ſeveral perſons had hanged themſelves; but as he intended to cut it down, in order to build a houſe in the place where it ſtood, he gave them notice of it, that if any of them had a mind to hang themſelves, they muſt make haſte and do it ſpeedily." He had an epitaph engraved on his tomb, filled with imprecations againſt thoſe who read it. Shakeſpeare has formed a tragedy on his ſtory.

TIMOR, an iſland of Aſia, in the Eaſt Indian ſea, to the ſouth of the Moluccas, and to the eaſt of the iſland of Java, being 150 miles in length, and 37 in breadth. It abounds in ſandal-wood, wax, and honey; and the Dutch have a fort here. The inhabitants are Pagans, and are little better than ſavages; and ſome pretend they had not the uſe of fire till a few years ago.

TIMOTHEUS, one of the moſt celebrated poet-muſicians of antiquity, was born at Miletus, an Ionian city of Caria, 446 years B. C. He was contemporary with Philip of Macedon and Euripides; and not only excelled in lyric and dithyrambic poetry, but in his performance upon the cithara. According to Pauſanias, he perfected that inſtrument by the addition of four new ſtrings to the ſeven which it had before; though Suidas ſays it had nine before, and that Timotheus only added two, the 10th and 11th, to that number. See Lyre.

With reſpect to the number of ſtrings upon the lyre of Timotheus: The account of Pauſanius and Suidas is confirmed in the famous ſenatus conſultum againſt him, ſtill extant, preſerved at full length in Boethius. Mr Stillingfleet has given an extract from it, in proof of the ſimplicity of the ancient Spartan muſic. The fact is mentioned in Athenæus; and Caſaubon, in his notes upon that author, has inſerted the whole original text from Boethius, with corrections. The following is a faithful tranſlation of this extraordinary Spartan act of parliament. "Whereas Timotheus the Mileſian, coming to our city, has diſhonoured our ancient muſic, and, deſpiſing the lyre of ſeven ſtrings, has, by the introduction of a greater variety of notes, corrupted the ears of our youth; and by the number of his ſtrings, and the novelty of his melody, has given to our muſic an effeminate and artificial dreſs, inſtead of the plain and orderly one in which it has hitherto appeared; rendering melody infamous, by compoſing in the chromatic inſtead of the enharmonic:——————— The kings and the ephori have therefore reſolved to paſs cenſure upon Timotheus for theſe things; and, farther, to oblige him to cut all the ſuperfluous ſtrings of his eleven, leaving only the ſeven tones; and to baniſh him from our city; that men may be warned for the future not to introduce into Sparta any unbecoming cuſtom."———

The ſame ſtory, as related in Athenæus, has this additional circumſtance, That when the public executioner was on the point of fulfilling the ſentence, by cutting off the new ſtrings, Timotheus, perceiving a little ſtatue in the ſame place, with a lyre in his hand of as many ſtrings as that which had given the offence, and ſhowing it to the judges, was acquitted.

It appears from Suidas, that the poetical and muſical compoſitions of Timotheus were very numerous, and of various kinds. He attributes to him 19 nomes, or canticles, in hexameters; 36 proems, or preludes; 18 dithyrambics; 21 hymns; the poem in praiſe of Diana; one panegyric; three tragedies, the Perſians, Phinidas, and Laertes; to which muſt be added a fourth, mentioned by ſeveral ancient authors, called *Niobe*, without forgetting the poem on the birth of Bacchus. Stephen of Byzantium makes him author of 18 books of nomes, or airs, for the cithara, to 8000 verſes; and of 1000 Προοιμια, or preludes, for the nomes of the flutes.

Timotheus died in Macedonia, according to Suidas, at the age of 97; though the Marbles, much better authority, ſay at 90; and Stephen of Byzantium fixes his death in the fourth year of the 105th Olympiad, two years before the birth of Alexander the Great; whence it appears, that this Timotheus was not the famous player on the flute ſo much eſteemed by that prince, who was animated to ſuch a degree by his performance as to ſeize his arms; and who employed him, as Athenæus informs us, together with the other great muſicians of his time, at his nuptials. However, by an inattention to dates, and by forgetting that of theſe two muſicians of the ſame name the one was a Mileſian and the other a Theban, they have been hitherto often confounded.

TIMUR beck. See Tamerlane.

TIN, one of the four imperfect metals.

For an account of its metalline qualities, and the various ſtates in which it is found, ſee Mineralogy, page 118. For its chemical qualities, ſee the places referred to in Chemistry-*Index*. For the method of eſſaying and ſmelting its ore, ſee Metallurgy, Part ii. ſect. vi.; Part iii. ſect. vi. See alſo Cornwall, and Pharmacy-*Index*.—An advantageous commerce has been lately opened between Cornwall and the Eaſt Indies and China. In 1791 about 3000 tons of tin were raiſed in Cornwall; of which 2200 tons were ſold in the European market for L. 72 each, and 800 tons carried to India and China at L. 62 *per* ton.

TINCAL, the name by which crude or impure borax is called. See Borax and Chemistry-*Index*.

TINCTURE, in pharmacy. See Pharmacy-*Index*.

TINDAL (Dr Matthew), a famous Engliſh writer, was the ſon of the reverend Mr John Tindal of Beer Ferres in Devonſhire, and was born about the year 1657. He ſtudied at Lincoln college in Oxford, whence he removed to Exeter, and was afterwards elected fellow of All Souls. In 1685 he took the degree of doctor of law, and in the reign of James II. declared himſelf a Roman Catholic; but ſoon renounced that religion. After the revolution he publiſhed ſeveral pamphlets in favour of government, the liberty of the preſs, &c. His "Rights of the Chriſtian Church aſſerted," occaſioned his having a violent conteſt with the high church clergy; and his treatiſe "Chriſtianity as old as the Creation," publiſhed in 1730, made much noiſe, and was anſwered by ſeveral writers, particularly by Dr Conybeare, Mr Forſter, and Dr Leland. Dr Tindal died at London in Auguſt 1733. He left in manuſcript a ſecond volume of his "Chriſtianity as old as the Creation;" the preface to which has been publiſhed. Mr Pope has ſatirized Dr Tindal in his Dunciad.

TINDALE (William). See Tyndale.

TINNING, the covering or lining any thing with melted tin, or tin reduced to a very fine leaf. Looking-glaſſes are foliated or tinned with thin plates of beaten tin, the whole bigneſs of the glaſs, applied or faſtened thereto by means of quickſilver. See *Foliating of Looking Glaſſes*.

Tinning of Copper. See Copper, n° 25—28.

TINNITUS Aurium, a noiſe in the ears like the continued ſound of bells, very common in many diſorders, particularly in nervous fevers.

TIPPERARY, a county of the province of Munſter in Ireland, bounded on the weſt by that of Limerick and Clare, on the eaſt by the county of Kilkenny and Queen's county, on the ſouth by the county of Waterford, and on the north and north-eaſt by King's county and the territory of the ancient O'Carols. It extends about 42 miles in length, Gough's Edition of Cambden's Britannia.

length, 27 in breadth, containing 599,500 acres, divided into 12 baronies, in which are ſeveral market towns and boroughs. It ſends eight members to parliament, *viz.* two for the county, two for the city of Caſhel, and two for each of the boroughs of Clonmell, Fetherd, and Thurles. The north part of it is mountainous and cold; but in the ſouth the air is milder, and the ſoil much more fertile, producing plenty of corn and good paſture for the numerous herds of cattle and flocks of ſheep with which it abounds. The north part is called *Ormond*, and for a long time gave the title of *earl*, and afterwards of *marquis* and *duke*, to the noble family of Butler, deſcended from a ſiſter of Thomas a Becket archbiſhop of Canterbury, till, at the acceſſion of George I. the laſt duke was attainted of high-treaſon, and died abroad. In that part of the county, the family had great prerogatives and privileges granted them by Edward III. Another diſtrict in this county was anciently called the *County of the Holy Croſs of Tipperary*, from a famous abbey in it ſtyled *Holy Croſs*, on account of a piece of Chriſt's croſs that was ſaid to be preſerved there. This abbey and diſtrict enjoined alſo ſpecial privileges in former times. The remains of the abbey, or rather the ſpot where it ſtood, are ſtill held in great veneration, and much reſorted to by the Roman Catholics.

TIPSTAFF, an officer who attends the judges with a kind of ſtaff tipped with ſilver, and takes into his charge all priſoners who are committed or turned over at a judge's chambers.

TIPULA, the CRANE-FLY; a genus of inſects belonging to the order of *diptera*. The mouth is a prolongation of the head; the upper-jaw is arched. They have two palpi, which are curved, and longer than the head. The proboſcis is ſhort, and bends inwards. Gmelin enumerates 123 ſpecies, of which 14 are Britiſh. They are divided into two families. 1. Thoſe with wings diſplayed. 2. Thoſe with wings incumbent, and which in form reſemble a gnat.

This two winged inſect is often taken for the gnat, which it reſembles, but has not its miſchievous inſtinct, nor its murderous proboſcis. The larger tipulæ go by the name of *ſempſtreſſes*, the ſmall ones by that of *culiciform*; the latter, in fine ſummer evenings, flutter about the water-ſide in legions, through which a perſon may paſs on his way unhurt. The ſhrill noiſe they make with their wings is not very diſcernible. Tipulæ, before they become inhabitants of the air, creep under the form of grubs. Thoſe which turn to larger tipulæ dwell in holes of decayed willows, in the dampeſt places, where they change into chryſalids, and in that ſtate have the faculty of breathing through two ſmall curve horns; beſides which they are endowed with progreſſive motion, but not retrogreſſive, being impeded by little ſpines placed on every ring of the abdomen. When the ſhroud is torn, the inſect, prettily apparelled, eſcapes from his gloomy habitation by means of his wings, which often are variegated, and takes his paſtime in the fields. Its long legs and its wings mutually aſſiſt each other when it either walks or flies. The larvæ and chryſalids of the little tipulæ are found in water. They are various in colour, form, and carriage; ſome being grey, others brown, and others red; ſome, like the polypus, furniſhed with a pair of arms; ſeveral with cylindrical tubes that perform the office of vent-holes. Theſe ſwim with nimbleneſs; thoſe never leave the holes they have dug for themſelves in the banks of rivulets. Laſtly, others make a ſilken cod that receives part of their body; but all of them, after a period, renounce their reptile and aquatic life, and receive wings from the hands of nature. Their frame is then ſo weak, that a touch is enough to cruſh them. They are ſometimes of a beautiful green, ſometimes coal-black; and the moſt remarkable are thoſe whoſe fore-legs, extraordinarily long, do not touch the ground, and are movable like antennæ. In this ſtate of perfection, the tipulæ being provided with proper organs, apply themſelves to the propagation of the ſpecies. Thoſe ſame poor inſects, who in the ſtate of larvæ have eſcaped the voraciouſneſs of fiſhes, often become, in their progreſs through the air, a prey to equally mercileſs birds.

TIRE, in the ſea-language, is a row of cannon placed along a ſhip's ſide, either above upon deck, or below, diſtinguiſhed by the epithets of *upper* and *lower tires*.

TYROL, a county of Germany in the circle of Auſtria, under which may be included the territories belonging to the biſhops of Brixen, Trent and Chur, Teutonic Order, and the prince of Deitrichſtien, the Auſtrian ſeigniories before the Arlberg, and the Auſtrian diſtricts in Swabia. It is 150 miles in length, and 120 in breadth, and contains 28 large towns.

The face of the country is very mountainous. Of theſe mountains, ſome have their tops always buried in ſnow; others are covered with woods, abounding with a variety of game: and others are rich in metals, and marble of all colours. Of the lower, ſome yield plenty of corn, others wine, and woods of cheſnut trees. The valleys are exceeding fertile alſo, and pleaſant. In ſome places conſiderable quanties of flax are raiſed, in others there is a good breed of horſes and horned cattle; and, among the mountains, abundance of chamois and wild goats. In this country are alſo found precious ſtones of ſeveral ſorts; as granates, rubies, amethiſts, emeralds, and a ſpecies of diamonds, agates, cornelians, chalcedonies, malachites, &c. nor is it without hot-baths, acid waters, ſalt-pits, mines of ſilver, copper, and lead, mineral colours, alum, and vitriol. The principal river of Tirol is the Inn, which, after traverſing the country, and receiving a number of leſſer ſtreams into it, enters Bavaria, in which, at Paſſau, it falls into the Danube. The men here are very tall, robuſt, and vigorous; the women alſo are ſtout, and generally fair; and both ſexes have a mixture of the Italian and German in their tempers and characters. As there is little trade or manufacture in the country, except what is occaſioned by the mines and ſalt-works, many of the common people are obliged to ſeek a ſubſiſtence elſewhere. A particular kind of ſalutation is uſed all over Tirol. When a perſon comes into a houſe, he ſays, "Hail! Jeſus Chriſt:" the anſwer is, "May Chriſt be praiſed, and the Holy Virgin his mother." Then the maſter of the houſe takes the viſitor by the hand. This ſalutation is fixed up in print at all the doors, with an advertiſement tacked to it, importing, that pope Clement XI. granted 100 days indulgence, and a plenary abſolution, to thoſe who ſhould pronounce the ſalutation and anſwer, as often as they did it. The emperor has forts and citadels ſo advantageouſly ſituated on rocks and mountains all over the country, that they command all the valleys, avenues, and paſſes that lead into it. The inhabitants, however, to keep them in good humour, are more gently treated, and not ſo highly taxed as thoſe of the other hereditary countries. As to the ſtates, they are much the ſame in this country as in the other Auſtrian territories, except that the peaſants here ſend deputies to the diets. Tirol came to the houſe of Auſtria in the year 1363, when Margaret, counteſs thereof, bequeathed it to her uncles the dukes of Auſtria. The arms of Tirol are an eagle gules, in a field argent. The counts of Trap are hereditary ſtewards; the lords of Gloſz, chamberlains; the princes of Trautſon, marſhals; the counts of Wolkenſtein, maſters of the horſe and carvers; the houſe of Spaur, cup-bearers; the counts of Kungl, ſewers and rangers; the counts of Brandis, keepers of the jewels; the houſe of Welſperg, purveyors and ſtaff-bearers, and the counts of Coalto, falconers. Beſides the governor, here are three ſovereign colleges, ſubordinate to the court at Vienna, which ſit at Inſpruck, and have their different departments. Towards the expences of the military eſtabliſhment of this country, the proportion is 100,000 florins yearly; but no more than one regiment of foot is generally quartered in it.

Tirol is divided into ſix quarters, as they are called; namely, thoſe of the Lower and Upper Innthal, Vintſgow, Etch, Eiſack, and Puſterthal.

TITAN, in fabulous hiſtory, the ſon of Cœlus and Terra, and the eldeſt brother of Saturn, ſuffered the latter to enjoy the crown, on condition that he ſhould bring up none of his male iſſue, by which means the crown would at length revert to him; but Jupiter being ſpared by the addreſs of Rhea, Saturn's wife, Titan and his children were ſo enraged at ſeeing their hopes fruſtrated, that they took up arms to revenge the injury; and not only defeated Saturn, but kept him and his wife priſoners till he was delivered by Jupiter, who defeated the Titans; when from the blood of theſe Titans ſlain in the battle, proceeded ſerpents, ſcorpions, and all venomous reptiles. See SATURN.

Such is the account given by the poets of this family of Grecian and Roman gods. From the fragments of Sanchoniatho, however, and other ancient writers, many learned men have inferred that the Titans were an early race of ambitious heroes, who laid the foundation of that idolatry which quickly overſpread the world, and that by aſſuming the names of the luminaries of heaven they contrived to get themſelves every where adored as the *Dii majorum gentium*. That the word *Titan* ſignifies the ſun, there can indeed be very little doubt. Every one knows that ſuch was its ſignification in the Æolic dialect; and as it is evidently compounded of *Ti*, which, in ſome oriental tongues, ſignifies *bright* or *clear*, and *Tan*, which ſignifies a *country* or the *earth*, it may be ſafely concluded that *Titan* was the name of the ſun before the word was imported into Greece. But the great queſtion among antiquarians is, of what country was that race which, aſſuming to themſelves the names of the heavenly bodies, introduced into the world that ſpecies of idolatry which is known by the appellation of *Hero-worſhip*.

M. Pezron, in a work publiſhed many years ago, and entitled *The Antiquities of Nations*, maintains that the Titans were a family of Sacæ or Scythians, who made their firſt appearance beyond Media and Mount Imaus, in the upper regions of Aſia; that they were the deſcendants of Gomer the ſon of Japheth and grandſon of Noah; and that after conquering a great part of the world, upon entering Upper Phrygia, they quitted their ancient name of Gomerians or Cimmerians, and aſſumed that of Titans. All this, he ſays, happened before the birth of Abraham and the foundation of the Aſſyrian monarchy; and he makes Uranus, their ſecond prince in the order of ſucceſſion, to have conquered Thrace, Greece, the Iſland of Crete, and a great part of Europe. Uranus was ſucceeded by Saturn, and Saturn by Jupiter, who flouriſhed, he ſays, 300 years before Moſes, and divided his vaſt empire between himſelf, his brother Pluto, and his couſin-german Atlas, who was called *Telamon*. For the truth of this genealogy of the Titans M. Pezron appeals to the moſt approved Greek hiſtorians; but unluckily for his hypotheſis theſe writers have not a ſingle ſentence by which it can be fairly ſupported. It ſuppoſes not only the great antiquity of the Scythians, but likewiſe their early progreſs in arts and ſciences, contrary to what we have proved in other articles of this work. See SCULPTURE, n° 4 and 5. and SCYTHIA.

Others, taking the fragment of Sanchoniatho's Phenician hiſtory for their guide, have ſuppoſed the Titans to have been the deſcendants of Ham. Of this opinion was biſhop Cumberland; and our learned friend Dr Doig, to whom we have been indebted for great favours, indulged us with the peruſal of a manuſcript, in which, with erudition and ingenuity ſtruggling for the pre-eminence, he traces that impious family from the profane ſon of Noah, and ſhows by what means they ſpread the idolatrous worſhip of themſelves over the greater part of the ancient world. Cronus, of whoſe exploits ſome account has been given elſewhere (ſee SANCHONIATHO), he holds to be Ham; and tracing the progreſs of the family from Phœnicia to Cyprus, from Cyprus to Rhodes, thence to Crete, and from Crete to Samathrace, he finds reaſon to conclude that the branch called *Titans* or *Titanides* flouriſhed about the era of Abraham, with whom, or with his ſon Iſaac, he thinks the Cretan Jupiter muſt have been contemporary. As they proceeded from countries which were the original ſeat of civilization to others in which mankind had ſunk into the groſſeſt barbariſm, it was eaſy for them to perſuade the ignorant inhabitants that they derived the arts of civil life from their parent the ſun, and in conſequence of their relation to him to aſſume to themſelves divine honours. To aſk how they came to think of ſuch groſs impiety, is a queſtion as fooliſh as it would be to aſk how Ham their anceſtor became ſo wicked as to entail the curſe of God upon himſelf and his poſterity. The origin of evil is involved in difficulties; but leaving all inquiries into it to be proſecuted by the metaphyſician and moraliſt, it is ſurely more probable that the worſhip of dead men originated among the deſcendants of Ham than among thoſe of Shem and Japheth; and that the fragment of Sanchoniatho, when giving an account of the origin of the Titans, the undoubted authors of that worſhip, is more deſerving of credit than the fabulous and comparatively late writers of Greece and Rome.

TITHES, in eccleſiaſtical law, are defined to be the tenth-part of the increaſe, yearly ariſing and renewing from the profits of lands, the ſtock upon lands, and the perſonal induſtry of the inhabitants: the firſt ſpecies being uſually called *predial*, as of corn, graſs, hops, and wood; the ſecond *mixed*, as of wool, milk, pigs, &c. conſiſting of natural products, but nurtured and preſerved in part by the care of man; and of theſe the tenth muſt be paid in groſs; the third *perſonal*, as of manual occupations, trades, fiſheries, and the like; and of theſe only the tenth-part of the clear gains and profits is due.

We ſhall, in this article, conſider, 1. The original of the right of tithes. 2. In whom that right at preſent ſubſiſts. 3. Who may be diſcharged, either totally or in part, from paying them.

1. As to their original, we will not put the title of the clergy to tithes upon any divine right; though ſuch a right certainly commenced, and we believe as certainly ceaſed, with the Jewiſh theocracy. Yet an honourable and competent maintenance for the miniſters of the goſpel is undoubtedly *jure divino*, whatever the particular mode of that maintenance may be. For, beſides the poſitive precepts of the New Teſtament, natural reaſon will tell us, that an order of men who are ſeparated from the world, and excluded from other lucrative profeſſions for the ſake of the reſt of mankind, have a right to be furniſhed with the neceſſaries, conveniences, and moderate enjoyments of life, at their expence; for whoſe benefit they forego the uſual means of providing them. Accordingly all municipal laws have provided a liberal and decent maintenance for their national prieſts or clergy; ours, in particular, have eſtabliſhed this of tithes, probably in imitation of the Jewiſh law: and perhaps

Blackst. Comment.

haps, conſidering the degenerate ſtate of the world in general, it may be more beneficial to the Engliſh clergy to found their title on the law of the land, than upon any divine right whatſoever, unacknowledged and unſupported by temporal ſanctions.

We cannot preciſely aſcertain the time when tithes were firſt introduced into this country. Poſſibly they were contemporary with the planting of Chriſtianity among the Saxons by Auguſtin the monk, about the end of the ſixth century. But the firſt mention of them which we have met with in any written Engliſh law, is a conſtitutional decree, made in a ſynod held A. D. 786, wherein the payment of tithes in general is ſtrongly enjoined. This cannon or decree, which at firſt bound not the laity, was effectually confirmed by two kingdoms of the heptarchy, in their parliamentary conventions of eſtates, reſpectively conſiſting of the kings of Mercia and Northumberland, the biſhops, dukes, ſenators, and people. Which was a few years later than the time that Charlemagne eſtabliſhed the payment of them in France, and made that famous diviſion of them into four parts; one to maintain the edifice of the church, the ſecond to ſupport the poor, the third the biſhop, and the fourth the parochial clergy.

The next authentic mention of them is in the *fœdus Edwardi et Guthruni*; or the laws agreed upon between king Guthrun the Dane, and Alfred and his ſon Edward the Elder, ſucceſſive kings of England, about the year 900. This was a kind of treaty between thoſe monarchs, which may be found at large in the Anglo-Saxon laws: wherein it was neceſſary, as Guthrun was a pagan, to provide for the ſubſiſtence of the Chriſtian clergy under his dominion; and accordingly, we find the payment of tithes not only enjoined, but a penalty added upon non-obſervance: which law is ſeconded by the laws of Athelſtan, about the year 930. And this is as much as can certainly be traced out with regard to their legal original.

2. We are next to conſider the perſons to whom tithes are due. Upon their firſt introduction, though every man was obliged to pay tithes in general, yet he might give them to what prieſts he pleaſed; which were called *arbitrary conſecrations of tithes*; or he might pay them into the hands of the biſhop, who diſtributed among his dioceſian clergy the revenues of the church, which were then in common. But when dioceſes were divided into pariſhes, the tithes of each pariſh were allotted to its own particular miniſter; firſt by common conſent or the appointments of lords of manors, and afterwards by the written law of the land.

Arbitrary conſecrations of tithes took place again afterwards, and were in general uſe till the time of king John. This was probably owing to the intrigues of the regular clergy, or monks of the Benedictine and other orders, under archbiſhop Dunſtan and his ſucceſſors; who endeavoured to wean the people from paying their dues to the ſecular or parochial clergy (a much more valuable ſet of men than themſelves), and were then in hopes to have drawn, by ſanctimonious pretences to extraordinary purity of life, all eccleſiaſtical profits to the coffers of their own ſocieties. And this will naturally enough account for the number and riches of the monaſteries and religious houſes which were founded in thoſe days, and which were frequently endowed with tithes. For a layman, who was obliged to pay his tithes ſomewhere, might think it good policy to erect an abbey, and there pay them to his own monks, or grant them to ſome abbey already erected: ſince for this donation, which really coſt the patron little or nothing, he might, according to the ſuperſtition of the times, have maſſes for ever ſung for his ſoul. But in proceſs of years, the income of the poor laborious pariſh-prieſts being ſcandalouſly reduced by theſe arbitrary conſecrations of tithes, it was remedied by pope Innocent III. about the year 1200, in a decretal epiſtle ſent to the archbiſhip of Canterbury, and dated from the palace of Lateran: which has occaſioned Sir Henry Hobart and others to miſtake it for a decree of the council of Lateran, held A. D. 1179, which only prohibited what was called the *infeodation of tithes*, or their being granted to mere laymen; whereas this letter of pope Innocent to the archbiſhop enjoined the payment of tithes to the parſons of the reſpective pariſhes where every man inhabited, agreeable to what was afterwards directed by the ſame pope in other countries. This epiſtle, ſays Sir Edward Coke, bound not the lay ſubjects of this realm; but being reaſonable and juſt, it was allowed of, and ſo became *lex terræ*. This put an effectual ſtop to all the arbitrary conſecrations of tithes; except ſome footſteps which ſtill continue in thoſe portions of tithes which the parſon of one pariſh hath, though rarely, a right to claim in another: for it is now univerſally held, that tithes are due, of common right, to the parſon of the pariſh, unleſs there be a ſpecial exemption. This parſon of the pariſh may be either the actual incumbent, or elſe the appropriator of the benefice; appropriations being a method of endowing monaſteries, which ſeems to have been deviſed by the regular clergy, by way of ſubſtitution to arbitrary conſecrations of tithes.

3. We obſerved that tithes are due of common right to the parſon, unleſs by ſpecial exemption; let us therefore ſee, *thirdly*, who may be exempted from the payment of tithes, and how lands and their occupiers may be exempted or diſcharged from the payment of tithes, either in part or totally; firſt, by a real compoſition: or, ſecondly, by cuſtom or preſcription.

Firſt, a real compoſition is when an agreement is made between the owner of the lands and the parſon or vicar, with the conſent of the ordinary and the patron, that ſuch lands ſhall for the future be diſcharged from payment of tithes, by reaſon of ſome land or other real recompenſe given to the parſon in lieu and ſatisfaction thereof. This was permitted by law, becauſe it was ſuppoſed that the clergy would be no loſers by ſuch compoſition; ſince the conſent of the ordinary, whoſe duty it is to take care of the church in general, and of the patron, whoſe intereſt it is to protect that particular church, were both made neceſſary to render the compoſition effectual: and hence have ariſen all ſuch compoſitions as exiſt at this day by force of the common law. But experience ſhowing that even this caution was ineffectual, and the poſſeſſions of the church being by this and other means every day diminiſhed, the diſabling ſtatute 13 Eliz. c. 10. was made; which prevents, among other ſpiritual perſons, all parſons and vicars from making any conveyances of the eſtates of their churches, other than for three lives or 21 years. So that now, by virtue of this ſtatute, no real compoſition made ſince the 13 Eliz. is good for any longer term than three lives or 21 years, though made by conſent of the patron and ordinary: which has indeed effectually demoliſhed this kind of traffic; ſuch compoſitions being now rarely heard of, unleſs by authority of parliament.

Secondly, a diſcharge by cuſtom or preſcription, is where time out of mind ſuch perſons or ſuch lands have been either partially or totally diſcharged from the payment of tithes. And this immemorial uſage is binding upon all parties; as it is in its nature an evidence of univerſal conſent and acquieſcence, and with reaſon ſuppoſes a real compoſition to have been formerly made. This cuſtom or preſcription is either *de modo decimandi*, or *de non decimando*.

A *modus decimandi*, commonly called by the ſimple name of a *modus* only, is where there is by cuſtom a particular manner of tithing allowed, different from the general law of taking tithes in kind, which are the actual tenth-part of the annual increaſe. This is ſometimes a pecuniary compenſation, as twopence an acre for the tithe of land: ſometimes it is a compenſation in work and labour, as that the parſon ſhall have only the twelfth cock of hay, and not the tenth, in conſideration of the owner's making it for him: ſometimes, in lieu of a large quantity of crude or imperfect tithe, the parſon ſhall have a leſs quantity when arrived at greater maturity, as a couple of fowls in lieu of tithe-eggs, and the like. Any means, in ſhort, whereby the general law of tithing is altered, and a new method of taking them is introduced, is called a *modus decimandi*, or ſpecial manner of tithing.

A preſcription *de non decimando* is a claim to be entirely diſcharged of tithes, and to pay no compenſation in lieu of them. Thus the king by his prerogative is diſcharged from all tithes. So a vicar ſhall pay no tithes to the rector, nor the rector to the vicar, for *eccleſia decimas non ſolvit eccleſiæ*. But theſe perſonal privileges (not ariſing from or being annexed to the land) are perſonally confined to both the king and the clergy; for their tenant or leſſee ſhall pay tithes, though in their own occupation their lands are not generally tithable. And, generally ſpeaking, it is an eſtabliſhed rule, that in lay hands, *modus de non decimando non valet*. But ſpiritual perſons or corporations, as monaſteries, abbots, biſhops, and the like, were always capable of having their lands totally diſcharged of tithes by various ways: as, 1. By real compoſition. 2. By the pope's bull of exemption. 3. By unity of poſſeſſion; as when the rectory of a pariſh, and lands in the ſame pariſh, both belonged to a religious houſe, thoſe lands were diſcharged of tithes by this unity of poſſeſſion. 4. By preſcription; having never been liable to tithes, by being always in ſpiritual hands. 5. By virtue of their order; as the Knights Templars, Ciſtercians, and others, whoſe lands were privileged by the pope with a diſcharge of tithes. Though, upon the diſſolution of abbeys by Henry VIII. moſt of theſe exemptions from tithes would have fallen with them, and the lands become tithable again, had they not been ſupported and upheld by the ſtatute 31 Henry VIII. c. 13. which enacts, that all perſons who ſhould come to the poſſeſſion of the lands of any abbey then diſſolved, ſhould hold them free and diſcharged of tithes, in as large and ample a manner as the abbeys themſelves formerly held them. And from this original have ſprung all the lands which being in lay hands, do at preſent claim to be tithe-free: for if a man can ſhow his lands to have been ſuch abbey-lands, and alſo immemorially diſcharged of tithes by any of the means before-mentioned, this is now a good preſcription *de non decimando*. But he muſt ſhow both theſe requiſites: for abbey-lands, without a ſpecial ground of diſcharge, are not diſcharged of courſe; neither will any preſcription *de non decimando* avail in total diſcharge of tithes, unleſs it relates to ſuch abbey-lands.

It is univerſally acknowledged that the payment of tithes in kind is a great diſcouragement to agriculture. They are inconvenient and vexatious to the huſbandman, and operate as an impolitic tax upon induſtry. The clergyman, too, frequently finds them troubleſome and precarious; his expences in collecting are a conſiderable drawback from their value, and his juſt rights are with difficulty ſecured: he is too often obliged to ſubmit to impoſition, or is embroiled with his pariſhioners in diſputes and litigations, no leſs irkſome to his feelings than prejudicial to his intereſt, and tending to prevent thoſe good effects which his precepts ſhould produce. It is therefore of the utmoſt importance to parochial tranquillity, and even to religion, that ſome juſt and reaſonable ſtandard of compoſition could be fixed. Land has been propoſed, but in the preſent ſtate of the diviſion of property this is impoſſible: and as money is continually changing in its value, it would alſo be a very improper ſtandard, unleſs ſome plan could be formed by which the compoſition could be increaſed as the value of money diminiſhes. A plan of this kind has been publiſhed in the Tranſactions of the Society inſtituted at Bath, Vol. IV. which thoſe who are intereſted in this ſubject may conſult for farther information.

TITHING, (*Tithinga*, from the Sax. *Theothunge*, *i. e. Decuria*), a number or company of ten men, with their families, knit together in a kind of ſociety, and all bound to the king, for the peaceable behaviour of each other. Anciently no man was ſuffered to abide in England above forty days, unleſs he were enrolled in ſome tithing.—One of the principal inhabitants of the tithing was annually appointed to preſide over the reſt, being called the *tithing-man*, the head-borough, and in ſome countries the borſeholder, or borough's ealder, being ſuppoſed the diſcreeteſt man in the borough, town, or tithing. The diſtribution of England into tithings and hundreds is owing to king Alfred. See BORSEHOLDER.

TITIANO VECELLI, or TITIAN, the moſt univerſal genius for painting of all the Lombard ſchool, the beſt colouriſt of all the moderns, and the moſt eminent for hiſtories, portraits, and landſcapes, was borne at Cadore, in the province of Friuli, in the ſtate of Venice, in 1477, or in 1480 according to Vaſari and Sandrart. His parents ſent him at ten years of age to one of his uncles at Venice, who finding that he had an inclination to painting, put him to the ſchool of Giovanni Bellino.

Pilkington's Dictionary of Painters.

But as ſoon as Titian had ſeen the works of Giorgione, whoſe manner appeared to him abundantly more elegant, and leſs conſtrained than that of Bellino, he determined to quit the ſtyle to which he had ſo long been accuſtomed, and to purſue the other that recommended itſelf to him, by having more force, more relief, more nature, and more truth. Some authors affirm, that he placed himſelf as a diſciple with Giorgione; yet others only ſay, that he cultivated an intimacy with him; but it is undoubtedly certain that he ſtudied with that great maſter: that he learned his method of blending and uniting the colours; and practiſed his manner ſo effectually, that ſeveral of the paintings of Titian were taken for the performances of Giorgione; and then his ſucceſs inſpired that artiſt with an invincible jealouſy of Titian, which broke off their connection for ever after.

The reputation of Titian roſe continually; every new work contributed to extend his fame through all Europe; and he was conſidered as the principal ornament of the age in which he flouriſhed. And yet, Sandrart obſerves, that amidſt all his applauſe, and conſtant employment at Venice, his income and fortune were inconſiderable; and he was more remarkable for the extenſiveneſs of his talents, than for the affluence of his circumſtances. But when his merit was made known to the emperor Charles V. that monarch knew how to ſet a juſt value on his ſuperior abilities; he enriched him by repeated bounties, allowed him a conſiderable penſion, conferred on him the honour of knighthood, and what was ſtill more, honoured him with his friendſhip. He painted the portrait of that benefactor ſeveral times; and it is recorded by Sandrart, that one day, while the emperor was ſitting for his picture, a pencil happening to drop from the painter, he ſtooped, took it up, and returned it; obligingly anſwering to the modeſt apology of the artiſt (who bluſhed at the condeſcenſion of ſo great a monarch), that the merit of a Titian was worthy of the attendance of an emperor.

The excellence of Titian was not ſo remarkably apparent in the hiſtorical compoſitions which he painted as in his portraits and landſcapes, which ſeem to be ſuperior to all competition; and even to this day, many of them preſerve their original beauty, being as much the admiration of the preſent age as they have deſervedly been of the ages paſt. —It is obſerved of Titian by moſt writers, that in the different periods of his life he had four different manners; one reſembling his firſt inſtructor Bellino, which was ſomewhat ſtiff; another, in imitation of Giorgione, more bold, and full of force; his third manner was the reſult of experience, knowledge, and judgment, beautifully natural, and finiſhed with exquiſite care, which manner was peculiarly his own; and in thoſe pictures which he painted between the years of approaching old age and his death may be noticed his fourth manner. His portraits were very differently finiſhed in his early, and in his latter time, according to the teſtimony of Sandrart. At firſt he laboured his pictures highly, and gave them a poliſhed beauty and luſtre, ſo as to produce their effect full as well when they were examined cloſely as when viewed at a diſtance; but afterwards, he ſo managed his penciling, that their greateſt force and beauty appeared at a more remote view, and they pleaſed leſs when they were beheld more nearly. So that many of thoſe artiſts who ſtudied to imitate him, being miſled by appearances which they did not ſufficiently conſider, have imagined that Titian executed his work with readineſs and a maſterly rapidity; and concluded that they ſhould imitate his manner moſt effectually by a freedom of hand and a bold pencil: Whereas in reality, Titian took abundance of pains to work up his pictures to ſo high a degree of perfection; and the freedom that appears in the handling was entirely effected by a ſkilful combination of labour and judgment.

It cannot be truly affirmed, that Titian equalled the great maſters of the Roman ſchool in deſign; but he always took care to diſpoſe his figures in ſuch attitudes as ſhowed the moſt beautiful parts of the body. His taſte in deſigning men was not generally ſo correct or elegant as it appeared in his boys and female figures; but his colouring had all the look of real fleſh, his figures breathe. He was not ſo bold as Giorgione, but in tenderneſs and delicacy he proved himſelf much ſuperior to him and all other artiſts. The expreſſion of the paſſions was not his excellence, though even in that reſpect many of his figures merited the juſteſt commendation; but he always gave his figures an air of eaſe and dignity. His landſcapes are univerſally allowed to be unequalled, whether we conſider the forms of his trees, the grand ideas of nature which appear in his ſcenery, or his diſtances which agreeably delude and delight the eye of every obſerver; and they are executed with a light, tender, and mellow pencil. He learned from nature the harmony of colours, and his tints ſeem aſtoniſhing, not only for their force, but their ſweetneſs; and in that reſpect his colouring is accounted the ſtandard of excellence to all profeſſors of the art.

It would prove almoſt an endleſs taſk to enumerate the variety of works executed by this illuſtrious artiſt, at Rome, Venice, Bologna, and Florence, as well as thoſe which are to be ſeen in other cities of Italy, in England, Spain, Germany, and France; but there are two, which are mentioned as being truly admirable. One is, a Laſt Supper, preſerved in the Refectory at the Eſcurial in Spain, which is inimitably fine; the other is at Milan, repreſenting Chriſt crowned with Thorns. The principal figure in the latter has an attitude full of grace and dignity more than mortal, and the countenance ſhows a benevolence and humility, combined with dignity and pain, which no pencil but that of Titian could ſo feelingly have deſcribed. It is admirably coloured, and tenderly and delicately penciled; the heads are wonderfully beautiful, the compoſition excellent, and the whole has a charming effect by the chiaro-ſcuro.

He was of ſo happy a conſtitution, that he was never ill till the year 1576, when he died of the plague, at 99 years of age. His diſciples were Paulo Veroneſe, Giacomo Tintoret, Giacomo de Porte Baſſano, and his ſons.

TITLARK, in ornithology. See Alauda.

TITLE, an appellation of dignity or rank given to princes and perſons of diſtinction.

Titles were not ſo common among the ancient Greeks or Romans as they are in modern times. Till the reign of Conſtantine the title of *Illuſtrious* was never given except to thoſe who were diſtinguiſhed in arms or letters: But at length it became hereditary in the families of princes, and every ſon of a prince was illuſtrious. The title of *Highneſs* was formerly given only to kings. The kings of England before the reign of Henry VIII. were addreſſed by the title of *your Grace*. That monarch firſt aſſumed the title of *Highneſs*, and afterwards that of *Majeſty*. The title of majeſty was firſt given him by Francis I. in their interview in 1520. Charles V. was the firſt king of Spain who aſſumed the ſame title.

Princes, nobles, and clergy generally have one title derived from their territories and eſtates, and another derived from their rank or from ſome other remarkable circumſtance. The Pope is called the *Biſhop of Rome*, and has the title of *Holineſs*. A cardinal has his name generally from ſome church, and is ſaluted by the name of *Eminent* or *moſt Eminent*. An archbiſhop, beſides being named from his dioceſe, is called *his Grace* and *moſt Reverend:* a biſhop is alſo diſtinguiſhed by the name of his dioceſe, and has the title of *his Lordſhip* and *right Reverend*. Inferior clergymen are denominated *Reverend*.

The titles of crowned heads derived from their dominions it is unneceſſary to mention. It will be ſufficient to mention thoſe by which they are addreſſed. To an emperor is given the title of *Imperial Majeſty;* to kings, that of *Majeſty;* to the princes of Great Britain, *Royal Highneſs;* to thoſe of Spain, *Infant;* to electors, *Electoral Highneſs;* to the grand duke of Tuſcany, *Moſt Serene Highneſs;* to the other princes of Italy and Germany, *Highneſs;* to the Doge of Venice, *Moſt Serene Prince;* to the grand-maſter of Malta, *Eminence;* to nuncios and ambaſſadors of crowned heads, *Excellency;* to dukes, *Grace;* to marquiſſes, earls, and barons, *Lordſhip*.

The emperor of China, among his titles, takes that of *Tian Su*, "Son of Heaven." The Orientals, it is obſerved, are exceedingly fond of titles: the ſimple governor of Schiras, for inſtance, after a pompous enumeration of qualities, lordſhips, &c. adds the titles of *Flower of Courteſy*, *Nutmeg of Conſolation*, and *Roſe of Delight*.

Title, in law, denotes any right which a perſon has to the poſſeſſion of a thing, or an authentic inſtrument whereby he can prove his right. See the articles Right, Property, &c.

Title to the Crown in the Britiſh Conſtitution. See Succession.

TITMOUSE, in ornithology. See Parus.

TITULAR, denotes a perſon inveſted with a title, in virtue of which he holds an office or benefice, whether he perform the functions thereof or not.

TITUS Vespasianus, the Roman Emperor, the ſon of Veſpaſian; of whom it is related, that not being able to recollect

collect any remarkable good action he had done on a certain day, he exclaimed, "I have loſt a day!" He might truly be called the *father of his people;* and though Rome laboured under various public calamities during his reign, ſuch was his equitable and mild adminiſtration, that he conſtantly preſerved his popularity. He was a great lover of learning, and compoſed ſeveral poems. He reigned but two years; and it is thought Domitian his brother poiſoned him, A. D. 81, aged 41. See (*Hiſtory of*) ROME.

TIVIOT HILLS. See CHEVIOT.

TIVOLI, the modern name of TIBUR.

TOAD, in zoology. See RANA.

TOAD-Fiſh. See LOPHIUS.

TOAD-Flax, in botany. See ANTIRRHINUM.

TOAD-Stone, a genus of argillaceous earths examined by Dr Withering. He deſcribes it as of a dark-browniſh grey colour; its texture granular; neither efferveſcing with acids nor ſtriking fire with ſteel. The cavities of it are filled with cryſtallized ſpar, and in a ſtrong heat it is fuſible *per ſe*. An hundred parts of toad-ſtone contain from 56 to 63.5 of ſiliceous earth, near 15 of argillaceous earth, 7.5 of calcareous earth, and 16 of oxydated iron. Dr Kirwan obſerves, that the toad-ſtone is not much different from baſaltes, only that it is ſofter: it contains alſo a ſmaller proportion of iron, and a larger one of ſiliceous earth.

Philoſophical Tranſactions for 1782.

TOBACCO, in botany. See NICOTIANA and SNUFF.

The Indians (ſay Dr Leake) poiſon their arrows with the oil of tobacco, which, infuſed into a freſh wound, occaſions ſickneſs and vomiting, or convulſions and death; with what ſafety therefore, ſetting aſide propriety, the ſubtile powder of this plant, called *ſnuff*, may be applied to the tender, internal ſurface of the noſe, it may be proper to inquire; for, if the oil of tobacco is a mortal poiſon when applied to the open veſſels of a wound, ſurely this plant, when taken in ſubſtance as ſnuff, muſt in a certain degree be injurious. From the infinite number of nerves diffuſed over the mucous membrane of the noſe, it is endowed with exquiſite feeling; and, the better to preſerve the ſenſe of ſmelling, thoſe nerves are continually lubricated with moiſture.

Leake's Practical Eſſay on the Diſeaſes of the Viſcera.

By the almoſt cauſtic acrimony of ſnuff, this moiſture is dried up, and thoſe fine, delicate nerves, the organs of ſmelling, are rendered callous and inſenſible. To this ſelf-evident bad effect may be added the *narcotic* or ſtupifying power of tobacco, by which not only the brain and nerves are injured, but alſo the eyes depending upon their influence, together with the ſenſe of ſmelling; and, from the force with which ſnuff is uſually drawn up the noſe, its paſſage will be obſtructed, and the voice loſe its clearneſs and diſtinct articulation.

Beſides thoſe pernicious qualities, ſnuff often involuntarily deſcends into the ſtomach, creating nauſea, loſs of appetite, and vomiting; and by its narcotic power will diminiſh nervous influence and impair digeſtion; it diſcolours the ſkin contiguous to the noſe, and will taint the ſweeteſt breath with the rank odour of a tobacco-caſk. For this reaſon the ladies of faſhion in France ſeldom take ſnuff till they are married; a very high compliment, no doubt, to their huſbands. The only advantage of taking ſnuff is that of ſneezing, which, in ſluggiſh, phlegmatic habits, will give univerſal concuſſion to the body, and promote a more free circulation of the blood; but of this benefit, ſnuff-takers are deprived, from being familiar with its uſe.

We have been told, that tobacco, when chewed, is a preſervative againſt hunger: but this is a vulgar error; for, in reality, it may more properly be ſaid to deſtroy appetite by the profuſe diſcharge of ſaliva, which has already been conſidered as a powerful, diſſolving fluid, eſſential both to appetite and digeſtion. In ſmoking, the fumes of tobacco induce a kind of pleaſing inſenſibility not eaſily deſcribed. Its narcotic odour, thus adminiſtered, equally infatuates the ignorant ſavage and the intelligent philoſopher; but, by the large expence of ſaliva thereby occaſioned, it is productive of many diſorders of the head and ſtomach, particularly the laſt.

TOBACCO-Pipe-Fiſh. See FISTULARIA.

TOBACCO-wine. See PHARMACY-*Index*.

TOBAGO, one of the Caribbee iſlands, ceded to Great Britain by the treaty of Paris in 1763, taken by the French in 1781, and retaken by the Britiſh in 1793. It lies in the latitude of 11 degrees 10 minutes north, and 59 degrees 40 minutes longitude weſt from London, about 40 leagues ſouth-by-weſt from Barbadoes, 35 ſouth-eaſt from St Vincents, 20 ſouth-eaſt from Grenada, 12 north-eaſt from the Spaniſh iſland of Trinidada, and between 30 and 40 north-eaſt from the Spaniſh main. According to the lateſt accounts, it is ſomewhat more than 30 miles in length from north-eaſt to ſouth-weſt, between 8 and 9 in breadth, and from 23 to 25 leagues in circumference. The Engliſh viſited this iſland very early, Sir Robert Dudly being there in the reign of queen Elizabeth. In that of Charles I. William earl of Pembroke procured a grant of this, with two other ſmall iſlands; but died before he was able to carry into execution his deſign of ſettling them. In A. D. 1632 ſome merchants of Zealand ſent over a ſmall colony thither, and gave it the name of *New Walcheren;* but before they were able thoroughly to eſtabliſh themſelves, they were deſtroyed by the Indians aſſiſted by the Spaniards. Ten years after, James Duke of Courland ſent a colony thither, who ſettled themſelves upon Great Courland bay, and made a conſiderable progreſs in planting. A. D. 1654, Meſſieurs Adrian and Cornelius Lampſius, two opulent merchants of Fluſhing, ſent a conſiderable number of people thither, who ſettled on the other ſide of the iſland, and lived in amity with the Courlanders, until they learned that the king of Sweden had ſeized the perſon of their duke and diſpoſſeſſed him of his dominions, when they attacked and forced his ſubjects to ſubmit. The duke being afterwards reſtored, he obtained from Charles II. a grant of this iſland, dated the 17th of November 1664. In the ſecond Dutch war the count d'Eſtrees, by order of his maſter, totally ruined it at the cloſe of the year 1677; and from that time it continued waſte till Britain took poſſeſſion of it after the treaty of Paris. The climate, notwithſtanding its vicinity to the line, is ſo tempered by the breezes from the ſea, as to be very ſupportable even to Europeans; and hath the ſame advantages with that of Grenada, in having regular ſeaſons, and alſo in being exempt from the hurricanes. There are throughout the iſland many riſing grounds, though, except at the north-eaſt extremity, there is no part of it that can be ſtiled mountainous; and even there the country is far from being rugged or impaſſable. The ſoil, if we may credit either Dutch or French writers, is as fertile and luxuriant as any of the iſlands, and very finely diverſified. Ground proviſions of all ſorts have been raiſed in great plenty, a vaſt variety of vegetables, excellent in their kind, ſome for food, ſome for phyſic. Almoſt every ſpecies of uſeful timber is to be found here, and ſome of an enormous ſize; amongſt others, the true cinnamon and nutmeg tree, as the Dutch confeſs, and of which none could be better judges; whole groves of ſaſſafras, and of trees that bear the true gum copal, with other odoriferous plants that render the air wholeſome and pleaſant. It is as well watered as can be wiſhed, by rivers that fall into the ſea on both ſides, many ſmaller ſtreams, and fine freſh ſprings in almoſt every part of the iſland. The ſea-coaſt is indented by 10 or 12 fair and ſpacious bays, and there are amongſt theſe one or two ports capable of receiving as large ſhips as ever viſited thoſe ſeas. There are wild hogs in great plenty, abundance of fowls of different kinds, a vaſt variety of ſea and river fiſh. At the north eaſt extremity lies Little Tobago, which is two miles long, and about half a mile broad, very capable of improvement.

TOBOLSKI, the capital of Siberia, is ſituated at the confluence of the rivers Tobol and Irtiſh, in N. Lat. 58° 12′ E. Long. 68° 18′. The city ſtands upon the aſcent of a high hill, the lower part of which is inhabited by Mahometan Tartars, who carry on a conſiderable traffic upon the river Irtiſh, and convey their merchandiſe quite acroſs Great Tartary as far as China. The river Irtiſh is reckoned as rapid as the Danube; runs from the ſouth, and empties itſelf into the Oby: the Tobol waſhes the other ſide of the town, and a little below it falls into the Irtiſh. By means of theſe two rivers, there is a conſtant flow of merchandiſe into the city during the ſummer ſeaſon. Tobolſki is therefore a great mart for the commodities of Muſcovy, Tartary and other countries: and here is a great concourſe of merchants. All ſorts of proviſions are plentiful and cheap. An hundred weight of rice is ſold for 16 copecs, equal to about eight pence Sterling; a ſturgeon weighing 40 pounds, for half that money; an ox for two rix-dollars, and every other article in proportion: the adjacent country abounds with game in great variety. The ſupreme court of judicature for all Siberia is held in this city, which is alſo the ſeat of a metropolitan, ſent hither from Moſcow to exerciſe ſpiritual juriſdiction over the whole kingdom. Tobolſki is well fortified, and defended by a ſtrong garriſon, under the command of the waiwode, who reſides in the place, and takes charge of the fur tribute, which is here depoſited in proper magazines. This governor enjoys a very extenſive command, and can occaſionally bring into the field 9000 men, beſides a ſtrong body of Tartars on horſeback, to make head againſt the Kalmucks and Coſſacks, in their repeated incurſions. A ſufficient number of Ruſſians, called *Jemſkoiks*, are kept in continual pay by the government, on the banks of the Irtiſh, to ſupply travellers on the czar's account with men, boats, or carriages, to convey them as far as Surgut on the Oby, a voyage of 200 leagues by water. This is the common method of travelling in the ſummer; but in winter the journey by land is not half ſo long, being performed in ſleds over the ice and ſnow, with which the country is covered. Theſe ſleds are moved by a pair of dogs, which will draw a load of 300 pounds with ſurpriſing expedition. They are hired at eaſy rates, and during one half of the year may be ſeen flying over the ſnow in great numbers. The city is ſuppoſed to contain 15,000 inhabitants. It is 800 miles eaſt from Moſcow, and 1000 from Peterſburgh.

TODDA PANNA. See CYCAS.

TODDY, a name given to the juice of the cocoa nut tree. See ARAK.—Toddy is alſo a name given to a mixture of ſpirits, water, and ſugar.

Toddy-Bird. See LOXIA, ſpecies 11.

TODUS, the TODY, in ornithology; a genus belonging to the order of *picæ*. The beak is ſlender, depreſſed, broad, and the baſe beſet with briſtles. The noſtrils are ſmall and oval. The toes are placed three before and one behind; the middle are greatly connected to the outer. There are 15 ſpecies according to Dr Latham.

"Birds of this genus (ſays that eminent ornithologiſt) inhabit the warmer parts of America. They vary conſiderably in their bills as to breadth, but all of them have a certain flatneſs, or depreſſion, which is peculiar. They have great affinity to the flycatchers; and indeed, to ſpeak the truth, the two genera run much into one another: however, in one thing they differ materially; for in the tody the outer and middle toes are much connected, whereas in the flycatcher genus they are divided to their origin."

TOGA, in Roman antiquity, a wide woollen gown or mantle, which ſeems to have been of a ſemicircular form, without ſleeves; differing both in richneſs and largeneſs, according to the circumſtances of the wearer, and uſed only upon occaſion of appearing in public.

Every body knows that the toga was the diſtinguiſhed mark of a Roman: hence, the *jus togæ*, or privilege of a Roman citizen; *i. e.* the right of wearing a Roman habit, and of taking, as they explain it, fire and water through the Roman empire.

TOKAY-Wine, derives its name from a town of Hungary, where it is produced. There are four ſorts of wine made from the ſame grapes, diſtinguiſhed at Tokay by the names of *eſſence*, *auſpruch*, *maſslach*, and the *common wine*. The eſſence is made by picking out the half-dried and ſhrivelled grapes, and putting them into a perforated veſſel, where they remain as long as any juice runs off by the mere preſſure of their own weight. This is put into ſmall caſks. The auſpruch is made by pouring the expreſſed juice of the grapes from which the former had been picked on thoſe that yielded the eſſence, and treading them with the feet. The liquor thus obtained ſtands for a day or two to ferment, and then is poured into ſmall caſks, which are kept in the air for about a month, and afterwards put into caſks. The ſame proceſs is again repeated by the addition of more juice to the grapes which have already undergone the two former preſſures, and they are now wrung with the hands; and thus is had the maſslach. The fourth kind is made by taking all the grapes together at firſt, and ſubmitting them to the greateſt preſſure: this is chiefly prepared by the peaſants. The eſſence is thick, and very ſweet and luſcious: it is chiefly uſed to mix with the other kinds. The auſpruch is the wine commonly exported, and which is known in foreign countries by the name of *Tokay*.

The goodneſs of it is determined by the following rules. The colour ſhould neither be reddiſh nor very pale, but a light ſilver: in trying it, the palate and tip of the tongue ſhould be wetted without ſwallowing it, and if it manifeſt any acrimony to the tongue, it is not good; but the taſte ought to be ſoft and mild: when poured out, it ſhould form globules in the glaſs, and have an oily appearance: when genuine, the ſtrongeſt is always of the beſt quality: when ſwallowed, it ſhould have an earthy aſtringent taſte in the mouth, which is called the taſte of the root. All tokay wine has an aromatic taſte, which diſtinguiſhes it from every other ſpecies of wine. It keeps to any age, and improves by time: but is never good till about three years old. It is the beſt way to tranſport it in caſks; for when it is on the ſeas, it ferments three times every ſeaſon, and thus refines itſelf. When in bottles, there muſt be an empty ſpace left between the wine and the cork, otherwiſe it would burſt the bottle. A little oil is put upon the ſurface, and a piece of bladder tied over the cork. The bottles are always laid on their ſides in ſand. *Philoſophical tranſactions.* vol. lxiii. part ii. p. 292, &c.

TOKENS. See *TRADESMENS-Tokens*.

TOISE, a French meaſure containing ſix of their feet, or a fathom.

TOLAND (John), a very famous writer, was born near Londonderry in Ireland, 1670, and educated in the Popiſh religion; but at 16 years of age embraced the principles of the Proteſtants. He ſtudied three years at the univerſity of Glaſgow; was created maſter of arts in the univerſity of Edinburgh; and afterwards completed his ſtudies at Leyden, where he reſided two years. He then went to Oxford, Toledo.

where, having the advantage of the public library, he collected materials upon various ſubjects, and compoſed ſome pieces; among which was, A Diſſertation to prove the received hiſtory of the tragical death of Atilius Regulus, the Roman conſul, to be a fable. He began likewiſe a work of greater conſequence, in which he undertook to ſhow that there are no myſteries in the Chriſtian religion. He publiſhed it in 1696 at London, under the title of *Chriſtianity not myſterious*. This book gave great offence, and was attacked by ſeveral writers. He afterward wrote in favour of the Hanoverian ſucceſſion, and many other pieces. In 1707 he went into Germany, where he viſited ſeveral courts; and in 1710 he was introduced to Prince Eugene, who gave him ſeveral marks of his generoſity. Upon his return to England he was for ſome time ſupported by the liberality of the earl of Oxford lord-treaſurer, and kept a country-houſe at Epſom; but ſoon loſing his lordſhip's favour, he publiſhed ſeveral pamphlets againſt that miniſter's meaſures. In the four laſt years of his life he lived at Putney, but uſed to ſpend moſt part of the winter in London. Mr. Toland died at London in 1722. He was a man of uncommon abilities, publiſhed a number of curious tracts, and was perhaps the moſt learned of all the infidel writers; but his private character was far from being an amiable one; for he was extremely vain, and wanted thoſe ſocial virtues which are the chief ornaments as well as duties of life. His poſthumous works, two volumes octavo, were publiſhed in 1726, with an account of his life and writings, by Mr Des Maizeaux.

TOLEDO, an ancient and trading city of Spain in New Caſtile, of which it was formerly the capital. About two centuries ago it is ſaid to have contained more than 200,000 inhabitants; but they are now diminiſhed to 20,000. or at moſt to 30,000. It is advantageouſly ſeated on the river Tajo, which ſurrounded it on two ſides; and on the land-ſide it has an ancient wall built by a Gothic king, and flanked with 100 towers. It is ſeated on a mountain, which renders the ſtreets uneven, and which are narrow; but the houſes are fine, and there are a great number of ſuperb ſtructures, beſides 17 public ſquares, where the markets are kept. The fineſt buildings are the royal caſtle and the cathedral church; which laſt is the richeſt and moſt conſiderable in Spain. It is ſeated in the middle of the city, joining to a handſome ſtreet, with a fine ſquare before it. Several of the gates are very large, and of bronze. There is alſo a ſuperb ſteeple extremely high, from whence there is a very diſtant proſpect. The Sagrariro, or principal chapel, is a real treaſury, in which are 15 large cabinets let into the wall, full of prodigious quantities of gold and ſilver veſſels, and other works. There are two mitres of ſilver gilt, ſet all over with pearls and precious ſtones, with three collars of maſſy gold, enriched in like manner. There are two bracelets and an imperial crown of the Virgin Mary, conſiſting of large diamonds and other jewels. The weight of the gold in the crown is 15 pounds. The veſſel which contains the conſecrated wafer is of ſilver gilt, as high as a man, and ſo heavy, that it requires 30 men to carry it; within it is another of pure gold enriched with jewels. Here are 38 religious houſes, moſt of which are worthy a traveller's notice, with many other ſacred buildings, a great number of churches belonging to 27 pariſhes, and ſome hoſpitals. Without the town are the remains of an amphitheatre, and other antiquities.

Bourgoanne's Travels Spain, vol. ii.

Toledo is an archbiſhop's ſee, and the ſeat of the primate of Spain. His revenue is ſaid to be worth 400,000 ducats, but there are large deductions to be made from it. It pays 15,000 ducats to the monks of the Eſcurial, beſides ſeveral other penſions. Toledo has alſo a univerſity. It was formerly celebrated for the exquiſite temper of the ſword blades made there. It is ſituated in eaſt longitude 3. 15. in north latitude 39. 50. and is 37 miles ſouth from Madrid.

Swinburn's Travels in Spain.

Toleration.

TOLERATION, in matters of religion, is either civil or eccleſiaſtical. Civil toleration is an impunity and ſafety granted by the ſtate to every ſect that does not maintain doctrines inconſiſtent with the public peace: and eccleſiaſtical toleration is the allowance which the church grants to its members to differ in certain opinions, not reputed fundamental.

As the gods of Paganiſm were almoſt all local and tutelary, and as it was a maxim univerſally received that it was the duty of every man to worſhip, together with his own deities, the tutelary gods of the country in which he might chance to reſide, there was no room for perſecution in the Heathen world, on account of different ſentiments in religion, or of the different rites with which the various deities were worſhipped. Had the primitive Chriſtians joined their fellow-citizens in the worſhip of Jupiter, Juno, and the reſt of the rabble of Roman divinities, they would have been ſuffered to worſhip, without moleſtation, the Creator of the world and the Redeemer of mankind; for in that caſe the God of the Chriſtians would have been looked upon as a Being of the ſame kind with the gods of the empire; and the great principle of intercommunity would have remained unviolated. But the true God had expreſsly prohibited both Jews and Chriſtians from worſhipping any other God beſides Himſelf; and it was their refuſal to break that precept of their religion which made their Heathen maſters look upon them as Atheiſts, and perſecute them as a people inimical to the ſtate. Utility, and not truth, was the object for which the Heathen legiſlatures ſupported the national religion. They well knew that the ſtories told by their poets of their different divinities, of the rewards of Elyſium, and of the puniſhments of Tartarus, were a collection of ſenſeleſs fables; but they had nothing better to propoſe to the vulgar, and they were not ſuch ſtrangers to the human heart, as to ſuppoſe that mankind could live together in ſociety without being influenced in their conduct by ſome religion.

Widely different from the genius of Paganiſm was the ſpirit of the Jewiſh diſpenſation. Truth, which is in fact always coincident with general utility, was the great object of the Moſaic law. The children of Iſrael were ſeparated from the reſt of the world, to preſerve the knowledge, and worſhip of the true God, at a time when all the other nations on earth, forgetting the Lord that made them, were falling proſtrate to ſtocks and ſtones, and worſhipping devils and impure ſpirits. Such was the contagion of idolatry, and ſo ſtrong the propenſity of the Iſraelites to the cuſtoms and manners of the Egyptians, and other polytheiſtic nations around them, that the purpoſe of their ſeparation could not have been ſerved, had not Jehovah condeſcended to become not only their tutelary God, but even their ſupreme civil Magiſtrate (ſee THEOLOGY, n° 151.); ſo that under the Moſaic economy, idolatry was the crime of high treaſon, and as ſuch juſtly puniſhed by the laws of the ſtate. Among the Jews, the church and ſtate were not indeed different ſocieties. They were ſo thoroughly incorporated, that what was a ſin in the one was a crime in the other; and the forfeiture of eccleſiaſtical privileges was the forfeiture of the rights of citizens.

In many reſpects the Chriſtian religion is directly oppoſite to the ritual law of Moſes. It is calculated for all nations, and intended to be propagated among all. Inſtead of ſeparating one people from another, one of its principal objects is to diſſeminate univerſal benevolence, and to inculcate upon the whole human race, that mutual love which naturally ſprings from the knowledge that all men are brethren. Its ultimate end being to train its votaries for heaven, it concerns itſelf no farther with the affairs of earth than to enforce by eternal ſanctions the laws of morality; and the kingdom of its Founder not being of this world, it leaves every nation at liberty to fabricate its own municipal laws, ſo as beſt to ſerve its own intereſt in the various circumſtances in which it may be placed; and denounces a curſe upon all who pay not to thoſe laws the fulleſt obedience, when they were not obviouſly inconſiſtent with the laws of piety and virtue, which are of prior obligation. The Chriſtian church therefore muſt always remain a diſtinct ſociety from the ſtate; and tho', till the preſent age of hazardous innovations, it has been deemed expedient in every country, where the truth of the goſpel is admitted, to give to the religion of Chriſt a legal eſtabliſhment, and to confer immunities on its miniſters, this meaſure has been adopted, not to ſecure the purity of the faith which appeals to the private judgment of each individual, but merely to preſerve the peace of ſociety, and to put a reſtraint upon thoſe actions of which human laws cannot take cognizance. With religion, Chriſtian governments have no farther concern than as it tends to promote the practice of virtue. The early Chriſtians, however, not underſtanding the principle upon which penal laws were employed to preſerve the purity of the Jewiſh religion; and, as our bleſſed Lord obſerved to two of his apoſtles, not knowing what ſpirit they were of—haſtily concluded that they had a right to enforce the doctrines and worſhip of the New Teſtament, by the ſame means which had been uſed to preſerve the Iſraelites ſteady to the doctrines and worſhip of the Old. Hence, though they had ſuffered the cruelleſt perſecutions themſelves (ſee PERSECUTION), they no ſooner got the power of the ſtate in their hands, than they perſecuted the Pagans for their idolatry; and afterwards, when hereſies aroſe in the church, perſecuted one another for expreſſing in different phraſes metaphyſical propoſitions, of ſuch a nature as no human mind can fully comprehend. The apoſtle had forewarned them that there muſt be hereſies in the church, that they who are approved may be made manifeſt; but it did not occur to them that perſecution for opinion is the worſt of all hereſies, as it violates at once truth and charity.

Hitherto theſe unhallowed means of bringing Chriſtians to uniformity of faith and practice, had been only occaſionally employed from their not accurately diſtinguiſhing between the ſpirit of the goſpel and that of the law; but as ſoon as the biſhops of Rome had brought the inhabitants of Europe to recognize their infallibility in explaining articles of faith, and deciding points of controverſy, perſecution became a regular and permanent inſtrument of eccleſiaſtical diſcipline. To doubt or to deny any doctrine to which theſe unerring inſtructors had given the ſanction of their approbation, was held to be not only a reſiſting of the truth, but an act of rebellion againſt their ſacred authority; and the ſecular power, of which, by various arts, they had acquired the abſolute direction, was inſtantly employed to avenge both.

Robertſon's Hiſtory of Charles V.

"Thus Europe had been accuſtomed, during many centuries, to ſee ſpeculative opinions propagated or defended by force, the charity and mutual forbearance which Chriſtianity recommends with ſo much warmth, were forgotten, the ſacred rights of conſcience and of private judgment were unheard of; and not only the idea of toleration, but even the word itſelf, in the ſenſe now affixed to it, was unknown. A right to extirpate error by force, was univerſally allowed to be the prerogative of thoſe who poſſeſſed the knowledge of truth;" and though the firſt reformers did not arrogate to themſelves in direct terms that infallibility which they had refuſed to the church of Rome, they were not leſs confident of the truth of their own doctrines, and required with equal ardour the princes of their party to check ſuch as preſumed to impugn or to oppoſe them. To this requeſt too many of theſe princes lent a willing ear. It flattered at once their piety and their pride to be conſidered as poſſeſſing all the rights of Jewiſh princes; and Henry the VIII. of England, after labouring to make his divines declare that all authority eccleſiaſtical as well as civil flows from the crown, perſecuted alternately the Papiſts and Proteſtants. Many of his ſucceſſors, whoſe characters were much better than his, thought themſelves duly authorized, in virtue of their acknowledged ſupremacy over all ſtates and conditions of men, to enforce by means of penal laws a uniformity of faith and worſhip among their ſubjects; and it was not till the revolution that any ſect in England ſeems to have fully underſtood, that all men have an unalienable right to worſhip God in the manner which to them may ſeem moſt ſuitable to his nature, and the relation in which they ſtand to him; or that it is impoſſible to produce uniformity of opinion by any other means than candid diſquiſition and ſound reaſoning. That the civil magiſtrate has a right to check the propagation of opinions which tend only to ſap the foundations of virtue, and to diſturb the peace of ſociety, cannot, we think, be queſtioned; but that he has no right to reſtrain mankind from publicly profeſſing any ſyſtem of faith, which comprehends the being and providence of God, the great laws of morality, and a future ſtate of rewards and puniſhments, is as evident as that it is the object of religion to fit mankind for heaven, and the whole duty of the magiſtrates to maintain peace, liberty, and property, upon earth. We have elſewhere obſerved (ſee TEST), that among a number of different ſects of Chriſtians, it is not the ſuperior purity of the ſyſtem of faith profeſſed by one of them, that gives it a right to the immunities of an eſtabliſhment in preference to all its rivals; but tho' the legiſlature is authorized, in certain circumſtances, to make a leſs pure ſyſtem the religion of the ſtate, it would be the height of abſurdity to ſuppoſe that any man, or body of men, can have authority to prevent a purer ſyſtem from being acknowledged as the religion of individuals. For propagating opinions and purſuing practices which neceſſarily create civil diſturbance, every man is anſwerable to the laws of his country; but for the ſoundneſs of his faith, and the purity of his worſhip, he is anſwerable to no tribunal but that which can ſearch the heart.

When churches are eſtabliſhed, and creeds drawn up as guides to the preaching of the national clergy, it is obvious that every clergyman who teaches any thing directly contrary to the doctrine of ſuch creeds, violates the condition on which he holds his living, and may be juſtly deprived of that living, whether his obnoxious opinion be in itſelf true or falſe, important or unimportant; but his puniſhment ſhould be extended no farther. To expel a Chriſtian from private communion for teaching any doctrine which is neither injurious to the ſtate, nor contrary to the few ſimple articles which compriſe the ſum of the Chriſtian faith, is the groſſeſt tyranny; and the governors of that church which is guilty of it, uſurp the prerogative of their bleſſed Lord, who commanded the apoſtles themſelves not to be called maſters in this ſenſe; for one (ſays he) is your maſter (υμων ὁ καθηγητης), even Chriſt. It is indeed a hardſhip to deprive a man of his living for conſcientiouſly illuſtrating what he believes to be a truth of the goſpel, only becauſe his illuſtration may be different from that which had formerly been given by men fallible like himſelf; but if the eſtabliſhment of human compilations of faith be neceſſary, this hardſhip cannot be removed, but by making ſuch compilations as ſimple as poſſible, and drawing them up in Scripture language. Such a reformation, could it be effected peaceably, would ſerve other good purpoſes; for while it would ſufficiently guard the purity of the faith, it would withdraw that temptation which too many eſtabliſhments throw in the way of men, to ſubſcribe to the truth of what they do not really believe; and it would effectually baniſh from the Chriſtian church every thing which can be called by the name of *perſecution*. See Nonconformists.

TOLL, a tax or cuſtom paid for liberty to vend goods in a market or fair, or for keeping roads in proper repair. The firſt appointment of a toll on highways of which we read, took place in 1346. See Road.

TOLOUSE. See Toulouse.

TOLU, a town of South America in Terra Firma, and in the government of Carthagena; famous for the fine balſam of Tolu, brought into Europe from thence, and produced from a tree like a pine. It is ſeated on a bay of the North Sea, 60 miles ſouth of Carthagena. W. Long. 72. 55. N. Lat. 9. 40.

TOLUIFERA, the Balsam or Tolu-tree; a genus of plants belonging to the claſs of *decandria*, and order of *monogynia*. There is only one ſpecies; the *balſamum*.

Woodville's Medical Botany.

This tree grows to a conſiderable height; it ſends off numerous large branches, and is covered with rough, thick, greyiſh bark: the leaves are elliptical or ovate, entire, pointed, alternate, of a light green colour, and ſtand upon ſhort ſtrong footſtalks: the flowers are numerous, and produced in lateral racemi: the calyx is bell-ſhaped, divided at the brim into five teeth, which are nearly equal, but one is projected to a greater diſtance than the others: the petals are inſerted into the receptacle, and are five in number, of which four are equal, linear, and a little longer than the calyx; the fifth is much the largeſt, inverſely heart-ſhaped, and its unguis is of the length of the calyx: the 10 filaments are very ſhort, and furniſhed with long antheræ: the germen is oblong: there is no ſtyle: the ſtigma is pointed: the fruit is a round berry.

It grows in Spaniſh America, in the province of Tolu, behind Carthagena, whence we are ſupplied with the balſam, which is brought to us in little gourd-ſhells. This balſam is obtained by making inciſions in the bark of the tree, and is collected into ſpoons, which are made of black wax, from which it is poured into proper veſſels.

This balſam is of a reddiſh yellow colour, tranſparent, in conſiſtence thick and tenacious: by age it grows ſo hard and brittle, that it may be rubbed into a powder between the finger and thumb. Its ſmell is extremely fragrant, ſomewhat reſembling that of lemons; its taſte is warm and ſweetiſh, and on being chewed it adheres to the teeth. Thrown into the fire it immediately liquifies, takes flame, and diſperſes its agreeable odour. Though it does not diſſolve in water, yet if boiled in it for two or three hours in a covered veſſel, the water receives its odoriferous ſmell: water alſo ſuffers a ſimilar impregnation from the balſam by diſtillation. With the aſſiſtance of mucilage it unites with water, ſo as to form a milky ſolution. It diſſolves entirely in ſpirit of wine, and eaſily mixes with diſtilled oils, but leſs eaſily with thoſe of the expreſſed kind. Diſtilled without addition, it produces not only an empyreumatic oil, of a pale dark colour, but ſometimes a ſmall portion of a ſaline matter, ſimilar to that of the flowers of benzoin.

This balſam poſſeſſes the ſame general virtues with the balſam of Gilead, and that of Peru; it is, however, leſs heating and ſtimulating, and may therefore be employed with more ſafety. It has been chiefly uſed as a pectoral, and is ſaid to be an efficacious corroborant in gleets and ſeminal weakneſſes. It is directed by the Pharmacopœias in the ſyrupus tolutanus, tinctura tolutana, and ſyrupus balſamicus. See *Pharmacy-Index*.

TOMATOES. See Solanum.

TOMB, includes both the grave or ſepulchre wherein a defunct is interred, and the monument erected to preſerve his memory. The word is formed from the Greek τυμϐος, *tumulus*, "ſepulchre;" or, according to Menage, from the Latin *tumba*, which ſignifies the ſame.

In many nations it has been cuſtomary to burn the bodies of the dead; and to collect the aſhes with pious care into an urn, which was depoſited in a tomb or ſepulchre. See Burning. Among many nations it has alſo been the practice to lay the dead body in a tomb, without conſuming it, after having wrapped it up decently, and ſometimes placing it in a coffin. See Coffin.

The tombs of the Jews were generally hollow places hewn out of a rock. Abraham buried Sarah in a cave. Such was the place too in which the kings of Judah and Iſrael were interred; and ſuch was the place in which the body of our Saviour was depoſited by Joſeph of Arimathea. But it is probable that the common people buried their dead in graves; for our Saviour compares the Phariſees to "graves which appear not, and the men that walk over are not aware of them." Over the tombs, perhaps only of people of diſtinction, a ſtone or monument was erected, to intimate to paſſengers that they were burying places, that they might not pollute themſelves by touching them. With the ſame intention, as Lightfoot informs us, they whitened them every year on the 15th of February.

The Egyptians alſo buried their dead in caves, called *catacombs*. See Catacomb. The pyramids, as ſome think, were alſo employed for the ſame purpoſe. Sometimes alſo, after embalming their dead, they placed them in niches in ſome magnificent apartment in their houſes.

The Greeks and Romans burned their dead, and depoſited their aſhes in a tomb. The Greeks interred the aſhes without the cities, by the ſides of their highways. Sometimes indeed, by way of particular honour, they were buried in an elevated part of the town; and the Lacedemonians were allowed by Lycurgus to bury in the city and round their temples: But this was forbidden among the Romans by the law of the twelve tables, *In urbe ne ſepelito, ne-ve urito*; yet Valerius Publicola, Poſthumus Tubertius, and the family of the Claudii, were buried in the Capitol. To bury by the ſides of public roads was common among the Romans alſo; hence their epitaphs frequently began with *ſiſte viator*. Highways were made choice of probably for two reaſons; 1. That the dead might not be offenſive or injure the health of the living, which they certainly would if buried in towns or populous places; and, 2dly, That they might hold out to travellers a leſſon of mortality, and teach the ruſtic moraliſt to die.

As it would ſwell this article to too great a ſize to deſcribe all the different kinds of tombs which have been uſed by different nations and ages, we muſt content ourſelves with ſhortly deſcribing the tombs of a few nations, and adding a few concomitant circumſtances.

The tombs of the Parſees are ſingular. The defunct, after lying a proper time in his own houſe, for the purpoſes of mourning, is carried, followed by his relations and friends, the females chanting a requiem, and depoſited in a tomb of the following conſtruction. It is a circular building, open at top, about 55 feet diameter, and 25 feet in height, filled to within 5 feet of the top, excepting a well of 15 feet diameter in the centre. The part ſo filled is terraced, with a ſlight declivity toward the well. Two circular grooves three inches deep are raiſed round the well; the firſt at the diſtance of four, the ſecond at ten, feet from the well. Grooves of the like depth or height, and four feet diſtant from each other at the outer part of the outer circle, are carried ſtraight from the wall to the well, communicating with the circular ones, for the purpoſe of carrying off the water, &c. The tomb, by this means, is divided into three circles of partitions: the outer, about ſeven feet by four; the middle, ſix by three; the inner, four by two: the outer for the men, the middle for the women, the inner for the children; in which the bodies are reſpectively placed, wrapped looſely in a piece of cloth, and left to be devoured by the vultures; which is very ſoon done, as numbers of thoſe animals are always ſeen hovering and watching about theſe charnel houſes, in expectation of their prey. The friends of the deceaſed, or the perſons who have charge of the tomb, come at the proper time, and throw the bones into their receptacle, the well in the centre; for which purpoſe, iron rakes and tongs are depoſited in the tomb. The entrance is cloſed by an iron door, four feet ſquare, on the eaſtern ſide, as high up as the terrace, to which a road is raiſed. Upon the wall, above the door, an additional wall is raiſed, to prevent people from looking into the tomb, which the Parſees are particularly careful to prevent. A Perſian inſcription is on a ſtone inſerted over the door, which we once copied, but have forgotten its tenor. From the bottom of the wall ſubterraneous paſſages lead to receive the bones, &c. and prevent the well from filling.

Archæologia, vol. vii.

Of the ancient ſepulchres found in Ruſſia and Siberia, ſome are perfect tumuli, raiſed to an enormous height, while others are almoſt level with the ground. Some of them are encompaſſed with a ſquare wall of large quarry ſtones placed in an erect poſition; others are covered only with a ſmall heap of ſtones, or they are tumuli adorned with ſtones at top. Some are mured with brick within, and vaulted over; others are no more than pits or common graves. In ſome the earth is excavated ſeveral fathoms deep; others, and eſpecially thoſe which are topped by a lofty tumulus, are only dug of a ſufficient depth for covering the carcaſe. In many of theſe ſepulchres the bones of men, and frequently of horſes, are found, and in a condition that renders it probable the bodies were not burnt before they were inhumed. Other bones ſhow clearly that they have been previouſly burnt; becauſe a part of them is unconſumed, and becauſe they lie in a diſordered manner, and ſome of them are wanting. Urns, in which other nations of antiquity have depoſited the aſhes of their dead, are never met with here. But ſometimes what remained of the bodies after the combuſtion, and even whole carcaſes, are found wrapped up in thin plates of gold. Many dead bodies are frequently ſeen depoſited together in one tomb; a certain indication that either a battle had been fought in the neighbourhood of the place, or that ſome families buried their relations in an hereditary tomb.

Chenier's Morocco, vol. i.

The Moors, like all other Mahometans, hold it a thing irreverent, and contrary to the ſpirit of religion, to bury their dead in moſques, and to profane the temple of the Moſt High by the putrefaction of dead bodies. In the infancy of the church the Chriſtians had the like piety, and gave example of the reſpect in which they held temples dedicated to religious worſhip; but ill-guided devotion, mingled with ſuperſtitious vanities, and that contagious ſpirit of ſelf-intereſt which pervades all human affairs, without reſpecting the altar of God, have, together, inſenſibly perverted men's ideas. The burial grounds of the Mahometans are moſt of them without the city; the emperors have their ſepulchres diſtinct and diſtant from the moſque, in ſanctuaries, built by themſelves, or in places which they have indicated: their tombs are exceedingly ſimple; the Moors do not imitate the oſtentation of Europeans, where ſuperb monuments are raiſed rather to gratify the pride of the living than the merit of the dead.

All Mahometans inter the dead at the hour ſet apart for prayer. The defunct is not kept in the houſe, except he expires after ſun-ſet; but the body is tranſported to the moſque, whither it is carried by thoſe who are going to prayer. Each, from a ſpirit of devotion, is deſirous to carry in his turn. The Moors ſing at their burial ſervice; which uſage perhaps they have imitated after the Chriſtians of Spain, for the oriental Mahometans do not ſing. They have no particular colour appropriated to mourning; their grief for the loſs of relations is a ſenſation of the heart they do not attempt to expreſs by outward ſymbols. Women regularly go on the Friday to weep over and pray at the ſepulchres of the dead, whoſe memory they hold dear.

Among the northern nations it was cuſtomary to bury their dead under heaps of ſtones called *cairns*, or under barrows: (See the articles CAIRNS and BARROW). The inhabitants of Tibet, it is ſaid, neither bury nor burn their dead, but expoſe them on the tops of the mountains. See TIBET.

TOMPION, a ſort of bung or cork uſed to ſtop the mouth of a cannon. At ſea this is carefully encircled with tallow or putty, to prevent the penetration of the water into the bore, whereby the powder contained in the chamber might be damaged or rendered incapable of ſervice.

TON, a meaſure or weight. See TUN.

TONE, or TUNE, in muſic, a property of ſound, whereby it comes under the relation of *grave* and *acute*; or the degree of elevation any ſound has, from the degree of ſwiftneſs of the vibrations of the parts of the ſonorous body.

The variety of tones in human voices ariſes partly from the dimenſions of the windpipe, which, like a flute, the longer and narrower it is, the ſharper the tone it gives; but principally from the head of the larynx or knot of the throat: the tone of the voice being more or leſs grave as the rima or cleft thereof is more or leſs open.

The word *tone* is taken in four different ſenſes among the ancients: 1. For any ſound; 2. For a certain interval, as when it is ſaid the difference between the diapente and diateſſaron is a tone; 3. For a certain locus or compaſs of the voice, in which ſenſe they uſed the Dorian, Phrygian, Lydian tones; 4. For tenſion, as when they ſpeak of an acute, grave, or a middle tone.

TONE is more particularly uſed, in muſic, for a certain degree or interval of tune, whereby a ſound may be either raiſed or lowered from one extreme of a concord to the other, ſo as ſtill to produce true melody.

TONGUE. See ANATOMY, nº 102.

TONIC, in muſic, ſignifies a certain degree of tenſion, or the ſound produced by a vocal ſtring in a given degree of tenſion, or by any ſonorous body when put in vibration.

Tonic, ſays Rouſſeau, is likewiſe the name given by Ariſtoxenus to one of the three kinds of chromatic muſic, whoſe diviſions he explains, and which was the ordinary chromatic of the Greeks, proceeding by two ſemitones in ſucceſſion, and afterwards a third minor.

Tonic Dominant. See DOMINANT.

TONNAGE *and* POUNDAGE, an ancient duty on wine and other goods, the origin of which ſeems to have been this: About the 21ſt of Edward III. complaint was made that merchants were robbed and murdered on the ſeas. The king thereupon, with the conſent of the peers, levied a duty of 2 s. on every ton of wine, and 12 d. in the pound on all goods imported; which was treated as illegal by the commons. About 25 years after, the king, when the knights of ſhires were returned home, obtained a like grant from the citizens and burgeſſes, and the year after it was regularly granted in parliament. Theſe duties were diminiſhed ſometimes, and ſometimes increaſed; at length they ſeem to have been fixed at 3s. tonnage and 1s. poundage. They were at firſt uſually granted only for a ſtated term of years, as, for two years in 5 Ric. II.; but in Henry VI.'s time they were granted him for life by a ſtatute in the 31ſt year of his reign; and again to Edward IV. for the term of his life alſo: ſince which time they were regularly granted to all his ſucceſſors for life, ſometimes at the firſt, ſometimes at other ſubſequent parliaments, till the reign of Charles I.; when, as the noble hiſtorian expreſſes it, his miniſters were not ſufficiently ſolicitous for a renewal of this legal grant. And yet theſe impoſts were imprudently and unconſtitutionally levied and taken, without conſent of parliament, for 15 years together; which was one of the cauſes of thoſe unhappy diſcontents, juſtifiable at firſt in too many inſtances, but which degenerated at laſt into cauſeleſs rebellion and murder. For, as in every other, ſo in this particular caſe, the king (previous to the commencement of hoſtilities) gave the nation ample ſatisfaction for the errors of his former conduct, by paſſing an act, whereby he renounced all power in the crown of levying the duty of tonnage and poundage, without the expreſs conſent of parliament; and alſo all power of impoſition upon any merchandiſes whatever. Upon the reſtoration this duty was granted to King Charles II. for life, and ſo it was to his two immediate ſucceſſors; but now, by three ſeveral ſtatutes. 9 Ann. c. 6. 1 Geo. I. c. 12. and 3 Geo. I. c. 7. it is made perpetual, and mortgaged for the debt of the public.

Blackſt. Comment. vol. i.

TONQUIN, a kingdom of Aſia, in the Eaſt Indies, beyond the Ganges; bounded on the north by the province of Yunnan in China, on the eaſt by the province of Canton and the bay of Tonquin, on the ſouth by Cochin China, and on the weſt by the kingdom of Laos. It is about 1200 miles in length and 500 in breadth; and is one of the fineſt and moſt conſiderable kingdoms of the Eaſt, as well on account of the number of inhabitants as the riches it contains and the trade it carries on. The country is thick ſet with villages; and the natives in general are of a middle ſtature and clean limbed, with a tawny complexion. Their faces are oval and flattiſh, and their noſes and lips well proportioned. Their hair is black, long, lank, and coarſe; and they let it hang down their ſhoulders. They are generally dexterous, nimble, active, and ingenious in mechanic arts. They weave a multitude of fine ſilks, and make curious lacker-works, which are tranſported to other countries. There is ſuch a number of people, that many want employment; for they ſeldom go to work but when foreign ſhips arrive. The money and goods brought hither by the Engliſh and Dutch put them in action; for they have not money of their own ſufficient to employ themſelves; and therefore one-third at leaſt muſt be advanced beforehand by the merchants: and the ſhips muſt ſtay here till the goods are finiſhed, which is generally five or ſix months. They are ſo addicted to gaming, that when every thing elſe is loſt, they will ſtake their wives and children. The garments of the Tonquineſe are made either of ſilk or cotton; but the poor people and ſoldiers wear only cotton of a dark tawny colour. Their houſes are ſmall and low; and the walls either of mud, or hurdles daubed over with clay. They have only a ground-floor, with two or three patritions; and each room has a ſquare hole to let in the light. The villages conſiſt of 30 or 40 houſes, ſurrounded with trees; and in ſome places there are banks to keep the water from overflowing their gardens, where they have oranges, betels, melons, and ſalad-herbs. In the rainy ſeaſon they cannot paſs from one houſe to another without wading through the water; they ſometimes have boats. In the capital city called *Cacho* there are about 20,000 houſes with mud-walls, and covered with thatch; a few are built with brick, and roofed with pan-tiles. In each yard is a ſmall arched building like an oven, about ſix feet high, made of brick, which ſerves to ſecure their goods in caſe of fire. The principal ſtreets are very wide, and paved with ſmall ſtones. The king of Tonquin has three palaces in it, ſuch as they are; and near them are ſtables for his horſes and elephants. The houſe of the Engliſh factory is ſeated at the north end of the city, fronting the river, and is the beſt in the city. The people in general are courteous, and civil to ſtrangers; but the great men are proud, haughty, and ambitious; the ſoldiers inſolent, and the poor thieviſh. They buy all their wives, of which the great men have ſeveral; but the poor are ſtinted for want of money. In hard times the men will ſell both their wives and children to buy rice to maintain themſelves. The women offer themſelves to ſtrangers as wives while they ſtay, and agree with them for a certain price. Even the great men will offer their daughters to the merchants and officers who are likely to ſtay ſix months in the country. They are not afraid of being with child; for if they are girls they can ſell them well when they are young, becauſe they are fairer than the other inhabitants. Theſe women are ſaid to be very faithful; and are truſted with money and goods by the Europeans during their abſence, and will make great advantage with them. The firſt new moon in the year that happens after the middle of January, is a great feſtival; when they rejoice for 10 or 12 days together, and ſpend their time in all manner of ſports. Their common drink is tea, but they make themſelves merry with arrack. The language is ſpoken very much in the throat; and ſome of the words are pronounced through the teeth, and has a great reſemblance to the Chineſe. They have ſeveral mechanic arts or trades; ſuch as ſmiths, carpenters, joiners, turners, weavers, taylors, potters, painters, money-changers, paper-makers, workers in lacker, and bell-founders. Their commodities are gold, muſk, ſilks, callicoes, drugs of many ſorts, woods for dyeing, lacquered wares, earthen wares, ſalt, anniſeeds, and worm-ſeeds. The lacquered ware is not inferior to that of Japan, which is accounted the beſt in the world. With all theſe merchandiſes, one would expect the people to be very rich, but they are in general very poor; the chief trade being carried on by the Chineſe, Engliſh, and Dutch. The goods imported, beſides ſilver, are ſaltpetre, ſulphur, Engliſh broad cloth, pepper, ſpices, and great guns.

TONSILS. See ANATOMY. n° 102.

TONSURE, in eccleſiaſtical hiſtory, a particular manner of ſhaving or clipping the hair of eccleſiaſtics or monks. The ancient tonſure of the clergy was nothing more than polling the head, and cutting the hair to a moderate degree, for the ſake of decency and gravity: and the ſame obſervation is true with reſpect to the tonſure of the ancient monks. But the Romans have carried the affair of tonſure much farther; the candidate for it kneeling before the biſhop, who cuts the hair in five different parts of the head, *viz.* before, behind, on each ſide, and on the crown.

TONTINE, a loan given for life annuities with benefit of ſurvivorſhip; ſo called from the inventor Laurence Tonti, a Neapolitan. He propoſed his ſcheme in 1653 to reconcile the people to cardinal Mazarine's government, by amuſing them with the hope of becoming ſuddenly rich. He obtained the conſent of the court, but the parliament would not regiſter the edict. He made attempts afterwards, but without ſucceſs.

It was not till Louis XIV. was diſtreſſed by the league of Augſburg, and by his own immenſe expences, that he had recourſe to the plans of Tonti, which, though long laid aſide, were not forgotten. By an edict in 1689 he created a Tontine royale of 1,400,000 livres annual rent, divided into 14 claſſes. The actions were 300 livres apiece, and the proprietors were to receive 10l. *per cent.* with benefit of ſurvivorſhip in every claſs. This ſcheme was executed but very imperfectly; for none of the claſſes roſe to above 25,000 livres, inſtead of 100,000, according to the original inſtitution; though the annuities were very regularly paid. A few years after, the people ſeeming in better humour for projects of this kind, another tontine was erected upon nearly the ſame terms, but this was never above half full. They both ſubſiſted in the year 1726, when the French king united the 13th claſs of the firſt tontine with the 14th of the ſecond; all the actions of which were poſſeſſed by Charlotte Bonnemay, widow of Lewis Barbier, a ſurgeon of Paris, who died at the age of 96. This gentlewoman had ventured 300 livres in each tontine; and in the laſt year of her life ſhe had for her annuity 73,500 livres, or about 3600l. a-year, for about 30l.

The nature of the tontine is this; there is an annuity, after a certain rate of intereſt, granted to a number of people; divided into claſſes, according to their reſpective ages; ſo that annually the whole fund of each claſs is divided among the ſurvivors of that claſs; till at laſt it falls to one, and upon the extinction of that life, reverts to the power by which the tontine was erected, and which becomes thereby ſecurity for the due payment of the annuities.

TOOL, among mechanics, denotes in general any ſmall inſtrument uſed as well for making other complex inſtruments and machines, as in moſt other operations in the mechanic arts.

TOOTH, for a deſcription of, ſee ANATOMY, n° 27.

TOOTHACH. See MEDICINE, n° 210, SURGERY, n° 236, TEETH, and ELECTRICITY, p. 535.

Toothach-Tree. See ZANTHOXYLUM.

TOOTHWORT. See PLUMBAGO.

TOP, a ſort of platform ſurrounding the lower maſt head, from which it projects on all ſides like a ſcaffold.

The principal intention of the top is to extend the topmaſt ſhrouds, ſo as to form a greater angle with the maſt, and thereby give additional ſupport to the latter. It is ſuſtained by certain timbers fixed acroſs the hounds or ſhoulders of the maſt, and called the *treſtle-trees*, and *croſs-trees*.

Beſides the uſe above-mentioned, the top is otherwiſe extremely convenient to contain the materials neceſſary for extending the ſmall ſails, and for fixing or repairing the rigging and machinery with more facility and expedition. In ſhips of war it is uſed as a kind of redoubt, and is accordingly fortified for attack or defence; being furniſhed with ſwivels, muſketry, and other fire-arms, and guarded by a thick fence of corded hammocs. Finally, it is employed as a place for looking out, either in the day or night.

Top-Maſt, the ſecond diviſion of a maſt, or that part which ſtands between the upper and lower pieces. See the article MAST.

Top-Sails, certain large ſails extended acroſs the topmaſts, by the topſail-yard above, and by the yard attached to the lower maſt beneath; being faſtened to the former by robands, and to the latter by means of two great blocks fixed on its extremities, through which the topſail-ſheets are inſerted, paſſing from thence to two other blocks fixed on the inner part of the yard cloſe by the maſt; and from theſe latter the ſheets lead downwards to the deck, where they may be ſlackened or extended at pleaſure. See the article SAIL.

TOPAZ, in natural hiſtory, a gem called by the ancients *chryſolite*, as being of a gold colour; its texture foliaceous; its form cubic, parallelopipedal, or priſmatic; its ſpecific gravity from 3,46 to 4,56; it loſes its colour only in a very ſtrong heat, and of the uſual fluxes it yields only to borax and microcoſmic ſalt. According to Bergman, 100 parts of it contain 46 of argill, 39 of ſiliceous earth, 8 of mild calcareous, and 6 of iron. Its great ſpecific gravity ſhews theſe earths to be very perfectly united.

Kirkwan's Mineralogy.

The fineſt topazes in the world are found in the Eaſt Indies; but they are very rare there of any great ſize: the Great Mogul, however, at this time, poſſeſſes one which is ſaid to weigh 157 carets, and to be worth more than 20,000 pounds. The topazes of Peru come next after theſe in beauty and in value. The European are principally found in Sileſia and Bohemia, and are generally full of cracks and flaws, and of a browniſh yellow.

TOPE, in ichthyology, a ſpecies of SQUALUS.

TOPHET. See HINNOM and MOLOCH.

TOPHUS, in medicine, denotes a chalky or ſtony concretion in any part of the body; as the bladder, kidney, &c. but eſpecially in the joints.

TOPIC, a general head or ſubject of diſcourſe.

TOPICS, in oratory. See ORATORY, n° 10—13.

TOPICS, or *Topical Medicines*, are the ſame with external ones, or thoſe applied outwardly to ſome diſeaſed and painful part; ſuch are plaſters, cataplaſms, unguents, &c.

TOPOGRAPHY, a deſcription or draught of ſome particular place, or ſmall tract of land, as that of a city or town, manor or tenement, field, garden, houſe, caſtle, or the like; ſuch as ſurveyors ſet out in their plots, or make draughts of, for the information and ſatisfaction of the proprietors.

TOPSHAM, a town in Devonſhire, in England, ſeated on the river Exmouth, five miles ſouth-eaſt of Exeter, to which place the river was formerly navigable; but in time of war was choaked up deſignedly, ſo that ſhips are now obliged to load and unload at Topſham. W. Long. 3. 26. N. Lat. 50. 39.

TORBAY, a fine bay of the Engliſh channel, on the coaſt of Devonſhire, a little to the eaſt of Dartmouth, formed by two capes, called *Bury Points*, and *Bob's Noſe*.

TORDA, or RASOR-BILL. See ALCA, n° 4.

TORDYLIUM, HART-WORT, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *digynia*; and in the natural ſyſtem arranged under the 45th order, *Umbellatæ*. The corollets are radiated, and all hermaphrodite; the fruit is roundiſh, and crenated on the margin; the involucra long and undivided. There are ſeven ſpecies: of which two are Britiſh, the *nodoſum* and *officinale*. 1. The *nodoſum*, or knotted parſley, has ſimple ſeſſile umbels, the exterior ſeeds being rough. It grows in the borders of corn-fields, and in dry ſtony places. 2. The *officinale*, officinal hart-wort, has partial involucra, as long as the flowers; leafets oval and jagged: the ſeeds are large and flat, and their edges notched.

TORIES, a political faction in Britain, oppoſed to the Whigs.

The name of *Tories* was given to a ſort of banditti in Ireland, and was thence transferred to the adherents of Charles I. by his enemies, under the pretence that he favoured the rebels in Ireland. His partiſans, to be even with the republicans, gave them the name of *Whigs*, from a word which ſignifies *whey*, in deriſion of their poor fare. The Tories, or *cavaliers*, as they were alſo called, had then principally in view the political intereſts of the king, the crown, and the church of England; and the round heads, or Whigs, propoſed chiefly the maintaining of the rights and intereſts of the people, and of Proteſtantiſm. This is the moſt popular account; and yet it is certain the names *Whig* and

Tory were but little known till about the middle of the reign of king Charles II. M. de Cize relates, that it was in the year 1678 that the whole nation was firſt obſerved to be divided into Whigs and Tories; and that on occaſion of the famous depoſition of Titus Oates, who accuſed the Catholics of having conſpired againſt the king and the ſtate, the appellation of *Whig* was given to ſuch as believed the plot real; and *Tory* to thoſe who held it fictitious.

Theſe parties may be conſidered either with regard to the ſtate or to religion. The ſtate Tories are either violent or moderate: the firſt would have the king to be abſolute, and therefore plead for paſſive obedience, non-reſiſtance, and the hereditary right of the houſe of Stuart. The moderate Tories would not ſuffer the king to loſe any of his prerogative; but then they would not ſacrifice thoſe of the people. The ſtate Whigs are either ſtrong republicans or moderate ones. "The firſt (ſays Rapin) are the remains of the party of the long parliament, who attempted to change monarchy to a commonwealth: but theſe make ſo ſlender a figure, that they only ſerve to ſtrengthen the party of other Whigs. The Tories would perſuade the world, that all the Whigs are of this kind; as the Whigs would make us believe that all the Tories are violent. The moderate ſtate Whigs are much in the ſame ſentiments with the moderate Tories, and deſire that the government may be maintained on the ancient foundation; all the difference is, that the firſt bear a little more to the parliament and people, and the latter to that of the king. In ſhort, the old Whigs were always jealous of the encroachments of the royal prerogative, and watchful over the preſervation of the liberties and properties of the people."

TORMENTILLA, TORMENTIL, in botany: A genus of plants belonging to the claſs of *icoſandria*, and order of *polygynia*; and in the natural ſyſtem ranging under the 35th order, *Senticoſæ*. The calyx is octofid; the petals are four; the ſeeds round, naked, and affixed to a juiceleſs receptacle. There are two ſpecies; the *erecta* and *repens*, both indigenous.

1. The *erecta*, common tormentil, or ſeptfoil, has a ſtalk ſomewhat erect, and ſeſſile leaves. The roots conſiſt of thick tubercles, an inch or more in diameter, replete with red juice of an aſtringent quality. They are uſed in moſt of the Weſtern-Iſles, and in the Orkneys, for tanning of leather; in which intention they are proved by ſome late experiments to be ſuperior even to the oak-bark. They are firſt of all boiled in water, and the leather is afterwards ſteeped in the liquor. In the iſland of Tirey and Col the inhabitants have deſtroyed ſo much ground by digging them up, that they have lately been prohibited the uſe of them. A decoction of theſe roots in milk is alſo frequently adminiſtered by the inhabitants of the ſame iſlands in diarrhœas and dyſenteries, with good ſucceſs; but perhaps it would be moſt proper not to give it in dyſenteries till the morbid matter be firſt evacuated. A ſpirituous extract of the plant ſtands recommended in the ſea-ſcurvy, to ſtrengthen the gums and faſten the teeth. Linnæus informs us, that the Laplanders paint their leather of a red colour with the juice of the roots.

2. The *reptans*, or creeping tormentil, has reddiſh ſtalks, ſlender and creeping. The leaves are ſharply ſerrated, grow on ſhort footſtalks, and are five-lobed. The flowers are numerous and yellow, bloſſom in July, and are frequent in woods and barren paſtures.

TORNADO, a ſudden and vehement guſt of wind from all points of the compaſs, frequent on the coaſt of Guinea.

TORPEDO, the CRAMP-FISH. See RAJA, and ELECTRICITY, nº 258—261.

TORPOR, a numbneſs, or defect of feeling and motion. Galen ſays it is a ſort of intermediate diſorder between palſy and health.

TORREFACTION, in chemiſtry, is the roaſting or ſcorching of a body by the fire, in order to diſcharge a part either unneceſſary or hurtful in another operation. Sulphur is thus diſcharged from an ore before it can be wrought to advantage.

TORRENT, denotes a temporary ſtream of water falling ſuddenly from mountains, whereon there have been great rains, or an extraordinary thaw of ſnow.

TORRICELLI (Evangeliſte), an illuſtrious Italian mathematician and philoſopher, born at Faenza in 1608. He was trained in Latin literature by his uncle a monk; and after cultivating mathematical knowledge for ſome time without a maſter, he ſtudied it under father Benedict Caſtelli, profeſſor of mathematics at Rome. Having read Galileo's dialogues, he compoſed a treatiſe on motion, on his principles, which brought him acquainted with Galileo, who took him home as an aſſiſtant: but Galileo died in three months after. He became profeſſor of mathematics at Florence, and greatly improved the art of making teleſcopes and microſcopes: but he is beſt known for finding out a method of aſcertaining the weight of the atmoſphere by quickſilver: the barometer being called, from him, the *Torricellian tube*. He publiſhed *Opera Geometrica*, 4to, 1644; and died in 1647.

TORRICELLIAN EXPERIMENT, a famous experiment made by Torricelli, by which he demonſtrated the preſſure of the atmoſphere in oppoſition to the doctrines of ſuction, &c. finding that preſſure able to ſupport only a certain length of mercury, or any other fluid, in an inverted glaſs tube. See BAROMETER.

TORSK, or TUSK, in ichthyology. See GADUS.

TORTOISE, in zoology. See TESTUDO.

TORTOISE-ſhell, the ſhell, or rather ſcales, of the teſtaceous animal called a *tortoiſe*; uſed in inlaying, and in various other works, as for ſnuff-boxes, combs, &c. Mr Cateſby obſerves, that the hard ſtrong covering which incloſes all ſorts of tortoiſes, is very improperly called a *ſhell*; being of a perfect bony contexture; but covered on the outſide with ſcales, or rather plates, of a horny ſubſtance; which are what the workmen call *tortoiſe-ſhell*. Phil. Tranſ. nº 438, p. 117.

There are two general kinds of tortoiſes, *viz.* the *land* and *ſea tortoiſe*, *teſtudo terreſtris*, and *marina*. The ſea-tortoiſe, again, is of ſeveral kinds; but it is the caret, or teſtudo imbricata of Linnæus, alone, which furniſhes that beautiful ſhell ſo much admired in Europe.

The ſhell of the caretta, or hawkſbill tortoiſe, is thick; and conſiſts of two parts, the upper, which covers the back, and the lower the belly: the two are joined together at the ſides by ſtrong ligaments, which yet allow of a little motion. In the fore-part is an aperture for the head and fore-legs, and behind for the hind-legs and tail. It is the under ſhell alone that is uſed: to ſeparate it, they make a little fire beneath it, and as ſoon as ever it is warm, the under ſhell becomes eaſily ſeparable with the point of a knife, and is taken off in laminæ or leaves.

The whole ſpoils of the caret conſiſt in 13 leaves or ſcales, eight of them flat, and five a little bent. Of the flat ones, there are four large ones, ſometimes a foot long, and ſeven inches broad. The beſt tortoiſe-ſhell is thick, clear, tranſparent, of the colour of antimony, ſprinkled with brown and white. When uſed in marquetry, &c. the workmen give it what colour they pleaſe by means of coloured leaves, which they put underneath it.

Working and joining of TORTOISE-*ſhell*.—Tortoiſe-ſhell and horn become ſoft in a moderate heat, as that of boiling water, ſo as to be preſſed, in a mould, into any form, the ſhell or horn being previouſly cut into plates of a proper ſize. Plumier informs us, in his *Art de Tourner*, that two plates are likewiſe united into one by heating and preſſing them; the edges being thoroughly cleaned, and made to fit cloſe to one another. The tortoiſe-ſhell is conveniently heated for this purpoſe by applying a hot iron above and beneath the juncture, with the interpoſition of a wet cloth to prevent the ſhell from being ſcorched by the irons: theſe irons ſhould be pretty thick, that they may not loſe their heat before the union is effected. Both tortoiſe-ſhell and horns may be ſtained of a variety of colours, by means of the colouring drugs commonly uſed in dyeing, and by certain metallic ſolutions.

TORTURE, a violent pain inflicted on perſons to force them to confeſs the crimes laid to their charge, or as a puniſhment for crimes committed.

Torture was never permitted among the Romans except in the examination of ſlaves: it would therefore appear, that it was a general opinion among them, that a ſlave had ſuch a tendency to falſehood, that the truth could only be extorted from him. To the diſgrace of the profeſſors of Chriſtianity, torture was long practiſed by thoſe who called themſelves Catholics, againſt thoſe whom they termed *heretics*; that is, thoſe who differed in opinion from themſelves. Finding that they could not bring over others to adopt their ſentiments by the force of argument, they judge it proper to compel them by the force of puniſhment. This practice was very general among orthodox Chriſtians, but eſpecially among Roman Catholics. See INQUISITION.

By the law of England, torture was at one period employed to compel thoſe criminals who ſtood obſtinately mute when brought to trial, and refuſed either to plead guilty or not guilty; but it is now aboliſhed (ſee ARRAIGNMENT, RACK). A hiſtory of the machines which have been invented to torture men, and an account of the inſtances in which theſe have been employed, would exhibit a diſmal picture of the human character.

TORUS, in architecture, a large round moulding uſed in the baſes of columns. See Plate XXXVIII. fig. 3.

TOUCAN, in ichthyology. See RHAMPHASTOS.

TOUCH-NEEDLE, among aſſayers, refiners, &c. little bars of gold, ſilver, and copper, combined together, in all the different proportions and degrees of mixture; the uſe of which is to diſcover the degree of purity of any piece of gold or ſilver, by comparing the mark it leaves on the touchſtone with thoſe of the bars.

The metals uſually tried by the touch-ſtone are gold, ſilver, and copper, either pure, or mixed with one another in different degrees and proportions, by fuſion. In order to find out the purity or quantity of baſer metal in theſe various admixtures, when they are to be examined they are compared with theſe needles, which are mixed in a known proportion, and prepared for this uſe. The metals of theſe needles, both pure and mixed, are all made into laminæ or plates, one-twelfth of an inch broad, and of a fourth part of their breadth in thickneſs, and an inch and half long; theſe being thus prepared, you are to engrave on each a mark indicating its purity, or the nature and quantity of the admixture in it. The black rough marbles, the baſaltes, or the ſofter kinds of black pebbles, are the moſt proper for touch-ſtones.

The method of uſing the needles and ſtone is this: The piece of metal to be tried ought firſt to be wiped well with a clean towel or piece of ſoft leather, that you may the better ſee its true colour; for from this alone an experienced perſon will, in ſome degree, judge beforehand what the principal metal is, and how and with what debaſed.

Then chooſe a convenient, not over large, part of the ſurface of the metal, and rub it ſeveral times very hardly and ſtrongly againſt the touch-ſtone, that in caſe a deceitful coat or cruſt ſhould have been laid upon it, it may be worn off by that friction: this, however, is more readily done by a grindſtone or ſmall file. Then wipe a flat and very clean part of the touch-ſtone, and rub againſt it, over and over, the juſt mentioned part of the ſurface of the piece of metal, till you have, on the flat ſurface of the ſtone, a thin metallic cruſt, an inch long, and about an eighth of an inch broad: this done, look out the needle that ſeems moſt like to the metal under trial, wipe the lower part of this needle very clean, and then rub it againſt the touchſtone, as you did the metal, by the ſide of the other line, and in a direction parallel to it.

When this is done, if you find no difference between the colours of the two marks made by your needle and the metal under trial, you may with great probability pronounce that metal and your needle to be of the ſame alloy, which is immediately known by the mark engraved on your needle. But if you find a difference between the colour of the mark given by the metal, and that by the needle you have tried, chooſe out another needle, either of a darker or lighter colour than the former, as the difference of the tinge on the touchſtone directs; and by one or more trials of this kind you will be able to determine which of your needles the metal anſwers, and thence what alloy it is of, by the mark of the needle; or elſe you will find that the alloy is extraordinary, and not to be determined by the compariſon of your needles.

Touch-Stone, a black, ſmooth, gloſſy ſtone, uſed to examine the purity of metals. The ancients called it *lapis Lydius*, the Lydian ſtone, from the name of the country whence it was originally brought.

Any piece of pebble or black flint will anſwer the purpoſes of the beſt lapis lydius of Aſia. Even a piece of glaſs made rough with emery is uſed with ſucceſs, to diſtinguiſh true gold from ſuch as is counterfeit; both by the metallic colour and the teſt of aquafortis. The true touchſtone is of a black colour, and is met with in ſeveral parts of Sweden. See TRAPP.

TOUCHWOOD. See BOLETUS.

TOULON, a celebrated city and ſeaport of France, in that part of the late province of Provence which is now denominated the department of the *Var*. It is a very ancient place, having been founded, according to the common opinion, by a Roman general. It is the chief town of the department, and before the great revolution in 1789 was an epiſcopal ſee. The inhabitants are computed at 80,000. It is divided into the Old Quarter and the New Quarter. The firſt, which is very ill built, has nothing remarkable in it but the *Rue aux Arbres*, the Tree Street, which is a kind of courſe or mall, and the town-houſe; the gate of this is ſurrounded by a balcony, which is ſupported by two termini, the maſterpieces of the famous Pujet. The New Quarter, which forms as it were a ſecond city, contains, beſide the magnificent works conſtructed in the reign of Louis XIV. many fine houſes (among which that of the late ſeminary merits beyond compariſon the preference) and a grand oblong ſquare, lined with trees, and ſerving as a parade.

The Merchants Haven, along which extends a noble quay, on which ſtands the townhouſe, is protected by two moles, begun by Henry IV. The New Haven was conſtructed by Louis XIV. as were the fortifications of the city. In the front of this haven is an arſenal, containing all the places neceſſary for the conſtruction and fitting out of veſſels: the firſt object that appears is a rope-walk, entirely arched, extending as far as the eye can reach, and built after the deſigns of Vauban ; here cables are made, and above is a place for the preparation of hemp. Here likewiſe is the armoury for muſkets, piſtols, halberds, &c. In the park of artillery are cannons placed in piles, bombs, grenades, mortars, and balls of various kinds, ranged in wonderful order. The long ſail room, the foundery for cannon, the dockyards, the baſons, &c. are all worthy of obſervation.

Both the old and New Port have an outlet into the ſpacious outer road or harbour, which is ſurrounded by hills, and formed by nature almoſt circular. Its circuit is of very great extent, and the entrance is defended on both ſides by a fort with ſtrong batteries. In a word, the baſons, docks, and arſenal, at Toulon, warranted the remark of a foreigner that viſited them in the late reign, that "the king of France was greater there than at Verſailles." Toulon is the only mart in the Mediterranean for the re-exportation of the products of the Eaſt Indies.

This place was deſtroyed toward the end of the tenth century, and pillaged by the African pirates almoſt as ſoon as rebuilt. The conſtable of Bourbon, at the head of the Imperial troops, obtained poſſeſſion of it in 1524, as did Charles V. in 1536 ; but in the next century Charles Emanuel duke of Savoy could not enter it, and Prince Eugene in 1707 ineffectually laid ſiege to it. This city was ſurrendered by the inhabitants in September 1793 to the Britiſh admiral Lord Hood, as a condition and means of enabling them to effect the re-eſtabliſhment of monarchy in France, according to the conſtitution of 1789. Lord Hood accordingly, in conjunction with the Spaniſh land and naval forces, took poſſeſſion of the harbour and forts in truſt for Louis XVII. It was garriſoned for ſome time by the Britiſh troops, and their allies the Spaniards, Neapolitans, and Sardinians ; but the French having laid ſiege to it, the garriſon was obliged to evacuate the place in the month of December following, after having deſtroyed the grand arſenal, two ſhips of 84 guns, eight of 74, and two frigates ; and carried off the Commerce de Marſeilles, a ſhip of 120 guns, with an 80 and 74 gun ſhip. This exploit was moſt gallantly performed, after it was found impoſſible to defend the town, or to carry off the ſhips. Lord Hood entruſted the management of the affair to Sir Sydney Smith, ſo diſtinguiſhed for his intrepidity. Captain Hare commanded the fireſhip which was towed into the grand arſenal ; and ſo eager was he to execute his orders, that inſtead of ſetting fire to the train in the uſual cautious manner, he fired a piſtol loaded with powder into the bowl of the train, compoſed of 36 pounds of powder, and other combuſtibles. The conſequence was, he was blown into the water with ſuch violence, as to knock a lieutenant of the Victory's boat overboard, and narrowly eſcaped with his life. A Spaniſh captain was appointed to ſet fire to the ſmall arſenal, but cowardice prevented him from executing his orders ; and this is the reaſon why the whole French ſhips were not deſtroyed. We have been favoured with this account by an officer of the Britiſh fleet.

Toulon is ſeated on a bay of the Mediterranean, 17 leagues ſouth-eaſt of Aix, 15 ſouth-eaſt of Marſeilles, and 127 ſouth-eaſt of Paris. E. Long. 5. 37. N. Lat. 43. 7.

TOULOUSE, a very ancient City of France, in the department of Upper Garonne, and late province of Languedoc, with an archbiſhop's ſee. It is the moſt conſiderable city in France next to Paris and Lyons, although its population bears no proportion to its extent. According to Mr Neckar's calculation, it contains 56,000 inhabitants. The ſtreets are very handſome, and the walls of the city, as well as the houſes, are built with bricks. The townhouſe, a modern ſtructure, forms a perfect ſquare, 324 feet long and 66 high. The principal front occupies an entire ſide of the grand ſquare, lately called the *Place Royale*. In the great hall, called the *Hall of Illuſtrious Men*, is the ſtatue of the Chevalier Iſaure, and the buſts of all the great men to whom Toulouſe has given birth. Communicating with the ocean on one ſide by the river Garonne, and with the Mediterranean on the other by the canal of Languedoc, Toulouſe might have been a very commercial city ; but the taſte of the inhabitants has been principally for the ſciences and belles-lettres. Of courſe, there are two colleges, two public libraries, and three academies. The little commerce of Toulouſe conſiſts in leather, drapery, blankets, mignionets, oil, iron, mercery, hardware, and books. The bridge over the Garonne is at leaſt equal to thoſe of Tours and Orleans : it forms the communication between the ſuburb of St Cyprian and the city. The quays extend along the banks of the Garonne ; and it has been in contemplation to line them with new and uniform houſes. Toulouſe is 37 miles eaſt of Auch, 125 ſouth-eaſt of Bourdeaux, and 310 ſouth-by-weſt of Paris. E. Long. 1. 27. N. Lat. 43. 36.

TOUP (the Reverend Jonathan), was deſcended from a family formerly ſettled in Dorſetſhire. His grandfather, Oneſiphorus Toup, had been a man of good property, and patron as well as incumbent of Bridport, in that county ; but he appears to have been embarraſſed in his circumſtances before his death, as he parted with the advowſon, and left a numerous family very ſlenderly provided for. His ſecond ſon Jonathan was bred to the church, and was curate and lecturer of St Ives in Cornwall. He married Prudence, daughter of John Buſvargus, Eſq ; of Buſvargus in Cornwall, and by her had iſſue Jonathan, the ſubject of this article, and one daughter.

Mr Toup loſt his father while he was a child ; and his mother ſome time after marrying Mr Keigwyn, vicar of Landrake in Cornwall, his uncle Buſvargus (the laſt male of that family) took him under his care, and conſidered him as his own child. He bore the whole charge of his education both at ſchool and at college, and procured for him the rectory of St Martin's near Looe.

Mr Toup was born at St Ives in Cornwall in the year 1713. He received the firſt rudiments of his education in a grammar ſchool in that town ; and was afterwards placed under the care of Mr Gurney, maſter of a private ſchool in the pariſh of St Merryn. Thence he was removed to Exeter College in Oxford, where he took his degree of Bachelor of Arts. His maſter's degree he took at Cambridge in the year 1756. He obtained the rectory of St Martin's in 1750 ; was inſtalled prebendary of Exeter in 1774 ; and inſtituted to the vicarage of St Merryn in 1776 : the two laſt preferments he owed to the patronage of Biſhop Keppel of Exeter. By the death of his uncle Buſvargus without iſſue in 1751, Mrs Keigwyn (ſiſter to Mr Buſvargus, and mother to Mr Toup) ſucceeded as heir at law to his eſtate and effects. She died in 1773, and left a will bequeathing the whole of her eſtates to her ſon Mr Jonathan Toup.

In the year 1760 Mr Toup publiſhed the firſt part of his *Emendationes in Suidam*, and in 1764 the ſecond part of the ſame work. Theſe books procured him the notice of Biſhop Warburton, who from the time of their publication honoured him with his correſpondence and patronage. The Biſhop in one of his letters, laments his having a ſee without any preferment on it ; "had it been otherwiſe, he ſhould have been too ſelfiſh to invite any of his brethren to ſhare with him in the honour of properly diſtinguiſhing ſuch merit as Mr Toup's. All, however, that the Biſhop could do, he did with the warmth and earneſtneſs of ſincere friendſhip. He repeatedly recommended Mr Toup to Archbiſhop

Secker, to the Truſtees for diſpoſing of his Options, to Lord Shelburne, and to Biſhop Keppel; and the favours this prelate beſtowed on Mr Toup were owing to the ſolicitations of Biſhop Warburton. The third part of the *Emendationes in Suidam* was publiſhed in 1766. In the following year Archbiſhop Secker expreſſed a deſire that Mr Toup would lend his aſſiſtance towards a new edition of Polybius, which was then in contemplation. Biſhop Warburton ſtrongly preſſed his compliance with this wiſh, and that he would lay by for a while the Notes he was preparing for Mr Warton's edition of Theocritus. In the year 1767 Mr Toup's *Epiſtola Critica ad virum celeberrimum Gul. Epiſcop. Gloc.* made its appearance. In the year 1770, Mr. Warton's edition of Theocritus was printed at the univerſity preſs in Oxford. Mr Toup was a large contributor towards the corrections and annotations of this edition. A note of his on Idyll. xiv. 37. gave ſuch offence to ſome perſons, that the vice-chancellor of Oxford prevailed on the editor to cancel the leaf on which it was printed, and ſubſtitute another in its room. In 1772 Mr Toup publiſhed his *Appendiculum Notarum in Theocritum*, in which the ſubſtance (A) of the cancelled note was inſerted. He concludes his preface to this work with theſe words: "*Quod vero ſcripſimus ad* xiv. 37. *verum eſt et honeſtum. Sed rem pro ſingulari ſua ſagacitate minus ceperunt nonnulli Oxonienſes; qui et me ſugillare haud erubuerunt; homunculi eruditione mediocri, ingenio nulli; qui in Hebraicis per omnem fere vitam turpiter volutati, in literis elegantioribus plane hoſpites ſunt.*" Mr Toup's next work was the *Appendiculum Notarum in Suidam*, publiſhed in 1775. In 1778 his Longinus was publiſhed from the Oxford preſs in Quarto. A ſecond edition has ſince been printed in Octavo.

As a writer of great learning, and of ſingular critical ſagacity, Mr Toup needs no encomiaſt. The teſtimonies of Mr T. Warton, of Biſhop Warburton, and of every perſon in any way diſtinguiſhed for claſſical learning at home; of Erneſtus, Hemſterhuſius, Runkhenius, Valckenaer, Brunck, Kluit, D'Anſe de Villoiſon, L'Archer, &c. &c. in all parts of Europe, ſufficiently eſtabliſh his reputation as an author. To moſt or all of theſe he was aſſiſting in the ſeveral works they publiſhed.

As his whole life was paſt in literary retirement, his character as a man was known but to few. It will appear from his works that he was not wholly untinctured with that ſelf complacency which is the almoſt inſeparable companion of too much ſolitude; and by thoſe who beſt knew him, he is ſaid to have been unhappy in his diſpoſition. His virtues, however, were reſpectable, and his learning was confeſſedly great. His theological ſtudies were well directed: he ſought for the truths of religion where only they can be found, in the Scriptures; not in the gloſſes and comments of men: it will be needleſs to add, that he was a liberal and a tolerant divine. He was punctual and ſerious in the diſcharge of the duties of his profeſſion; and in his preaching ſingularly plain and forcible. He died on the 19th of January 1785, juſt entering into the 72d year of his age, and was buried under the communion-table in his church of St Martin's.

Mr Toup was a Chriſtian from conviction; not merely from the accident of having been born in a country where Chriſtianity was profeſſed. He fulfilled the duties of life conſcientiouſly, and from principle, without parade or oſtentation. In his purſuit of learning he was actuated by the moſt honourable motives; by the deſire of improving his own mind, and of amuſing himſelf and others. If in Biſhop Warburton he found a patron, capable of diſtinguiſhing merit, and zealous to reward it, let it be remembered, to the honour of both parties, that the Biſhop's patronage was offered, not ſolicited. In the year 1764 he was repeatedly preſſed by another prelate to quit his retirement at St Martin's, and to ſettle either in London or in Oxford, where he might have acceſs to books, and might place himſelf in the way of notice and preferment. He was aſſured, at the ſame time, that the biſhop of his dioceſe would himſelf make a tender of his connivance at his non-reſidence, without any application from Mr Toup on the ſubject. But every propoſal of this nature he conſtantly rejected; for he conſidered the non-reſidence of the parochial clergy as a neglect of duty, for which no apology can be made. He was never married, and rather capriciouſly left his fortune, amounting, it has been ſaid, to L.12,000, to a niece whoſe mother was his half-ſiſter, taking not the leaſt notice in his will of his other nieces and nephews, whoſe mother was his full ſiſter.

TOUR (Henry de la), viſcount Turenne, a celebrated French general, was the ſecond ſon of Henry de la Tour duke of Bouillon, and was born at Sedan in 1611. He made his firſt campaigns in Holland, under Maurice and Frederic Henry princes of Orange; who were his uncles by the mother's ſide; and even then diſtinguiſhed himſelf by his bravery. In 1634 he marched with his regiment into Lorraine; and having contributed to the taking of La Mothe, was, though very young, made mareſchal de camp. In 1636 he took Saverne, and the year following the caſtles of Hirſon and Sole; on which occaſion he performed an action like that of Scipio's, with reſpect to a very beautiful woman whom he ſent back to her huſband. The viſcount Turenne continued to diſtinguiſh himſelf in ſeveral ſieges and battles, and in 1644 was made marſhal of France; but had the misfortune to be defeated at the battle of Mariendal in 1645. However, he gained the battle of Nortlingen three months after; reſtored the elector of Treves to his dominions; and the following year made the famous junction of the French army with that of Sweden commanded by general Wrangel, which obliged the duke of Bavaria to demand a peace. Afterwards that duke breaking the treaty he had concluded with France, he was defeated by the viſcount Turenne at the battle of Zumarſhauſen, and in 1648 driven entirely out of his dominions. During the civil wars in France he ſided with the princes, and was defeated at the battle of Rhetel in 1650; but ſoon after was reſtored to the favour of the king, who in 1652 gave him the command of his army. He acquired great honour at the battles of Jergeau, Gren, and the ſuburbs of St Anthony, and by the retreat he made before the army commanded by the princes at Ville Neuve St George. In 1654 he made the Spaniards raiſe the ſiege of Arras: the next year he took Conde, St Guilian, and ſeveral other places; gained the famous battle of Dunes; and made himſelf maſter of Dunkirk, Oudenarde, and almoſt all Flanders: this obliged the Spaniards to conclude the peace of the Pyrenees in 1660. Theſe important ſervices occaſioned his being made marſhal-general of the king's camps and armies. The war being renewed with Spain in 1667, Turenne commanded in Flanders; and took ſo many places, that in 1668 the Spaniards were obliged to ſue for peace. He commanded the French army in the war againſt the Dutch in 1672; took 40 towns in 22 days; purſued the elector of Brandenburgh even to Berlin; gained the battles of Slintſheim, Ladenburg, Enſheim, Mulhauſen, and Turkeim; and obliged the imperial army, which

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(A) Not improbably all of that note which was omitted in the ſubſtituted leaf.

which conſiſted of 70,000 men, to repaſs the Rhine. By this campaign the viſcount Turenne acquired immortal honour. He paſſed the Rhine to give battle to general Montecuculi, whom he followed as far as Saſpach; but mounting upon an eminence to diſcover the enemy's camp, he was killed by a cannon-ball in 1675. All France regretted the loſs of this great man, who by his military exploits had raiſed the admiration of Europe.

TOURAINE, a province of France, bounded on the north by Maine, on the eaſt by Orleanois, on the ſouth by Berris, and on the weſt by Anjou and Poitou. It is about 58 miles in length, and 55 in breadth where it is broadeſt. This country is watered by 17 rivers, beſides many brooks, which not only render it delightful, but keep up a communication with the neighbouring provinces. The air is temperate, and the ſoil is ſo fruitful that it is called the *garden of France*. It now forms the department of Indre and Loire, of which Tours is the capital.

TOURMALINE, in mineralogy, a ſpecies of ſiliceous earth.

It has been found only in Ceylon, Brazil, and Tyrol. That of Ceylon is of a dark brown or yellowiſh colour; its ſpecific gravity 3,065, or 3,295; that of Brazil is green, blue, red, or yellow, and its ſpecific gravity 3,075 or 3,180; that of Tyrol by reflected light is of a blackiſh brown, but by refracted light yellowiſh, or in thin pieces green; its ſpecific gravity 3,050; moſtly cryſtallized in polygon priſms, but ſometimes amorphous. The thickeſt parts are opake: the thin more or leſs tranſparent.

The proportion of their conſtituent parts has been found by Bergman,

	Tourmaline		
	of Tyrol.	*of Ceylon.*	*of Brazil.*
Argill,	42	39	50
Silex,	40	37	34
Calcareous earth,	12	15	11
Iron,	6	9	5
	100	100	100

For the electrical qualities of tourmaline, ſee ELECTRICITY, n° 54.

TOURNAMENT, a martial ſport or exerciſe which the ancient cavaliers uſed to perform, to ſhow their bravery and addreſs. It is derived from the French word *tourner*, i. e. "to turn round," becauſe to be expert in theſe exerciſes, much agility both of horſe and man was requiſite, they riding round a ring in imitation of the ancient Circi.

The firſt tournaments were only courſes on horſeback, wherein the cavaliers tilted at each other with canes in manner of lances; and were diſtinguiſhed from juſts, which were courſes or careers, accompanied with attacks and combats, with blunted lances and ſwords. See JUST.

The prince who publiſhed the tournament, uſed to ſend a king at arms, with a ſafe conduct, and a ſword, to all the princes, knights, &c. ſignifying that he intended a tournament and a claſhing of ſwords, in the preſence of ladies and damſels; which was the uſual formula of invitation.

The firſt engaged man againſt man, then troop againſt troop; and after the combat, the judges allotted the prize to the beſt cavalier, and the beſt ſtriker of ſwords; who was accordingly conducted in pomp to the lady of the tournament; where, after thanking her very reverently, he ſaluted her and likewiſe her two attendants.

Theſe tournaments made the principal diverſion of the 13th and 14th centuries. Munſter ſays, it was Henry the Fowler, duke of Saxony, and afterwards emperor, who died in 936, that firſt introduced them; but it appears from the chronicle of Tours, that the true inventor of this famous ſport, at leaſt in France, was one Geoffry, lord of Preuilli, about the year 1066.

Inſtances of them occur among the Engliſh in the reign of king Stephen, about the year 1140; but they were not much in uſe till Richard's time, towards the year 1149. After which period theſe diverſions were performed with extraordinary magnificence in the Tilt-yard near St James's, Smithfield, and other places.

The following account of a tournament, from Maitland, is curious. King Richard II. deſigning to hold a tournament at London on the Sunday after Michaelmas, ſent divers heralds to make proclamations of it in all the principal courts of Europe; and accordingly not a few princes, and great numbers of the prime nobility, reſorted hither from France, Germany, the Netherlands, &c. This ſolemnity began on Sunday afternoon, from the Tower of London, with a pompous cavalcade of 60 ladies, each leading an armed knight by a ſilver chain, being attended by their 'ſquires of honour, and, paſſing through Cheapſide, rode to Smithfield, where the juſts and tournaments continued ſeveral days with magnificent variety of entertainments; on which occaſion the king kept open houſe at the biſhop of London's palace for all perſons of diſtinction, and every night concluded with a ball.

At laſt, however, they were found to be productive of bad effects, and the occaſions of ſeveral fatal misfortunes—as in the inſtance of Henry II. of France, and of the tilt exhibited at Chalons, which, from the numbers killed on both ſides, was called the *little war of Chalons*. Theſe and other inconveniences, reſulting from thoſe dangerous paſtimes, gave the popes occaſion to forbid them, and the princes of Europe gradually concurred in diſcouraging and ſuppreſſing them.

TOURNAY, a town of the Auſtrian Netherlands in Flanders, and capital of a diſtrict called *Tournayſis*, with a biſhop's ſee. It is divided into two parts by the river Scheld; and is large, populous, well built, and carries on a great trade in woollen ſtuffs and ſtockings. The cathedral is a very handſome ſtructure, and contains a great many chapels, with rich ornaments, and ſeveral magnificent tombs of marble and braſs. The town was taken by the allies in 1709; but was ceded to the houſe of Auſtria by the treaty of Utrecht, though the Dutch had a right to put in a garriſon. It was taken by the French in June 1745, who demoliſhed the fortifications. In 1781 the emperor Joſeph II. obliged the Dutch to withdraw their garriſon. It was taken by the French in 1791, abandoned by them in 1793, and again conquered by them in 1794. It is 14 miles ſouth-eaſt of Liſle, 30 ſouth-weſt of Ghent, and 135 north by eaſt from Paris. E. Long. 3. 28. N. Lat. 50. 33.

TOURNEFORT (Joſeph Pitton de), a famous French botaniſt, born at Aix in Provence in 1656. He had a paſſion for plants from his childhood, which overcame his father's views in putting him to ſtudy philoſophy and divinity; therefore on his death he quitted theology, and gave himſelf up entirely to phyſic, natural hiſtory, and botany. He wandered over the mountains of Dauphiny, Savoy, Catalonia, the Pyrenees, and the Alps, in ſearch of new ſpecies of plants, which he acquired with much fatigue and danger. His fame in 1683 procured him the employment of botanic profeſſor, in the king's garden; and by the king's order, he travelled into Spain, Portugal, Holland, and England, where he made prodigious collections of plants. In 1700, Mr Tournefort, in obedience to another order, ſimpled over all the iſles of the Archipelago, upon the coaſts of the Black Sea, in Bithynia, Pontus, Cappadocia, Armenia;

nia, and Georgia; making obſervations on natural hiſtory at large, ancient and modern geography, religion, manners, and commerce. He ſpent three years in this learned voyage; and then reſuming his profeſſion, was made profeſſor of phyſic in the college-royal. He died in conſequence of an accidental cruſh of his breaſt by a cart-wheel, which brought on a ſpitting of blood and hydrothorax, that carried him off in 1708. He wrote Elements of Botany, both in French and Latin; A Relation of his Voyage into the Levant; with other pieces of leſs conſideration.

TOURNIQUET, in ſurgery, an inſtrument formed with ſcrews, for compreſſing any part with rollers, &c. for the ſtopping of hæmorrhagies. See Surgery, n° 160.

TOWER, a tall building conſiſting of ſeveral ſtories, uſually of a round form, though ſome are ſquare or polygonal. Towers are built for fortreſſes, &c. as the Tower of London. See London, n° 46.

TOWN, a place inhabited by a conſiderable number of people, being of a middle ſize between a city and a village.

TOXICODENDRON, in botany. See Rhus.

TRAAS. See Terras.

TRACHEA. See Anatomy, n° 116.

TRACHINUS, the weever, a genius fiſhes belonging to the order of jugulares. There is but one ſpecies, viz. the *draco*, or common weever. The qualities of this fiſh were well known to the ancients, who take notice of them without any exaggeration: the wounds inflicted by its ſpines are exceedingly painful, attended with a violent burning and moſt pungent ſhooting, and ſometimes with an inflammation that will extend from the arm to the ſhoulder.

It is a common notion, that theſe ſymptoms proceed from ſomething more than the ſmall wound this fiſh is capable of inflicting; and that there is a venom infuſed at leaſt into the wounds made by the ſpines that form the firſt dorſal fin, which is dyed with black, and has a moſt ſuſpicious aſpect; though it is poſſible, that the malignity of the ſymptoms ariſes from the habit of body the perſon is in, or the part in which the wound is given. The remedy uſed by ſome fiſhermen is the ſea-ſand, with which they rub the place affected for a conſiderable time. At Scarborough, ſtale urine warmed is uſed with ſucceſs. In the Univerſal Muſeum for November 1765, is an inſtance of a perſon who was reduced to great danger by a wound from this fiſh, and who was cured by the application of ſweet oil, and taking opium and Venice treacle.

This fiſh buries itſelf in the ſands, leaving only its noſe out, and if trod on immediately ſtrikes with great force; and they have been ſeen directing their blows with as much judgment as fighting cocks. Notwithſtanding this noxious property of the ſpines, it is exceeding good meat.

The Engliſh name ſeems to have no meaning, being corrupted from the French *la vive*, ſo called as being capable of living long out of the water, according to the interpretation of Belon. It grows to the length of 12 inches, but is commonly found much leſs: the irides are yellow: the under jaw is longer than the upper, and ſlopes very much towards the belly; the teeth are ſmall: the back is ſtraight, the ſides are flat, the belly is prominent, the lateral line ſtraight: the covers of the gills are armed with a very ſtrong ſpine: the firſt dorſal fin conſiſts of five very ſtrong ſpines, which, as well as the intervening membranes, are tinged with black; this fin, when quieſcent, is lodged in a ſmall hollow: the ſecond conſiſts of ſeveral ſoft rays, commences juſt at the end of the firſt, and continues almoſt to the tail: the pectoral fins are broad and angular; the ventral fins ſmall: the vent is placed remarkably forward, very near the throat: the anal fin extends to a ſmall diſtance from the tail, is a little hollowed in the middle, but not ſo much as to be called forked: the ſides are marked lengthwiſe with two or three dirty yellow lines, and tranſverſely by numbers of ſmall ones; the belly ſilvery.

TRACT, in geography, an extent of ground, or a portion of the earth's ſurface.

Tract, in matters of literature, denotes a ſmall treatiſe or written diſcourſe upon any ſubject.

TRADE, in general, denotes the ſame with commerce, conſiſting in buying, ſelling, and exchanging of commodities, bills, money, &c. See Commerce, Coin, Money, Company, &c.

Trade-Winds, denote certain regular winds at ſea, blowing either conſtantly the ſame way, or alternately this way and that; thus called from their uſe in navigation, and the Indian commerce. See Wind.

TRADESMEN's tokens, a term ſynonymous among medalliſts with provincial coins.

This is a ſubject curious enough to deſerve attention, though we will not go ſo far as Mr Pinkerton does, who ſays that it is a ſubject in which the perpetual glory of the nation is intereſted. Since the year 1789 provincial halfpence have been made and circulated in conſiderable quantity. As ancient medals and coins have been frequently of uſe to hiſtorians, it is to be regretted that many of theſe provincial halfpence are rendered uſeleſs in this reſpect by unmeaning figures and puerile devices. Utility and elegance ought to be ſtudied: for this view it has been propoſed by a gentleman of taſte on this ſubject, that all coins ſhould be diſtinguiſhed by one of the following five characteriſtics. 1. Fac ſimiles of magnificent beautiful buildings. 2. Repreſentations of great and uſeful undertakings. 3. Emblems of the induſtry and commerce of the age. 4. The illuſtrious men, &c. to which the nation has given birth. 5. Important hiſtorical events.

For theſe hints we acknowledge ourſelves indebted to the papers of an ingenious gentleman publiſhed in the periodical works of the time. Thoſe who wiſh to ſee more upon the ſubject, may conſult the Univerſal Magazine for Auguſt 1796.

TRADITION, ſomething handed down from one generation to another without being written. Thus the Jews pretended, that beſides their written law contained in the Old Teſtament, Moſes had delivered an oral law which had been conveyed down from father to ſon; and thus the Roman Catholics are ſaid to value particular doctrines ſuppoſed to have deſcended from the apoſtolic times by tradition.

TRAGACANTH. See Astragalus, Pharmacy-*Index*.

TRAGEDY, a dramatic poem, repreſenting ſome ſignal action performed by illuſtrious perſons, and which has frequently a fatal iſſue or end. See Poetry, Part II. ſect. 1.

TRAGI-comedy, a dramatic piece, partaking both of the nature of tragedy and comedy; in which a mixture of merry and ſerious events is admitted.

TRAGOPOGON, goat's beard, in botany: A genus of plants belonging to the claſs of *ſyngeneſia*, and to the order of *polygamia æqualis*; and in the natural ſyſtem ranging under the 49th order, *Compoſitæ*. The receptacle is naked, the calyx ſimple, and the pappus plumoſe. There are 14 ſpecies; of which two are Britiſh, the *pratenſe* and *porrifolium*.

1. The *pratenſe*, or yellow goat's beard, has its calyxes equal with the florets, and its leaves entire, long, narrow, ſeſſile, and graſſy. In fair weather this plant opens at ſunriſing, and ſhuts between nine and ten in the morning. The

roots are conical and eſculent, and are ſometimes boiled and ſerved up at table like aſparagus. It grows on meadows. 2. The *porrifolium*, or purple goat's beard, has the calyx longer than the radius of the floret; the flowers are large, purple, ſingle, and terminal; and the leaves long, pointed, and bluiſh. The root is long, thick, and eſculent. It grows in meadows, and is cultivated in gardens under the name of *ſalſafy*.

TRAJAN (Marcus Ulpius), a celebrated Roman emperor, who gained many victories over the Parthians and Germans, puſhing the empire to its utmoſt extent on the eaſt and north ſides. He died at Silinunte, a city of Cilicia, which from him was called *Trajanopolis*, in the year 117.

Trajan's Column, a famous hiſtorical column erected in Rome, in honour of the emperor Trajan. It is of the Tuſcan order, though ſomewhat irregular: its height is eight diameters, and its pedeſtal Corinthian: it was built in a large ſquare called *Forum Romanum*. Its baſe conſiſts of 12 ſtones of an enormous ſize, and is raiſed on a ſocle, or foot, of eight ſteps: withinſide is a ſtaircaſe illuminated with 44 windows. It is 140 feet high, which is 35 feet ſhort of the Antonine column, but the workmanſhip of the former is much more valued. It is adorned from top to bottom with baſſo relievos, repreſenting the great actions of the emperor againſt the Dacians.

TRAIN, a line of gunpowder laid to give fire to a quantity thereof, in order to do execution by blowing up earth, works, buildings, &c.

Train of Artillery, includes the great guns and other pieces of ordnance belonging to an army in the field.

Train-Oil, the oil procured from the blubber of a whale by boiling.

TRALLIAN (Alexander), a Greek writer on phyſic, a native of Tralles in Lydia, who lived about the middle of the ſixth century. His works are divided into 12 books; in which he treats of diſtempers as they occur, from head to foot. He was the firſt who opened the jugular vein, and that uſed cantharides as a bliſter for the gout. Dr Freind, in his Hiſtory of Phyſic, ſtyles him one of the moſt valuable authors ſince the time of Hippocrates. Though he appears on the whole to have been a rational phyſician, yet there are things in his writings that ſavour of enthuſiaſm and ſuperſtition.

TRA-LOS-MONTES, a province of Portugal, called in Latin *Tranſmontana*, becauſe ſituated on the eaſt ſide of a chain of hills that ſeparate it from Entre Duero-e-Mintio. It is bounded on the north by Galicia; on the ſouth by the provinces of Beira and Leon; by the laſt of which it is bounded alſo to the eaſt. Its length from north to ſouth is upwards of 120 miles, and its breadth about 80. It is full of mountains, and produces little corn, but plenty of wine, fruits of ſeveral ſorts, and abundance of game.

TRANSACTIONS, a name generally given to a collection of the papers read before literary or philoſophical ſocieties. The name of *Philoſophical Tranſactions* was firſt adopted by the Royal Society of London. See an account of the Royal Society, Vol. XVII. p. 582.

The Philoſophical Tranſactions to the end of the year 1700 were abridged in three volumes by Mr John Lowthorp: thoſe from the year 1700 to 1720 were abridged in two volumes by Mr Henry Jones: thoſe from 1719 to 1733 were abridged in two volumes by Mr John Eames and Mr John Martyn; Mr Martyn continued the abridgement of thoſe from 1732 to 1744 in two volumes, and of thoſe from 1743 to 1750 in two volumes.

They were for many years publiſhed in numbers, and the printing of them was always, from time to time, the ſingle act of the reſpective ſecretaries, till the year 1752, when the ſociety thought fit that a committee ſhould be appointed to reconſider the papers read before them, and to ſelect out of them ſuch as they ſhould judge moſt proper for publication in the future Tranſactions. They are publiſhed annually in two parts at the expence of the ſociety, and each fellow is entitled to receive one copy *gratis* of every volume publiſhed after his admiſſion into the ſociety.

They were firſt ſet on foot in 1665, by Mr Oldenburg, ſecretary of the ſociety, and were continued by him till the year 1677. Upon his death, they were diſcontinued till January 1678, when Dr Grew reſumed the publication of them, and continued it for the months of December 1678, and January and February 1679, after which they were intermitted till January 1683. During this laſt interval they were ſupplied in ſome meaſure by Dr Hooke's Philoſophical Collections. They were alſo interrupted for three years, from December 1687 to January 1691, beſide other ſmaller interruptions amounting to near one year and a half more, before October 1695, ſince which time the Tranſactions have been regularly carried on.

TRANSCENDENTAL, or TRANSCENDENT, ſomething elevated, or raiſed above other things; which paſſes and tranſcends the nature of other inferior things.

TRANSCRIPT, a copy of any original writing, particularly that of an act or inſtrument inſerted in the body of another.

TRANSFER, in commerce, an act whereby a perſon ſurrenders his right, intereſt, or property, in any thing moveable or immoveable to another.

TRANSFORMATION, in general, denotes a change of form, or the aſſuming a new form different from a former one.

TRANSFUSION, the act of pouring a liquor out of one veſſel into another.

Transfusion of Blood, an operation by which it was ſome time ago imagined that the age of animals would be renewed, and immortality, or the next thing to it conferred on thoſe who had undergone it.

The method of tranſfuſing Dr Lower gives us to the following effect: take up the carotid artery of the dog, or other animal, whoſe blood is to be tranſfuſed into another of the ſame, or a different kind; ſeparate it from the nerve of the eighth pair, and lay it bare above an inch. Make a ſtrong ligature on the upper part of the artery; and an inch nearer the heart another ligature with a running knot, to be looſened and faſtened as occaſion requires. Draw two threads between the two ligatures, open the artery, put in a quill, and tie up the artery again upon the quill by the two threads, and ſtop the quill by a ſtick.

Then make bare the jugular vein of the other animal for about an inch and half in length, and at each end make a ligature with a running knot; and in the ſpace between the two knots draw under the veins two threads, as in the other. Open the vein, and put into it two quills, one into the deſcending part of the vein, to receive the blood from the other dog, and carry it to the heart; the other quill put into the other part of the jugular, towards the head, through which the ſecond animal's own blood is to run into diſhes. The quills thus tied faſt, ſtop them up with ſticks till there be occaſion to open them.

Things thus diſpoſed, faſten the dogs on their ſides towards one another, in ſuch manner as that the quills may go into each other; then unſtop the quill that goes down into the ſecond dog's jugular vein, as alſo that coming out of the other dog's artery; and by the help of two or three other quills put into each other, as there ſhall be occaſion, inſert them into one another. Then ſlip the running knots, and immediately the blood runs through the quills as through an artery, very impetuouſly. As the blood runs into the dog, unſtop the quill in the upper part of his jugular, for his own blood to run out at, though not conſtantly, but as you perceive him able to bear it, till the other dog begins to cry and faint, and at laſt die. *Laſtly*, take both quills out of the jugular, tie the running knot faſt, and cut the vein aſunder, and ſew up the ſkin: the dog, thus diſmiſſed, will run away as if nothing ailed him.

In the Philoſophical Tranſactions we have accounts of the ſucceſs of various tranſfuſions practiſed at London, Paris, in Italy, &c. Sir Edmund King tranſfuſed forty-nine ounces of blood out of a calf into a ſheep; the ſheep, after the operation, appearing as well and as ſtrong as before.

M. Denis tranſfuſed the blood of three calves into three dogs, which all continued briſk, and eat as well as before. The ſame perſon tranſfuſed the blood of four wethers into a horſe twenty-ſix years old, which thence received much ſtrength, and a more than ordinary appetite.

Soon after this operation was introduced at Paris, *viz.* in 1667 and 1668, M. Denis performed it on five human ſubjects, two of whom recovered of diſorders under which they laboured, one being in perfect health ſuffered no inconvenience from it; and two perſons who were ill, and ſubmitted to the operation, died: in conſequence of which the magiſtrates iſſued a ſentence, prohibiting the tranſfuſion on human bodies under pain of impriſonment.

Mr John Hunter, we are told, made many ingenious experiments to determine the effects of tranſfuſing blood, ſome of which are ſufficient to attract attention. But whether ſuch experiments can ever be made with ſafety on the human body, is a point not eaſily determined. They might be allowed in deſperate caſes proceeding from a corruption of the blood, from poiſon, &c. as in hydrophobia.

TRANSIT, from *tranſit*, "it paſſes over," ſignifies the paſſage of any planet over the ſun, moon, or ſtars.

TRANSITION, the paſſage of any thing from one place to another.

TRANSITION, in oratory. See ORATORY, n° 39.

TRANSITIVE, in grammar, an epithet applied to ſuch verbs as ſignify an action which paſſes from the ſubject that does it, to or upon another ſubject which receives it. Under the head of verbs tranſitive come what we uſually call *verbs active* and *paſſive*; other verbs, whoſe action does not paſs out of themſelves, are called *neuters*.

TRANSLATION, the act of transferring or removing a thing from one place to another; as we ſay, the tranſlation of a biſhop's ſee, a council, a ſeat of juſtice, &c.

TRANSLATION is alſo uſed for the verſion of a book or writing out of one language into another.

The principles of tranſlation have been clearly and accurately laid down by Dr Campbell of Aberdeen in his invaluable Preliminary Diſſertations to his excellent tranſlations of the goſpels. The fundamental rules which he eſtabliſhes are three: 1. That the tranſlation ſhould give a complete tranſcript of the ideas of the original. 2. That the ſtyle and manner of the original ſhould be preſerved in the tranſlation. 3. That the tranſlation ſhould have all the eaſe of original compoſition. The rules deducible from theſe general laws are explained and illuſtrated with much judgment and taſte, in a late Eſſay on the principles of Tranſlation, by Mr Tytler, judge-advocate of Scotland.

TRANSMARINE, ſomething that comes from or belongs to the parts beyond ſea.

TRANSMIGRATION, the removal or tranſlation of a whole people into another country, by the power of a conqueror.

TRANSMIGRATION is particularly uſed for the paſſage of the ſoul out of one body into another. See METEMPSYCHOSIS.

TRANSMUTATION, the act of changing one ſubſtance into another.

Nature, ſays Sir Iſaac Newton, is delighted with tranſmutation: water, which is a fluid, volatile, taſteleſs, ſalt, is, by heat, tranſmuted into vapour, which is a kind of air; and by cold into ice, which is a cold, tranſparent, brittle ſtone, eaſily diſſolvable; and this ſtone is convertible again into water by heat, as vapour is by cold.—Earth, by heat, becomes fire, and, by cold, is turned into earth again: denſe bodies, by fermentation, are rarefied into various kinds of air; and that air, by fermentation alſo, and ſometimes without it, reverts into groſs bodies. All bodies, beaſts, fiſhes, inſects, plants, &c. with all their various parts, grow and increaſe out of water and aqueous and ſaline tinctures? and, by putrefaction, all of them revert into water, or an aqueous liquor again.

TRANSMUTATION, in alchemy, denotes the act of changing imperfect metals into gold or ſilver. This is alſo called the *grand operation*; and, they ſay, it is to be effected with the philoſopher's ſtone.

The trick of tranſmuting cinnabar into ſilver is thus: the cinnabar, being bruiſed groſsly, is ſtratified in a crucible with granulated ſilver, and the crucible placed in a great fire; and, after due time for calcination, taken off; then the matter, being poured out, is found to be cinnabar turned into real ſilver, though the ſilver grains appear in the ſame number and form as when they were put into the crucible; but the miſchief is, coming to handle the grains of ſilver, you find them nothing but light friable bladders, which will crumble to pieces between the fingers.

The tranſmutability of water into earth ſeems to have been believed by Mr Boyle; and Biſhop Watſon thinks that it has not yet been diſproved. See his *Chemical Eſſays*.

TRANSMUTATION of Acids. See CHEMISTRY-*Index*.

TRANSMUTATION of Metals. See CHEMISTRY-*Index*.

TRANSOM, among builders, denotes the piece that is framed acroſs a double-light window.

TRANSOMS, in a ſhip, certain beams or timbers extended acroſs the ſternpoſt of a ſhip, to fortify her afterpart, and give it the figure moſt ſuitable to the ſervice for which ſhe is calculated.

TRANSPARENCY, in phyſics, a quality in certain bodies, whereby they give paſſage to the rays of light; in contradiſtinction to opacity, or that quality of bodies which renders them impervious to the rays of light.

It has been generally ſuppoſed by philoſophers, that tranſparent bodies have their pores diſpoſed in ſtraight lines, by which means the rays of light have an opportunity of penetrating them in all directions; but ſome experiments in electricity have made it apparent, that by the action of this fluid the moſt opaque bodies, ſuch a ſulphur, pitch, and ſealing-wax, may be rendered tranſparent as glaſs, while yet we cannot ſuppoſe the direction of their pores to be anyway altered from what it originally was (ſee ELECTRICITY, n° 4.) A curious inſtance of an increaſe of tranſparency we have in rubbing a piece of white paper over one that has been written upon or printed: while the white paper is at reſt, the writing or print will perhaps ſcarce appear through it; but when in motion, will be very, eaſily legible, and continue ſo till the motion is diſcontinued.

TRANSPOSITION, in grammar, a diſturbing or diſlocating

cating the words of a diſcourſe, or a changing their natural order of conſtruction, to pleaſe the ear by rendering the contexture more ſmooth, eaſy and harmonious.

TRANSUBSTANTIATION, in theology, the converſion or change of the ſubſtance of the bread and wine in the euchariſt, into the body and blood of Jeſus Chriſt; which the Romiſh church ſuppoſe to be wrought by the conſecration of the prieſt. See *Supper of the Lord*, n° 5.

TRANSVERSALIS, in anatomy, a name given to ſeveral muſcles. See Anatomy, Part II.

TRANSVERSE, ſomething that goes acroſs another from corner to corner: thus bends and bars in heraldry are tranſverſe pieces or bearings; the diagonals of a parallelogram or a ſquare are tranſverſe lines.

TRANSYLVANIA, a province of Europe, annexed to Hungary, and bounded on the north by Upper Hungary and Poland, on the eaſt by Moldavia and Walachia, on the ſouth by Walachia, and on the weſt by Upper and Lower Hungary. It is ſurrounded on all parts by high mountains, which, however, are not barren. The inhabitants have as much corn and wine as they want themſelves; and there are rich mines of gold, ſilver, lead, copper, quickſilver, and alum. It has undergone various revolutions; but it now belongs to the houſe of Auſtria. The inhabitants are of ſeveral ſorts of religions; as Papiſts, Lutherans, Calviniſts, Socinians, Photinians, Arians, Greeks, and Mahometans. It is about 162 miles in length, and 150 in breadth. The adminiſtration of affairs is conducted by 12 perſons; namely, three Roman Catholics, three Lutherans, three Calviniſts, and three Socinians. The militia is commanded by the governor, whoſe commiſſion is the more important, as Tranſylvania is the bulwark of Chriſtendom. It is divided into ſeveral ſmall diſtricts, called *palatinates* and *counties*; and is inhabited by three different nations, Saxons, Sicilians, and Hungarians. Hermanſtadt is the capital town.

TRAPEZIUM, in geometry, a plane figure contained under four unequal right lines.

TRAPEZIUS, a muſcle. See Anatomy, Part II.

TRAPP (Dr Joſeph), an Engliſh divine of excellent parts and learning, was born at Cherington in Glouceſterſhire, of which place his father was rector in 1579. He was the firſt perſon choſen to the profeſſorſhip of poetry founded at Oxford by Dr Birkhead; and publiſhed his lectures under the title of *Prælectiones Poeticæ*, in which he laid down excellent rules for every ſpecies of poetry in very elegant Latin. He ſhowed afterwards, however, by his tranſlation of Virgil, that a man may be able to direct who cannot execute, and may have the critic's judgment without the poet's fire. In the early part of his life Dr Trapp is ſaid to have been chaplain to the father of the famous Lord Bolingbroke: he obtained the living of Chriſt-church in Newgate Street, and St Leonard's, Foſter-lane, London; and his very high-church principles probably obſtructed his farther preferment. He publiſhed ſeveral occaſional poems, a tragedy called *Abramule*, tranſlated Milton's Paradiſe Loſt into Latin verſe, and died in 1747.

Trapp, in mineralogy, a ſpecies of ſiliceous earth. It is deſcribed by Dr Kirwan as nearly the ſame with baſaltes: a dark grey or black ſtone, generally inveſted with a ferruginous cruſt, and cryſtallized in opake, triangular, or polyangular columns, is called *baſaltes*; that which is amorphous, or breaks in large, thick, ſquare pieces, is called *trapp*. Their conſtituent principles, and relation to acids and fluxes, are exactly the ſame. The texture of this ſtone is either coarſe, rough, and diſtinct, or fine and indiſcernible. It is often reddiſh; it is always opake, and moulders by expoſure to the air; ſome ſpecimens give fire with ſteel very difficultly, though it is always very compact; ſometimes it is ſprinkled over with a few minute ſhining particles; its ſpecific gravity is 3000.

When heated red-hot, and quenched in water, it becomes by degrees of a reddiſh brown colour: it melts *per ſe* in a ſtrong heat into a compact ſlag. Borax alſo diſſolves it in fuſion, but mineral alkali not entirely.

According to Mr Bergman, 100 parts of the baſaltes contain 52 of ſiliceous earth, 15 of argil, 8 of calcareous, 2 of magneſia, and 25 of iron; and with this Mr Meyer very nearly agrees.

For a more complete account of this ſpecies of ſtone, ſee M. Faujas de St Fond on the *Nat. Hiſt. of Trapp*.

TRAVELLERS joy. See Clematis.

TRAVERSE, or transverse, in general, denotes ſomething that goes athwart another; that is, croſſes and cuts it obliquely.

Traverse, in navigation, implies a compound courſe, or an aſſemblage of various courſes, lying at different angles with the meridian. See Navigation, p. 688.

Traverse Board, a thin circular piece of board, marked with all the points of the compaſs, and having eight holes bored in each, and eight ſmall pegs hanging from the centre of the board. It is uſed to determine the different courſes run by a ſhip during the period of the watch, and to aſcertain the diſtance of each courſe.

TRAVESTY, a name given to an humorous tranſlation of any author. The word is derived from the French *traveſter* "to diſguiſe."

TRAUMATIC balsam. See Pharmacy, n° 428.

TREACLE. See Theriaca.—Some alſo give the name *treacle* to molaſſes. See Pharmacy, n° 605.

Treacle Beer. See Spruce.

Treacle Muſtard. See Clypeola.

TREASON, a general appellation made uſe of by the law, to denote not only offences againſt the king and government, but alſo that accumulation of guilt which ariſes whenever a ſuperior repoſes a confidence in a ſubject or inferior, between whom and himſelf there ſubſiſts a natural, a civil, or even a ſpiritual relation; and the inferior ſo abuſes that confidence, ſo forgets the obligations of duty, ſubjection, and allegiance, as to deſtroy the life of any ſuch ſuperior or lord. Hence treaſon is of two kinds, *high* and *petty*.

High Treaſon, or *Treaſon Paramount* (which is equivalent to the *crimen læſæ majeſtatis* of the Romans, as Glanvil denominates it alſo in the Engliſh law), is an offence committed againſt the ſecurity of the king or kingdom, whether by imagination, word, or deed. In order to prevent the inconveniences which aroſe in England from a multitude of conſtructive treaſons, the ſtatute 25 Edw. III. c. 2. was made; which defines what offences only for the future ſhould be held to be treaſon; and this ſtatute comprehends all kinds of high-treaſon under ſeven diſtinct branches.

"1. When a man doth compaſs or imagine the death of our lord the king, of our lady his queen, or of their eldeſt ſon and heir." Under this deſcription it is held that a queen-regnant (ſuch as Queen Elizabeth and Queen Anne) is within the words of the act, being inveſted with royal power, and intitled to the allegiance of her ſubject: but the huſband of ſuch a queen is not compriſed within theſe words; and therefore no treaſon can be committed againſt him.

Let us next ſee what is a *compaſſing* or *imagining* the death of the king, &c. Theſe are ſynonymous terms: the word *compaſs* ſignifying the purpoſe or deſign of the mind or will; and not, as in common ſpeech, the carrying ſuch deſign to effect. And therefore an accidental ſtroke, which may mortally wound the ſovereign, *per infortunium*, without any traitorous intent, is no treaſon: as was the caſe of Sir Walter Tyrrel, who, by the command of King William Rufus, ſhooting at a hart, the arrow glanced againſt a tree, and killed the king upon the ſpot. But as this compaſſing or imagination is an act of the mind, it cannot poſſibly fall under any judicial cognizance, unleſs it be demonſtrated by ſome open or overt act. The ſtatute expreſsly requires, that the accuſed “ be thereof upon ſufficient proof attainted of ſome open act by men of his own condition.” Thus, to provide weapons or ammunition for the purpoſe of killing the king, is held to be a palpable overt act of treaſon in imagining his death. To conſpire to impriſon the king by force, and move towards it by aſſembling company, is an overt act of compaſſing the king's death; for all force, uſed to the perſon of the king, in its conſequences may tend to his death, and is a ſtrong preſumption of ſomething worſe intended than the preſent force, by ſuch as have ſo far thrown off their bounden duty to their ſovereign: it being an old obſervation, that there is generally but a ſhort interval between the priſons and the graves of princes. It ſeems clearly to be agreed, that by the common law and the ſtatute of Edw. III. words ſpoken amount only to a high miſdemeanor, and no treaſon. For they may be ſpoken in heat, without any intention; or be miſtaken, perverted, or miſremembered by the hearers; their meaning depends always on their connection with other words and things; they may ſignify differently even according to the tone of voice with which they are delivered; and ſometimes ſilence itſelf is more expreſſive than any diſcourſe. As therefore there can be nothing more equivocal and ambiguous than words, it would indeed be unreaſonable to make them amount to high treaſon. And accordingly, in 4 Car. I. on a reference to all the judges, concerning ſome very atrocious words ſpoken by one Pyne, they certified to the king, “ that though the words were as wicked as might be, yet they were no treaſon; for unleſs it be by ſome particular ſtatute, no words will be treaſon.” If the words be ſet down in writing, it argues more deliberate intention; and it has been held, that writing is an overt act of treaſon; for *ſcribere eſt agere*. But even in this caſe the bare words are not the treaſon, but the deliberate act of writing them.

2. The ſecond ſpecies of treaſon is, “ if a man do violate the king's companion, or the king's eldeſt daughter unmarried, or the wife of the king's eldeſt ſon and heir.” By the king's companion is meant his wife; and by violation is underſtood carnal knowledge, as well without force as with it: and this is high treaſon in both parties if both be conſenting; as ſome of the wives of Henry VIII. by fatal experience evinced.

3. The third ſpecies of treaſon is, “ if a man do levy war againſt our lord the king in his realm.” And this may be done by taking arms, not only to dethrone the king, but under pretence to reform religion, or the laws, or to remove evil counſellors, or other grievances whether real or pretended. For the law does not, neither can it, permit any private man, or ſet of men, to interfere forcibly in matters of ſuch high importance; eſpecially as it has eſtabliſhed a ſufficient power for theſe purpoſes in the high court of parliament: neither does the conſtitution juſtify any private or particular reſiſtance for private or particular grievances; though, in caſes of national oppreſſion, the nation has very juſtifiably riſen as one man, to vindicate the original contract ſubſiſting between the king and his people.

4. “ If a man be adherent to the king's enemies in his realm, giving to them aid and comfort in the realm or elſewhere,” he is alſo declared guilty of high-treaſon. This muſt likewiſe be proved by ſome overt act; as by giving them intelligence, by ſending them proviſions, by ſelling them arms, by treacherouſly ſurrendering a fortreſs, or the like.

5. “ If a man counterfeit the king's great or privy ſeal,” this is alſo high-treaſon. But if a man takes wax bearing the impreſſion of the great ſeal off from one patent and fixes it to another, this is held to be only an abuſe of the ſeal, and not a counterfeiting of it: as was the caſe of a certain chaplain, who in ſuch a manner framed a diſpenſation for non-reſidence. But the knaviſh artifice of a lawyer much exceeded this of the divine. One of the clerks in chancery glued together two pieces of parchment; on the uppermoſt of which he wrote a patent, to which he regularly obtained the great ſeal, the label going through both the ſkins. He then diſſolved the cement, and taking off the written patent, on the blank ſkin, wrote a freſh patent of a different import from the former, and publiſhed it as true. This was held no counterfeiting of the great ſeal, but only a great miſpriſion; and Sir Edward Coke mentions it with ſome indignation that the party was living at that day.

6. The ſixth ſpecies of treaſon under this ſtatute is, “ if a man counterfeit the king's money; and if a man bring falſe money into the realm counterfeit to the money of England, knowing the money to be falſe, to merchandiſe and make payment withal.” As to the firſt branch, counterfeiting the king's money; this is treaſon, whether the falſe money be uttered in payment or not. Alſo if the king's own minters alter the ſtandard or alloy eſtabliſhed by law, it is treaſon. But gold and ſilver money only are held to be within this ſtatute. With regard likewiſe to the ſecond branch, importing foreign counterfeit money in order to utter it here; it is held that uttering it, without importing it, is not within the ſtatute.

7. The laſt ſpecies of treaſon aſcertained by this ſtatute is, “ if a man ſlay the chancellor, treaſurer, or the king's juſtices of the one bench or the other, juſtices in eyre, or juſtices of aſſize, and all other juſtices aſſigned to hear and determine, being in their places doing their offices.” Theſe high magiſtrates, as they repreſent the king's majeſty during the execution of their offices, are therefore for the time equally regarded by the law. But this ſtatute extends only to the actual killing of them; and not to wounding, or a bare attempt to kill them. It extends alſo only to the officers therein ſpecified; and therefore the barons of the exchequer, as ſuch, are not within the protection of this act; but the lord keeper or commiſſioners of the great ſeal now ſeem to be within it, by virtue of the ſtatutes 5 Eliz. c. 18. and 1 W. and M. c. 21.

The new treaſons, created ſince the ſtatute 1 M. c. 1. and not comprehended under the deſcription of ſtatute 25 Edw. III. may be compriſed under three heads. The firſt ſpecies relates to Papiſts; the ſecond to falſifying the coin or other royal ſignatures, as falſely forging the ſign manual, privy ſignet, or privy ſeal, which ſhall be deemed high treaſon (1 M. ſtat. ii. c. 6.) The third new ſpecies of high treaſon is ſuch as was created for the ſecurity of the Proteſtant ſucceſſion in the houſe of Hanover. For this purpoſe, after the act of ſettlement was made, it was enacted by ſtatute 13 and 14 W. III. c. 3. that the pretended prince of Wales, aſſuming the title of King James III. ſhould be attainted of high treaſon; and it was made high-treaſon for any of the king's ſubjects to hold correſpondence with him or any perſon employed by him, or to remit money for his uſe. And by 17 Geo. II. c. 39. it is enacted, that if any of the ſons of the pretender ſhall land or attempt to land in this kingdom, or be found in the kingdom or any of its dominions, he ſhall be adjudged attainted of high-treaſon; and correſponding with them or remitting money to their uſe is made high-treaſon. By 1 Ann. ſtat. 2. c. 17. the offence of hindering the next in ſucceſſion from ſucceeding to the crown is high-treaſon: and by 6 Ann. c. 7. if any perſon ſhall maliciouſly, adviſedly, and directly, by writing or printing, maintain, that any other perſon hath any right to the crown of this realm, otherwiſe than according to the act of ſettlement, or that the kings of this realm with the authority of parliament are not able to make laws to bind the crown and its deſcent; ſuch perſon ſhall be guilty of high-treaſon.

The puniſhment of high treaſon in general is very ſolemn and terrible. 1. That the offender be drawn to the gallows, and not be carried or walk; though uſually (by connivance, at length ripened by humanity into law) a ſledge or hurdle is allowed, to preſerve the offender from the extreme torment of being dragged on the ground or pavement. 2. That he be hanged by the neck, and then cut down alive. 3. That his entrails be taken out, and burned while he is yet alive. 4. That his head be cut off. 5. That his body be divided into four parts. 6. That his head and quarters be at the king's diſpoſal.

The king may, and often doth, diſcharge all the puniſhment except beheading, eſpecially where any of noble blood are attainted. For beheading being part of the judgment, that may be executed, though all the reſt be omitted by the king's command. But where beheading is no part of the judgment, as in murder or other felonies, it hath been ſaid that the king cannot change the judgment, although at the requeſt of the party, from one ſpecies of death to another.

In the caſe of coining, which is a treaſon of a different complexion from the reſt, the puniſhment is milder for male offenders; being only to be drawn and hanged by the neck till dead. But in treaſons of every kind the puniſhment of women is the ſame, and different from that of men. For as the natural modeſty of the ſex forbids the expoſing and publicly mangling their bodies, their ſentence (which is to the full as terrible to ſenſe as the other) is to be drawn to the gallows, and there to be burned alive.

For the conſequences of this judgment, ſee ATTAINDER, FORFEITURE, and *CORRUPTION of Blood*.

Petty or *Petit Treaſon* according to the ſtatute 25 Edward III. c. 2. may happen three ways: by a ſervant killing his maſter, a wife her huſband, or an eccleſiaſtical perſon (either ſecular or regular) his ſuperior, to whom he owes faith and obedience. A ſervant who kills his maſter whom he has left, upon a grudge conceived againſt him during his ſervice, is guilty of petty treaſon: for the traiterous intention was hatched while the relation ſubſiſted between them, and this is only an execution of that intention. So if a wife be divorced *a menſe et thoro*, ſtill the *vinculum matrimonii* ſubſiſts; and if ſhe kills ſuch divorced huſband, ſhe is a traitreſs. And a clergyman is underſtood to owe canonical obedience to the biſhop who ordained him, to him in whoſe dioceſe he is beneficed, and alſo to the metropolitan of ſuch ſuffragan or dioceſan biſhop; and therefore to kill any of theſe is petit treaſon. As to the reſt, whatever has been ſaid with reſpect to wilful MURDER, is alſo applicable to the crime of petit treaſon, which is no other than murder in its moſt odious degree; except that the trial ſhall be as in caſes of high treaſon, before the improvements therein made by the ſtatutes of William III. But a perſon indicted of petit treaſon may be acquitted thereof, and found guilty of manſlaughter or murder: and in ſuch caſe it ſhould ſeem that two witneſſes are not neceſſary, as in caſes of petit treaſon they are. Which crime is alſo diſtinguiſhed from murder in its puniſhment.

The puniſhment of petit treaſon in a man, is to be drawn and hanged, and in a women to be drawn and burned: the idea of which latter puniſhment ſeems to have been handed down to us from the laws of the ancient Druids, which condemned a woman to be burned for murdering her huſband; and it is now the uſual puniſhment for all ſorts of treaſons committed by thoſe of the female ſex. Perſons guilty of petit treaſon were firſt debarred the benefit of clergy by ſtatute 12 Henry VII. c. 7. which has ſince been extended to their aiders, abettors, and counſellors, by ſtatutes 23 Henry VIII. c. 1. and 4 & 5 P. and M. c. 4.

TREASURE, in general, denotes a ſtore or ſtock of money in reſerve.

TREASURE-Trove, in law, derived from the French word *trover*, "to find," called in Latin *theſaurus inventus*, is where any money or coin, gold, ſilver, plate, or bullion, is found hidden in the earth or other private place, the owner thereof being unknown; in which caſe the treaſure belongs to the king: but if he that hid it be known, or afterwards found out, the owner and not the king is intitled to it.

TREASURER, an officer to whom the treaſure of a prince or corporation is committed to be kept and duly diſpoſed of, in payment of officers and other expences. See TREASURY.

Of theſe there is a great variety. His majeſty of Great Britain, in quality of elector of Brunſwick, is arch-treaſurer of the Roman empire. In England, the principal officers under this denomination are, the lord high-treaſurer, the treaſurer of the houſehold, treaſurer of the navy, of the king's chamber, &c.

The lord high-treaſurer of Great Britain, or firſt commiſſioner of the treaſury, when in commiſſion, has under his charge and government all the king's revenue which is kept in the exchequer. He holds his place during the king's pleaſure; being inſtituted by the delivery of a white ſtaff to him. He has the check of all the officers employed in collecting the cuſtoms and royal revenues: and in his gift and diſpoſition are all the offices of the cuſtoms in the ſeveral ports of the kingdom; eſcheators in every county are nominated by him; he alſo makes leaſes of the lands belonging to the crown.

The office of lord-treaſurer is now in commiſſion. The number of lords commiſſioners is five; one of whom is the firſt lord, whoſe annual ſalary was formerly L. 383, but is now L. 4000; and who, unleſs he be a peer, is alſo chancellor of the exchequer, and prime miniſter in the government of this country; the other lords commiſſioners have an annual ſalary of L. 1600 each.

TREASURER of the Houſehold, is an officer, who, in the abſence of the lord-ſteward, has power, with the comptroller and other officers of the green-cloth and the ſteward of the Marſhalſea, to hear and determine treaſons, felonies, and other crimes committed within the king's palace. See HOUSEHOLD.

There is alſo a treaſurer belonging to the eſtabliſhment of her majeſty's houſehold, &c.

TREASURER of the Navy, is an officer who receives money out of the exchequer, by warrant from the lord high-treaſurer, or the lords commiſſioners executing that place; and pays all charges of the navy, by warrant from the principal officers of the navy.

TREASURER of the County, he that keeps the county ſtock. There are two of them in each county, choſen by the major part of the juſtices of the peace, &c. at their general quarter ſeſſion; under previous ſecurity given for the money entruſted with them, and the faithful execution of the truſts repoſed in them.

TREASURY, the place wherein the revenues of a prince are

are received, preſerved, and diſburſed. In England the treaſury is a part of the exchequer; by ſome called the *lower exchequer*. The officers of his majeſty's treaſury, or the lower exchequer, are the lords commiſſioners, one of whom is chancellor, two joint ſecretaries, private ſecretary to the firſt lord, two chamberlains, an auditor, four tellers, a clerk of the pells, uſhers of the receipt, a tally-cutter, &c. See each officer under his proper article, CHANCELLOR, TELLER, TALLY, &c.

Lords of the TREASURY. In lieu of one ſingle director and adminiſtrator of his majeſty's revenues under the title of *lord high treaſurer*, it is at preſent thought proper to put that office in commiſſion, *i. e.* to appoint ſeveral perſons to diſcharge it with equal authority, under the title of *lords commiſſioners of the treaſury*.

TREATISE, a ſet diſcourſe in writing on any ſubject.

TREATY, a covenant between two or more nations; or the ſeveral articles or conditions ſtipulated and agreed upon between ſovereign powers.

TREBLE, in muſic, the higheſt or moſt acute of the four parts in ſymphony, or that which is heard the cleareſt and ſhrilleſt in a concert.

TREBUCHET, TREBUCKET, *Tribuch (Terbichetum)*, a tumbrel or cucking ſtool. Alſo a great engine to caſt ſtones to batter walls.

TREE, a large vegetable riſing with one woody ſtem to a conſiderable height.

Trees may be divided into two claſſes, *timber* and *fruit-trees*: the firſt including all thoſe trees which are uſed in machinery, ſhip building, &c. or, in general, for purpoſes of utility; and the ſecond comprehending thoſe trees valued only, or chiefly, for their fruit. It is not neceſſary to form a third claſs to include trees uſed for fuel, as timber is uſed for this purpoſe where it is abundant; and where it is not abundant the branches of the timber trees, or ſuch of them as are dwarfiſh, unhealthy, or too ſmall for mechanical purpoſes, are uſed as fuel.

The anatomy and phyſiology of trees have already been given under the generic name PLANT and SAP. For an account of their natural hiſtory, ſee NATURAL HISTORY, ſect. iii.

Certain trees, it is well known, are natives of particular diſtricts; but many of them have been tranſplanted from their native ſoil, and now flouriſh luxuriantly in diſtant countries, ſo that it becomes a matter of very conſiderable difficulty to aſcertain their original ſoil. The following rules are given for this purpoſe by the Honourable Daines Barrington.

1. They muſt grow in large maſſes, and cover conſiderable tracts of ground, the woods not ending abruptly by a change to other trees, except the ſituation and ſtrata become totally different. 2. They muſt grow kindly in copſes, and ſhoot from the ſtool, ſo as to continue for ever, if not very carefully grubbed up. 3. The ſeed muſt ripen kindly; nature never plants, but where a ſucceſſion in the greateſt profuſion will continue. Laſtly, trees that give names to many places are probably indigenous.

The growth of trees is a curious and intereſting ſubject; yet few experiments have been made to determine what the additions are which a tree receives annually in different periods of its age. The only obſervations which we have ſeen on this ſubject worth repeating were made by the ingenious Mr Barker, to whom the Philoſophical Tranſactions are much indebted for papers containing an accurate regiſter of the weather, which he has kept for many years. He has drawn up a table to point out the growth of three kinds of trees, oaks, aſhes, and elms; which may be ſeen in the Philoſophical Tranſactions for 1788. We ſhall give his concluſions.

"I find (ſays he) the growth of oak and aſh to be nearly the ſame. I have ſome of both ſorts planted at the ſame time, and in the ſame hedges, of which the oaks are the largeſt; but there is no certain rule as to that. The common growth of an oak or an aſh is about an inch in girth in a year; ſome thriving ones will grow an inch and a half; the unthriving ones not ſo much. Great trees grow more timber in a year than ſmall ones; for if the annual growth be an inch, a coat of one-ſixth of an inch is laid on all round, and the timber added to the body every year is its length multiplied into the thickneſs of the coat and into the girth, and therefore the thicker the tree is, the more timber is added."

We will preſent our readers with a table, ſhowing the growth of 17 kinds of trees for two years. The trees grew at Cavenham in Suffolk.

		July 1785.			July 1786.			July 1787.	
Nº		F.	In.		F.	In.		F.	In.
1	Oak	0	10½	—	0	11½	—	1	0½
2	Larch	1	0½	—	1	3	—	1	4
3	Scotch fir	1	3½	—	1	5½	—	1	7¾
4	Spruce fir	0	5¾	—	0	6½	—	0	7¼
5	Spaniſh cheſnut	0	7¼	—	0	7½	—	0	8
6	Elm	2	7½	—	2	9	—	2	11
7	Pinaſter	2	3½	—	2	4½	—	2	7½
8	Larch	1	5¼	—	1	6	—	1	7
9	Weymouth pine	0	5	—	0	6	—	0	7¾
10	Acacia	1	2¾	—	1	5¾	—	1	6½
11	Beech	0	6¼	—	0	6½	—	0	7¼
12	Plane occidental	0	6½	—	0	7¾	—	0	8¾
13	Lombardy poplar	1	8	—	2	0	—	2	3¾
14	Black poplar	1	2¼	—	1	4½	—	1	5¾
15	Willow	2	9½	—	3	2	—	3	3
16	Silver fir	0	7¾	—	0	8¾	—	0	9¼
17	Lime	1	8½	—	1	10¾	—	2	0

See HUSBANDRY, nº 165, where the growth of 11 kinds of trees in 21 years is given.

Trees ſometimes attain a very great ſize: this muſt depend in a great meaſure on the richneſs of ſoil, but no leſs on the degree of heat. Indeed heat is ſo eſſential to the growth of trees, that as we go from the place within the polar circles where vegetation begins, and advance to the equator, we find the trees increaſe in ſize. Greenland, Iceland, and other places in the ſame latitude yield no trees at all; and the ſhrubs which they produce are dwarfiſh; whereas in warm climates, they often grow to an immenſe ſize. Mr Marſham ſaw ſpruce and ſilver-firs in the dock-yard in Venice above 40 yards long, and one of 39 yards was 18 inches diameter at the ſmall end. He was informed that they came from Switzerland.

The largeſt tree in Europe, mentioned by travellers, is the cheſnut tree on mount Etna, already deſcribed under the article, ETNA, nº 18. It is a certain fact that trees acquire a very great ſize in volcanic countries. Beſide the multitude of fine groves in the neighbourhood of Albano in Italy, there are many detached oaks 20 feet in circumference, and many elms of the ſame ſize, eſpecially in the romantic way to Eaſtello, called the *Galleria*. In travelling by the ſide of the lake of Bolſena, the road leads us through an immenſe number of oaks, ſpread upon beautiful hills. Where the lava has been ſufficiently ſoftened, they are clean and ſtraight, and of a conſiderable ſize; but where the lava has not been converted into a ſoil proper for ſtrong vegetation, they are round-headed, and of leſs bigneſs; however, taken all together, they make a magnificent appearance;

ance; and the ſpot itſelf ought to be ranked among the fine parts of Italy. The ſame may be obſerved of the ſmall lake of Vico, encompaſſed with gentle riſings, that are all clothed with foreſt-trees.

Some yews have been found in Britain 60 feet round. Palms in Jamaica attain the height of 200 feet; and ſome of the pines in Norfolk Iſland are 280 feet high.

Of all the different kinds known in Europe, oak is beſt for building; and even when it lies expoſed to air and water, there is none equal to it. Fir-timber is the next in degree of goodneſs for building, eſpecially in England, where they build upon leaſes. It differs from oak in this, that it requires not much ſeaſoning, and therefore no great ſtock is required before hand. Fir is uſed for flooring, wainſcotting, and the ornamental parts of building within doors. Elm is the next in uſe, eſpecially in England and France: it is very tough and pliable, and therefore eaſily worked: it does not readily ſplit; and it bears driving of bolts and nails better than any other wood; for which reaſon it is chiefly uſed by wheel-wrights and coach-makers, for ſhafts, naves, &c. Beech is alſo uſed for many purpoſes: it is very tough and white when young, and of great ſtrength; but liable to warp very much when expoſed to the weather, and to be worm-eaten when uſed within doors; its greateſt uſe is for planks, bedſteads, chairs, and other houſehold goods. Aſh is likewiſe a very uſeful wood, but very ſcarce in moſt parts of Europe; it ſerves in buildings, and for any other uſe, when ſcreened from the weather; handſpikes and oars are chiefly made of it. Wild cheſnut timber is by many eſteemed to be as good as oak, and ſeems to have been much uſed in old buildings; but whether theſe trees are more ſcarce at preſent than formerly, or have been found not to anſwer ſo well as was imagined, it is certain that this timber is now but little uſed. Walnut tree is excellent for the joiner's uſe, it being of a more curious brown colour than beech, and not ſo ſubject to the worms. The poplar, abele, and aſpen trees, which are very little different from each other, are much uſed inſtead of fir; they look well, and are tougher and harder. See Quercus, Oak, Pinus, Ulmus, Platanus, Populus, &c.

The goodneſs of timber not only depends on the ſoil and ſituation in which it ſtands, but likewiſe on the ſeaſon wherein it is felled. In this people diſagree very much; ſome are for having it felled as ſoon as its fruit is ripe, others in the ſpring, and many in the autumn. But as the ſap and moiſture of the timber is certainly the cauſe that it periſhes much ſooner than it otherwiſe would do, it ſeems evident, that timber ſhould be felled when there is the leaſt ſap in it, *viz.* from the time that the leaves begin to fall till the trees begin to bud. This work uſually commences about the end of April in England, becauſe the bark then riſes moſt freely; for where a quantity of timber is to be felled, the ſtatute requires it to be done then, for the advantage of tanning. The ancients chiefly regarded the age of the moon in felling their timber; their rule was to fell it in the wane, or four days after the new moon, or ſometimes in the laſt quarter. Pliny adviſes it to be in the very inſtant of the change; which happening to be in the laſt day of the winter ſolſtice, the timber, ſays he, will be incorruptible

Timber ſhould likewiſe be cut when of a proper age; for when it is either too young or too old, it will not be ſo durable as when cut at a proper age. It is ſaid that oak ſhould not be cut under 60 years old, nor above 200. Timber, however, ſhould be cut in its prime, when almoſt fully grown, and before it begins to decay; and this will be ſooner or later, according to the dryneſs and moiſtneſs of the ſoil where the timber grows, as alſo according to the bigneſs of the trees; for there are no fixed rules in felling of timber, experience and judgment muſt direct here as in moſt other caſes.

Great attention is neceſſary in the ſeaſoning of timber. Some adviſe the planks of timber to be laid for a few days in ſome pool or running ſtream, in order to extract the ſap, and afterwards to dry them in the ſun or air. By this means, it is ſaid, they will be prevented from either chopping, caſting, or cleaving; but againſt ſhrinking there is no remedy. Some again are for burying them in the earth, others in a heat; and ſome for ſcorching and ſeaſoning them in fire, eſpecially piles, poſts, &c. which are to ſtand in water or earth. The Venetians firſt found out the method of ſeaſoning by fire: which is done after this manner: They put the piece to be ſeaſoned into a ſtrong and violent flame; in this they continually turn it round by means of an engine, and take it out when it is every where covered with a black coaly cruſt; the internal part of the wood is thereby ſo hardened, that neither earth nor water can damage it for a long time afterwards.

Dr Plott ſays, it is found by long experience, that the trunk or body of the trees, when barked in the ſpring, and left ſtanding naked all the ſummer expoſed to the ſun and wind, are ſo dried and hardened, that the ſappy part in a manner becomes as firm and durable as the heart itſelf. This is confirmed by M. Buffon, who, in 1738, preſented to the royal academy of ſciences at Paris, a memoir, intitled, "An eaſy method of increaſing the ſolidity, ſtrength, and duration of timber;" for which purpoſe he obſerves, "nothing more is neceſſary than to ſtrip the tree entirely of its bark, during the ſeaſon of the riſing of the ſap, and to leave it to dry completely before it be cut down."

By many experiments, particularly deſcribed in that eſſay, it appears, that the tree ſhould not be felled till the third year after it has been ſtripped of the bark; that it is then perfectly dry, and the ſap become almoſt as ſtrong as the reſt of the timber, and ſtronger than the heart of any other oak tree which has not been ſo ſtripped; and the whole of the timber ſtronger, heavier, and harder; from which he thinks it fair to conclude, that it is alſo more durable. "It would no longer (he adds) be neceſſary, if this method were practiſed, to cut off the ſap; the whole of the tree might be uſed as timber; one of 40 years growth would ſerve all the purpoſes for which one of 60 years is now required; and this practice would have the double advantage of increaſing the quantity, as well as the ſtrength and ſolidity, of the timber."

The navy board, in anſwer to the inquiries of the commiſſioners of the land revenue, in May 1789, informed them, that they had then ſtanding ſome trees ſtripped of their bark two years before, in order to try the experiment of building one half of a ſloop of war with that timber, and the other half with timber felled and ſtripped in the common way. This very judicious mode of making the experiment, if it be properly executed, will undoubtedly go far to aſcertain the effects of this practice. We are ſorry that we are not able to inform our readers what was the reſult of the experiment.

After the planks of timber have been well ſeaſoned and fixed in their places, care is to be taken to defend or preſerve them; to which the ſmearing them with linſeed oil, tar, or the like oleaginous matter, contributes much. The ancients, particularly Heſiod and Virgil, adviſe the ſmoke-drying of all inſtruments made of wood, by hanging them up in the chimneys where wood fires are uſed. The Dutch preſerve their gates, portcullices, drawbridges, ſluices, &c. by coating them over with a mixture of pitch and tar, whereon they ſtrew ſmall pieces of cockle and other ſhells, beaten almoſt to powder, and mixed with ſea-ſand, which incruſts and arms them wonderfully againſt all aſſaults of wind and weather. When timber is felled before the ſap is perfectly at reſt, it is very ſubject to worms; but to prevent and cure this, Mr Evelyn recommends the following remedy as the moſt approved: Put common ſulphur into a cucurbit, with as much aquafortis as will cover it three fingers deep; diſtil it to dryneſs, which is performed by two or three rectifications. Lay the ſulphur that remains at bottom, being of a blackiſh or ſand-red colour, on a marble, or put it in a glaſs, and it will diſſolve into an oil; with this oil anoint the timber which is infected with worms. This, he ſays, will not only prevent worms, but preſerve all kinds of woods, and many other things, as ropes, nets, and maſts, from putrefaction, either in water, air, or ſnow.

Annals of Agriculture, vol. vi. p. 256.

An experiment to determine the comparative durability of different kinds of timber, when expoſed to the weather, was made by a nobleman in Norfolk; of which an account is given by Sir Thomas Beevor. This nobleman, in the year 1774, ordered three poſts, forming two ſides of a quadrangle, to be fixed in the earth on a riſing ground in his park. Into theſe poſts were mortiſed planks, an inch and an half thick, cut out of trees from 30 to 45 years growth. Theſe, after ſtanding 10 years, were examined, and found in the following ſtate and condition:

The cedar was perfectly ſound; larch, the heart ſound, but the ſap quite decayed; ſpruce fir, ſound; ſilver fir, in decay; Scotch fir, much decayed; pinlaſter, quite rotten; cheſnut, perfectly ſound; abele, ſound; beech, ſound; walnut, in decay; ſycamore, much decayed; birch, quite rotten. Sir Thomas Beevor juſtly remarks, that the trees ought to have been of the ſame age; and Mr Arthur Young adds, they ought to have been cut out of the ſame plantation.

The immenſe quantity of timber conſumed of late years in ſhip-building and other purpoſes has diminiſhed in a very great degree the quantity produced in this country. On this account, many gentlemen who wiſh well to their country, alarmed with the fear of a ſcarcity, have ſtrongly recommended it to government to pay ſome attention to the cultivation and preſervation of timber.

Eleventh Report.

We find, on the beſt authority, that of Mr Irving inſpector general of imports and exports, that the ſhipping of England in 1760 amounted to 6,107 in number, the tonnage being 433,922; and the ſhipping in Scotland amounted to 976 in number, the tonnage being 52,818. In 1788 the whole ſhipping of Britain and Ireland and their colonies amounted to 13,800, being 1,359,752 tons burden, and employing 107,925 men. The tonnage of the royal navy in the ſame year was 413,667. We are informed alſo, on what we conſider as the beſt authority (the report of the commiſſioners of the land revenue), that the quantity of oak timber, of Engliſh growth, delivered into the dockyards from 1760 to 1788 was no leſs than 768,676 loads, and that the quantity uſed in the merchants yards in the ſame time was 516,630 loads; in all 1,285,306 loads. The foreign oak uſed in the ſame period was only 137,766 loads. So that, after deducting the quantity remaining in the dockyards in 1760 and 1788, and the foreign oak, there will remain about 1,054,284 loads of Engliſh oak, conſumed in 28 years, which is at an average 37,653 loads *per annum*, beſides from 8,300 to 10,000 loads expended annually by the Eaſt India company within the ſame period (A).

The price of wood has riſen in proportion to the demand and to its diminution. At the conqueſt, woods were valued, not by the quantity of timber which they contained, but the number of ſwine which the acorns could ſupport. In 1608, oak in the foreſts was ſold at 10s. *per* load, and fire-wood for 2 s. *per* load. In 1663 or 1665, in navy contracts from L.2 to 2l. 15s. 6d. *per* load was given. In 1756 it roſe to 4l. 5s. *per* load, and 3s. in addition, becauſe no tops are received. Plank four inch ſold in 1769 for L.7 a load, three inch L.6; which prices were the ſame in 1792.

So great an expenditure of valuable timber within ſo ſhort a period, gives reaſon to fear that the foreſts of this country will ſoon be entirely diſmantled, unleſs ſomething is done to raiſe freſh ſupplies. The building of a 70 gun ſhip, it is ſaid, would take 40 acres of timber. This calculation is indeed ſo exceſſive, that it is ſcarcely credible. This, however, is no exaggeration. According to the prevailing opinion of experienced ſurveyors, it will require a good ſoil and good management to produce 40 trees on an acre, which, in a hundred years, may, at an average, be computed at two loads each. Reckoning, therefore, two loads at 8l. 16s. one acre will be worth L.350, and conſequently 40 acres will only be worth L.14,200. Now a 70 gun ſhip is generally ſuppoſed to coſt L.70,000; and as ſhips do not laſt a great many years, the navy continually requires new ſhips, ſo that the foreſts muſt be ſtripped in a century or two, unleſs young trees are planted to ſupply their place.

Many plans have been propoſed for recruiting the foreſts. Premiums have been held forth to individuals; and it has been propoſed that the crown-lands ſhould be ſet apart for the ſpecial purpoſe of raiſing timber. With reſpect to individuals, as they muſt generally be diſpoſed to ſow or plant their lands with thoſe vegetables which will beſt reward their labours, it is not to be expected that they will ſet apart their fields for planting trees unleſs they have a greater return from them than other crops. But bad muſt that land be which will not yield much more than L.350 produce in 100 years. But though it be evident that good land will produce crops much more lucrative to the proprietor than timber, yet ſtill there are lands or pieces of land which might be applied with very great advantage to the production of wood. Uneven ground, or the ſides of fields where corn cannot be cultivated, might very properly be ſet apart for this purpoſe; barren lands, or ſuch as cannot be cultivated without great labour and expence, might alſo be planted. Hedge-rows and clumps of trees, and little woods ſcattered up and down, would ſhelter and defend the fields from deſtructive winds, would beautify the face of the country, render the climate warmer, improve barren lands, and furniſh wood for the arts and manufactures.

But to cultivate foreſt timber has alſo been thought of ſuch national importance, that it has been deemed worthy of the attention of government. It has been propoſed to appropriate ſuch part of the crown-lands as are fit for the purpoſe ſolely for producing timber for the navy. This appears a very proper ſcheme in ſpeculation; but it has been objected, that for government to attempt the farming of foreſts would be really to eſtabliſh groups of officers to pocket ſalaries for doing what, it is well known, will never

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(A) A writer in the Bath Tranſactions ſays, that the aggregate of oaks felled in England and Wales for 30 years paſt hath amounted to 320,000 loads a year; and affirms that he has documents in his poſſeſſion founded on indiſputable facts. The difference between this account, and that which we have given in the text from the report of the commiſſioners, we leave to be reconciled by thoſe who have proper opportunities. We give the facts merely on the authority of others.

be done at all. But to this objection we reply, that ſuch an agreement might be made with the inſpectors of foreſts, as to make it their own intereſt to cultivate trees with as much care as poſſible. Their ſalary might be fixed very low, and raiſed in proportion to the number of trees which they could furniſh of ſuch a ſize in a certain number of years. After all, we muſt acknowledge, that we muſt depend greatly on Ruſſia, Sweden, Norway, and America, for ſupplying us with timber; and while theſe countries take our manufactures in exchange, we have no reaſon to complain. Still, however, we ought ſurely not to neglect the cultivation of what is of ſo much importance to our exiſtence as a nation, for it may often be impoſſible in time of war to obtain timber from foreign countries.

In the beginning of this article we mentioned the general diviſion of trees into timber or foreſt-trees and fruit trees. We have already ſaid all that our limits will permit reſpecting the former: we will now, therefore, ſay ſomething of the latter. Our obſervations ſhall be confined to the methods of preſerving fruit trees in bloſſom from the effects of froſt, and from other diſeaſes to which they are liable.

European Magazine, March 1791.

The chevalier de Bienenberg of Prague, we are told, has diſcovered a method of effectually preſerving trees in bloſſom from the fatal effects of thoſe froſts which ſometimes in the ſpring deſtroy the moſt promiſing hopes of a plentiful crop of fruit. His method is extremely ſimple. He ſurrounds the trunk of the tree in bloſſom with a wiſp of ſtraw or hemp. The end of this he ſinks, by means of a ſtone tied to it, in a veſſel of ſpring water, at a little diſtance from the tree. One veſſel will conveniently ſerve two trees; or the cord may be lengthened ſo as to ſurround ſeveral, before its end is plunged into the water. It is neceſſary that the veſſel be placed in an open ſituation, and by no means ſhaded by the branches of the neighbouring trees, that the froſt may produce all its effect on the water, by means of the cord communicating with it.—This precaution is particularly neceſſary for thoſe trees the flowers of which appear nearly at the ſame time as the leaves; which trees are peculiarly expoſed to the ravages of the froſt. The proofs of its efficacy, which he had an opportunity of obſerving in the ſpring of 1787, were remarkably ſtriking. Seven apricot eſpaliers in his garden began to bloſſom in the month of March. Fearing that they would ſuffer from the late froſts, he ſurrounded them with cords as above directed. In effect, pretty ſharp froſts took place ſix or eight nights: the apricot-trees in the neighbouring gardens were all frozen, and none of them produced any fruit, whilſt each of the chevalier's produced fruit in abundance, which came to the greateſt perfection.

The following is the method propoſed by Mr William Forſyth for curing injuries and defects in trees; for which a reward was given to him by his majeſty, on condition that he ſhould make it public. It is equally applicable to foreſt as to fruit trees (b).

Take one buſhel of freſh cow-dung, half a buſhel of lime rubbiſh of old buildings (that from the ceilings of rooms is preferable); half a buſhel of wood-aſhes; and a ſixteenth part of a buſhel of pit or river ſand. The three laſt articles are to be ſifted fine before they are mixed; then work them well together with a ſpade, and afterwards with a wooden beater, until the ſtuff is very ſmooth, like fine plaſter uſed for the ceilings of rooms. The compoſition being thus made, care muſt be taken to prepare the tree properly for its application by cutting away all the dead, decayed, and injured parts, till you come to the freſh ſound wood, leaving the ſurface of the wood very ſmooth, and rounding off the edges of the bark with a draw-knife, or other inſtrument, perfectly ſmooth, which muſt be particularly attended to. Then lay on the plaſter about one eighth of an inch thick all over the part where the wood or bark has been ſo cut away, finiſhing off the edges as thin as poſſible. Then take a quantity of dry powder of wood-aſhes, mixed with a ſixth part of the ſame quantity of the aſhes of burnt bones; put it into a tin box, with holes in the top, and ſhake the powder on the ſurface of the plaſter, till the whole is covered over with it, letting it remain for half an hour to abſorb the moiſture; then apply more powder, rubbing it on gently with the hand, and repeating the application of the powder, till the whole plaſter becomes a dry ſmooth ſurface.

All trees cut down near the ground ſhould have the ſurface made quite ſmooth, rounding it off in a ſmall degree, as before mentioned; and the dry powder directed to be uſed afterwards ſhould have an equal quantity of powder of alabaſter mixed with it, in order the better to reſiſt the dripping of trees and heavy rains. If any of the compoſition be left for a future occaſion, it ſhould be kept in a tub or other veſſel, and urine of any kind poured on it, ſo as to cover the ſurface; otherwiſe the atmoſphere will greatly hurt the efficacy of the application. Where lime-rubbiſh of old buildings cannot be eaſily got, take powdered chalk, or common lime, after having been ſlaked a month at leaſt. As the growth of the tree will gradually affect the plaſter, by raiſing up its edges next the bark, care ſhould be taken, where that happens, to rub it over with the finger when occaſion may require (which is beſt done when moiſtened by rain), that the plaſter may be kept whole, to prevent the air and wet from penetrating into the wound.

Forſyth's Obſervations on the Diſeaſes of Trees.

By this proceſs, ſome old worn-out pear trees, that bore only a few ſmall, hard fruit, of a kernelly texture, were made to produce pears of the beſt quality and fineſt flavour the ſecond ſummer after the operation; and in four or five years they bore ſuch plenteous crops, as a young healthy tree would not have produced in four times that period.

By this proceſs, too, ſome large ancient elms, in a moſt decayed ſtate, having all their upper parts broken, and a ſmall portion only of the bark remaining, ſhot out ſtems from their tops, above thirty feet in height, in ſix or ſeven years from the firſt application of the compoſition.

Thus may valuable fruits be renovated; and foreſt trees, which are uſeful or ornamental from their particular ſituation, be preſerved in a flouriſhing ſtate. But what is far more intereſting, a perfect cure has been made, and ſound timber produced, in oak trees, which had received very conſiderable damage from blows, bruiſes, cutting of deep letters, the rubbing off the bark by the ends of rollers, or wheels of carts, or from the breaking of branches by ſtorms.

TREFOIL, in botany. See Trifolium.

TREMELLA, in botany; a genus of plants belonging to the claſs of *cryptogamia*, and natural order of *algæ*. It is a gelatinous membranous ſubſtance; the parts of the fructification ſcarcely viſible. There are 11 ſpecies; of which five are indigenous; the noſtoc, lichenoides, verrucoſa, hemiſpherica, and purpurea.

(b) A paſte for covering the wounds of trees, and the place where grafts are inſerted, was diſcovered long ago. It is recommended in a Treatiſe on Fruit Trees, publiſhed by Thomas Hitt in 1755; a third edition of which, with additions, was publiſhed in 1768. It conſiſts of a mixture of clay and cows-dung diluted with water. This paſte he directs to be laid on the wound with a bruſh; it adheres firmly, he ſays, without cracking till the wound heals. We are informed by a gentleman, to whoſe opinion and experience we pay great reſpect, that this paſte anſwers every purpoſe which Mr Forſyth's can ſerve.

1. The *noſtoc*, or jelly rain tremella, is found in paſtures and by the ſides of gravel-walks in gardens after rains; not uncommon in ſpring, ſummer, and autumn. It is a membranaceous, pellucid, and gelatinous ſubſtance, without any viſible root; of a yellowiſh duſl green colour; aſſuming various forms, either round, angular, plated, or folded together irregularly, like the inteſtines, or a pocket-handkerchief, an inch or two or more in diameter: ſoft to the touch when moiſt; but thin, membranaceous, and brittle, when dry; and of a black fuſcous colour.—The ancient alchemiſts called this vegetable *the flowers of heaven*, and imagined that from it they would procure the univerſal menſtruum: but all their reſearches ended in diſcovering that by diſtillation it yielded ſome phlegm, volatile ſalt, and empyreumatic oil. It has been extolled in wounds, ulcers, &c. but no regard is ever paid to it by judicious practitioners. Dr Darwin ſays, he has been well informed that this tremella is a mucilage voided by herons after they have eaten frogs!! 2. The *lichenoides*, or tranſparent tremella, is erect, plane, margin curled, lacinulated, and brown. It grows on heaths and in woods, &c. 3. *Verrucoſa*, or warty tremella, is tubercular, ſolid, wrinkled, roundiſh, and reſembling a bladder; it is of a blackiſh yellow. It grows on ſtones in rivulets. 4. *Hemiſpherica*, or ſea tremella, is ſcattered among conſervæ, fuci, &c. 5. *Purpurea*, or purple tremella, is globular, ſeſſile, ſolitary, and ſmooth. It grows on ditch-banks about London.

TREMELLIUS (Emanuel), a Jew by birth, was born at Ferrara in the year 1510. He was ſo carefully educated as to become a great maſter of the Hebrew tongue: he was converted to Chriſtianity by the celebrated Peter Martyr. After travelling to Germany and England, he was made profeſſor of Hebrew, firſt at Heidelberg, and then at Sedan, where he died in 1580. He tranſlated the Hebrew Bible and Syriac Teſtament into Latin; in the former he was aſſiſted by Junius, who afterwards corrected the ſecond edition in 1587. This work was received by the Proteſtant churches with great approbation.

TREMOR, an involuntary ſhaking, chiefly of the hands and head, ſometimes of the feet, and ſometimes of the tongue and heart.—Tremors ariſing from a too free uſe of ſpirituous liquors require the ſame treatment as palſies.

TRENCHES, in fortification, are ditches cut by the beſiegers, that they may approach the more ſecurely to the place attacked; whence they are alſo called *lines of approach*.

TRENT (biſhopric of), a province of Germany, in the circle of Auſtria, near the frontiers of Italy, is bounded on the north by Tirol; on the eaſt, by the Feltrino and Bulluneſe; on the ſouth, by Vicentino, the Veroneſe, Breſciano, and the lake de Garda; and on the weſt, by the Breſciano and the lake de Garda. The ſoil is ſaid to be pretty fruitful, and to abound in wine and oil.

TRENT, a city of Germany, and capital of the biſhopric of that name, is a very ancient place, and ſtands in a fertile and pleaſant plain, in the midſt of the high mountains of the Alps. The river Adige waſhes its walls, and creeping for ſome time among the hills, runs ſwiftly into Italy. Trent has three conſiderable churches, the principal of which is the cathedral: this is a very regular piece of architecture. The church of St Maria Major is all of red and white marble; and is remarkable for being the place where the famous council of Trent was held, whoſe deciſions are now the ſtanding rule of the Romiſh church. E. Long. 11. 5. N. Lat. 46. 10.

TRENT, one of the largeſt rivers in England, which riſes in the Moorland of Staffordſhire, and runs ſouth-weſt by Newcaſtle-under-Line; and afterwards dividing the county in two parts, runs to Burton, then to Nottingham and Newark; and ſo continuing its courſe due north to Gainſborough on the confines of Lincolnſhire, it joins ſeveral rivers, and falls into the Humber.

TRENT (council of), in eccleſiaſtical hiſtory, denotes the council aſſembled by Paul III. in 1545, and continued by 25 ſeſſions till the year 1563, under Julius III. and Pius IV. in order to correct, illuſtrate, and fix with perſpicuity, the doctrine of the church, to reſtore the vigour of its diſcipline, and to reform the lives of its miniſters. The decrees of this council, together with the creed of pope Pius IV. contain a ſummary of the doctrines of the Roman Catholics. Theſe decrees were ſubſcribed by 255 clergy, conſiſting of 4 legates, 2 other cardinals, 3 patriarchs, 25 archbiſhops, 168 biſhops, beſides inferior clergy. Of theſe 150 came from Italy; of courſe the council was entirely under the influence of the pope. For a more particular account of the council of Trent, ſee *Moſheim's Church Hiſtory*, the *Modern Univerſal Hiſtory*, Vol. XXIII. and *Father Paul's Hiſtory of the Council of Trent*.

TRENTON. See *New Jersey*.

TREPANNING. See SURGERY, n° 186.

TRES TABERNÆ (anc. geog.), a place in Latium, lying on the Via Appia, on the left or ſouth ſide of the river Aſtura, to the north of the Paludes Pomptinæ. Its ruins are now ſeen near Ciſterna, a village in the Campagna di Roma, 21 miles from Rome, whence the Chriſtians went out to meet St Paul.

TRESPASS, in law, ſignifies any tranſgreſſion of the law, under treaſon, felony, or miſpriſion of either: but it is commonly uſed for any wrong or damage that is done by one private perſon to another, or to the king in his foreſt.

TRESSLE-TREES, in ſhip-building, two ſtrong bars of timber fixed horizontally on the oppoſite ſides of the lower maſt-head, to ſupport the frame of the top and the weight of the top-maſt.

TRESSURE, in heraldry, a diminutive of an orle, uſually held to be half the breadth thereof.

TRET, in commerce, an allowance made for the waſte or the dirt that may be mixed with any commodity; which is commonly four pounds in every 104 pounds weight.

TREVERI, or TREVIRI (anc. geog.), an ancient and a powerful people both in horſe and foot, according to Cæſar; extending far and wide between the Meuſe and the Rhine. Their chief town was called *Treveris*. Now *Triers* or *Treves*.

TREVES, or TRIERS (in Latin *Trevere*, *Trevers*, *Treviris*, or *Auguſta Trevirorum*), the capital of a German archbiſhopric of the ſame name, ſtands 60 miles weſt of Mentz, 52 ſouth of Cologne, and 82 north of Straſburg. This city vies with moſt in Europe for antiquity, having been a large and noted town before Auguſtus ſettled a colony in it. It was free and imperial till the year 1560, when it was ſurpriſed and ſubjected by its archbiſhop James III. It ſtands on the Moſelle, over which it has a fair ſtone bridge. The cathedral is a large building; and near it ſtands the elector's palace, which not long ago was rebuilt. Here are three collegiate and five pariſh churches, three colleges of Jeſuits, thirteen monaſteries and nunneries, an univerſity founded in 1472, a houſe of the Teutonic order, and another of that of Malta, with ſome remains of the ancient Roman theatre. Roman coins and medals are often found in the ruins of the old city. In the cathedral they pretend to have our Saviour's coat and St Peter's ſtaff, to which they aſcribe miracles. The private houſes here are mean; and the city is neither well fortified nor inhabited. E. Long. 6. 41. N. Lat. 49. 45.

TRIAL, in law, the examination of a cauſe according to the laws of the land before a proper judge; or it is the manner and order obſerved in the hearing and determining of cauſes.

Trials are either civil or criminal.

I. *Civil* TRIALS. The ſpecies of trials in civil caſes are ſeven: By *record;* by *inſpection*, or examination; by *certificate;* by *witneſſes;* by wager of *battel;* by wager of *law;* and by *jury*. The firſt ſix are only had in certain ſpecial or eccentrical caſes, where the trial by jury would not be ſo proper or effectual: (See them explained under their reſpective titles). The nature of the laſt, that principal criterion of truth in the law of England, ſhall be explained in this article.

As trial by jury is eſteemed one of the moſt important privileges which members of ſociety can enjoy, and the bulwark of the Britiſh conſtitution, every man of reflection muſt be ſtimulated by the deſire of inquiring into its origin and hiſtory, as well as to be acquainted with the forms and advantages by which it is accompanied. We will therefore begin with tracing it to its origin. Its inſtitution has been aſcribed to our Saxon anceſtors by Sir William Blackſtone.

Blackſtone's Commentaries, vol. iii. p. 349.

"Some authors (ſays that illuſtrious lawyer) have endeavoured to trace the original of juries up as high as the Britons themſelves, the firſt inhabitants of our iſland; but certain it is, that they were in uſe among the earlieſt Saxon colonies, their inſtitution being aſcribed by biſhop Nicholſon to Woden himſelf, their great legiſlator and captain. Hence it is, that we may find traces of juries in the laws of all thoſe nations which adopted the feodal ſyſtem, as in Germany, France, and Italy; who had all of them a tribunal compoſed of twelve good men and true, *boni homines*, uſually the vaſſals or tenants of the lord, being the equals or peers of the parties litigant; and, as the lord's vaſſals judged each other in the lord's courts, ſo the king's vaſſals, or the lords themſelves, judged each other in the king's court. In England we find actual mention of them ſo early as the laws of king Ethelred, and that not as a new invention. Stiernhook aſcribes the invention of the jury, which in the Teutonic language is denominated *nembda*, to Regner king of Sweden and Denmark, who was contemporary with our king Egbert. Juſt as we are apt to impute the invention of this, and ſome other pieces of juridical polity, to the ſuperior genius of Alfred the Great; to whom, on account of his having done much, it is uſual to attribute every thing: and as the tradition of ancient Greece placed to the account of their own Hercules whatever atchievement was performed ſuperior to the ordinary proweſs of mankind. Whereas the truth ſeems to be, that this tribunal was univerſally eſtabliſhed among all the northern nations, and ſo interwoven in their very conſtitution, that the earlieſt accounts of the one give us alſo ſome traces of the other."

This opinion has been controverted with much learning and ingenuity by Dr Pettingal in his Enquiry into the Uſe and Practice of Juries among the Greeks and Romans, who deduces the origin of juries from theſe ancient nations.

He begins with determining the meaning of the word δικαϛαι in the Greek, and *judices* in the Roman, writers. "The common acceptation of theſe words (ſays he), and the idea generally annexed to them, is that of *preſidents of courts*, or, as we call them, *judges;* as ſuch they are underſtood by commentators, and rendered by critics. Dr Middleton, in his life of Cicero, expreſsly calls the judices, *judges of the bench:* and Archbiſhop Potter, and in ſhort all modern writers upon the Greek or Roman orators, or authors in general, expreſs δικαϛαι and *judices* by ſuch terms as convey the idea of *preſidents in courts of juſtice*. The propriety of this is doubted of, and hath given occaſion for this inquiry; in which is ſhown, from the beſt Greek and Roman authorities, that neither the δικαϛαι of the Greeks, or the *judices* of the Romans, ever ſignified *preſidents in courts of judicature*, or *judges of the bench;* but, on the contrary, they were diſtinguiſhed from each other, and the difference of their duty and function was carefully and clearly pointed out by the orators in their pleadings, who were the beſt authorities in thoſe caſes, where the queſtion related to forms of law, and methods of proceeding in judicial affairs and criminal proceſs.

The preſidents of the courts in criminal trials at Athens were the nine archons, or chief magiſtrates, of which whoever preſided was called ηγεμον δικαϛηριȣ, or preſident of the court. Theſe nine preſided in different cauſes peculiar to each juriſdiction. The archon, properly ſo called, had belonging to his department all pupillary and heritable caſes; the βασιλευς or *rex ſacrorum*, the chief prieſt, all caſes where religion was concerned; the polemarchus, or general, the affairs of the army and all military matters; and the ſix, the ſmothetæ, the other ordinary ſuits.

Wherever then the ανδρες δικαϛαι, or judicial men, are addreſſed by the Greek orators in their ſpeeches, they are not to be underſtood to be the preſiding magiſtrates, but another claſs of men, who were to inquire into the ſtate of the cauſe before them, by witneſſes and other methods of coming at truth; and after inquiry made and witneſſes heard, to report their opinion and verdict to the preſident, who was to declare it.

The ſeveral ſteps and circumſtances attending this judicial proceeding are ſo ſimilar to the forms obſerved by our jury, that the learned reader, for ſuch I muſt ſuppoſe him, cannot doubt but that the nature, intent, and proceedings of the δικαϛηριον among the Greeks were the ſame with the Engliſh jury; namely, for the protection of the lower people from the power and oppreſſion of the great, by adminiſtering equal law and juſtice to all ranks; and therefore when the Greek orators directed their ſpeeches to the ανδρες δικαϛαι, as we ſee in Demoſthenes, Æſchines, and Lyſias, we are to underſtand it in the ſame ſenſe as when our lawyers at the bar ſay, *Gentlemen of the jury*.

So likewiſe among the Romans, the *judices*, in their pleadings at the bar, never ſignified judges of the bench, or preſidents of the court, but a body or order of men, whoſe office in the courts of judicature was diſtinct from that of the prætor or *judex queſtionis*, which anſwered to our judge of the bench, and was the ſame with the archon, or ηγεμον δικαϛηριȣ, of the Greek: whereas the duty of the judices conſiſted in being impannelled, as we call it, challenged, and ſworn to try uprightly the caſe before them; and when they had agreed upon their opinion or verdict, to deliver it to the preſident who was to pronounce it. This kind of judicial proceſs was firſt introduced into the Athenian polity by Solon, and thence copied into the Roman republic, as probable means of procuring juſt judgment, and protecting the lower people from the oppreſſion or arbitrary deciſions of their ſuperiors.

When the Romans were ſettled in Britain as a province, they carried with them their *jura* and *inſtituta*, their laws and cuſtoms, which was a practice eſſential to all colonies; hence the Britons, and other countries of Germany and Gaul, learned from them the Roman laws and cuſtoms; and upon the irruption of the northern nations into the ſouthern kingdoms of Europe, the laws and inſtitutions of the Romans remained, when the power that introduced them was withdrawn: and Monteſquieu tells us, that under the firſt race of kings in France, about the fifth century, the Romans that remained, and the Burgundians their new maſters, lived together under the ſame Roman laws and police, and particularly the ſame forms of judicature. How reaſonable then is it to conclude, that in the Roman courts of judicature continued among the Burgundians, the form of a jury remained in the ſame ſtate it was uſed at Rome. It is certain, Monteſquieu, ſpeaking of thoſe times, mentions the *paires* or *hommes de fief*, homagers or peers, which in the ſame chapter he calls *juges*, *judges* or *jurymen*: ſo that we hence ſee how at that time the *hommes de fief*, or "men of the fief," were called *peers*, and thoſe peers were *juges* or jurymen. Theſe were the ſame as are called in the laws of the confeſſor *pers de la tenure*, the "peers of the tenure, or homagers," out of whom the jury of peers were choſen, to try a matter in diſpute between the lord and his tenant, or any other point of controverſy in the manor. So likewiſe in all other parts of Europe, where the Roman colonies had been, the Goths ſucceeding them, continued to make uſe of the ſame laws and inſtitutions, which they found to be eſtabliſhed there by the firſt conquerors. This is a much more natural way of accounting for the origin of a jury in Europe, than having recourſe to the fabulous ſtory of Woden and his ſavage Scythian companions, as the firſt introducers of ſo humane and beneficent an inſtitution."

Trials by jury in civil cauſes are of two kinds; *extraordinary* and *ordinary*.

1. The firſt ſpecies of *extraordinary* trial by jury is that of the grand aſſize, which was inſtituted by king Henry II. in parliament, by way of alternative offered to the choice of the tenant or defendant in a writ of right, inſtead of the barbarous and unchriſtian cuſtom of duelling. For this purpoſe a writ *de magna aſſiſa elegenda* is directed to the ſheriff, to return four knights, who are to elect and chooſe 12 others to be joined with them; and theſe all together form the grand aſſize, or great jury, which is to try the matter of right, and muſt now conſiſt of 16 jurors. Another ſpecies of extraordinary juries is the jury to try an attaint; which is a proceſs commenced againſt a former jury for bringing a falſe verdict. See the article Attaint.

2. With regard to the *ordinary* trial by jury in civil caſes, the moſt clear and perſpicuous way of treating it will be by following the order and courſe of the proceedings themſelves.

Blackſtone's Commentaries.

When therefore an iſſue is joined by theſe words, "And this the ſaid A prays may be inquired of by the country;" or, "And of this he puts himſelf upon the country, and the ſaid B does the like;" the court awards a writ of *venire facias* upon the roll or record, commanding the ſheriff "that he cauſe to come here, on ſuch a day, twelve free and lawful men, *liberes et legales homines*, of the body of his county, by whom the truth of the matter may be better known, and who are neither of kin to the aforeſaid A nor the aforeſaid B, to recognize the truth of the iſſue between the ſaid parties." And ſuch writ is accordingly iſſued to the ſheriff. It is made returnable on the laſt return of the ſame term wherein iſſue is joined, *viz.* hilary or trinity terms; which, from the making up of the iſſues therein, are uſually called *iſſuable terms*. And he returns the names of the jurors in a panel (a little pane or oblong piece of parchment) annexed to the writ. This jury is not ſummoned, and therefore not appearing at the day muſt unavoidably make default. For which reaſon a compulſive proceſs is now awarded againſt the jurors, called in the common pleas a writ of *habeas corpora juratorum*, and in the King's Bench *diſtringas*, commanding the ſheriff to have their bodies, or to diſtrain them by their lands and goods, that they may appear upon the day appointed. The entry therefore on the roll of record is, "That the jury is reſpited, through defect of the jurors, till the firſt day of the next term, then to appear at Weſtminſter; unleſs before that time, *viz.* on Wedneſday the fourth of March, the juſtices of our lord the king appointed to take aſſizes in that county ſhall have come to Oxford, that is, to the place aſſigned for holding the aſſizes. Therefore the ſheriff is commanded to have their bodies at Weſtminſter on the ſaid firſt day of next term, or before the ſaid juſtices of aſſize, if before that time they come to Oxford, *viz.* on the fourth of March aforeſaid." And as the judges are ſure to come and open the circuit-commiſſions on the day mentioned in the writ, the ſheriff returns and ſummons this jury to appear at the aſſizes; and there the trial is had before the juſtices of aſſize and *niſi prius*: among whom (as hath been ſaid*) are uſually two of the judges of the courts at Weſtminſter, the whole kingdom being divided into ſix circuits for this purpoſe. And thus we may obſerve, that the trial of common iſſues, at *niſi prius*, was in its original only a collateral incident to the original buſineſs of the juſtices of aſſize; though now, by the various revolutions of practice, it is become their principal civil employment; hardly any thing remaining in uſe of the real aſſizes but the name.

* See the article Aſſize.

If the ſheriff be not an indifferent perſon, as if he be a party in the ſuit, or be related by either blood or affinity to either of the parties, he is not then truſted to return the jury; but the *venire* ſhall be directed to the coroners, who in this, as in many other inſtances, are the ſubſtitutes of the ſheriff to execute proceſs when he is deemed an improper perſon. If any exception lies to the coroners, the *venire* ſhall be directed to two clerks of the court, or two perſons of the county named by the court, and ſworn. And theſe two, who are called *eliſors*, or electors, ſhall indifferently name the jury, and their return is final; no challenge being allowed to their array.

Let us now pauſe a while, and obſerve (with Sir Matthew Hale*), in theſe firſt preparatory ſtages of the trial, how admirably this conſtitution is adapted and framed for the inveſtigation of truth beyond any other method of trial in the world. For, firſt, the perſon returning the jurors is a man of ſome fortune and conſequence; that ſo he may be not only the leſs tempted to commit wilful errors, but likewiſe be reſponſible for the faults of either himſelf or his officers; and he is alſo bound by the obligation of an oath faithfully to execute his duty. Next, as to the time of their return: the panel is returned to the court upon the original *venire*, and the jurors are to be ſummoned and brought in many weeks afterwards to the trial, whereby the parties may have notice of the jurors, and of their ſufficiency or inſufficiency, characters, connections, and relations, that ſo they may be challenged upon juſt cauſe; while, at the ſame time, by means of the compulſory proceſs (of *diſtringas*, or *habeas corpora*) the cauſe is not like to be retarded through defect of jurors. Thirdly, as to the place of their appearance: which in cauſes of weight and conſequence is at the bar of the court; but in ordinary caſes at the aſſizes, held in the county where the cauſe of action ariſes, and the witneſſes and jurors live: a proviſion moſt excellently calculated for the ſaving of expence to the parties. For though the preparation of the cauſes in point of pleading is tranſacted at Weſtminſter, whereby the order and uniformity of proceeding is preſerved throughout the kingdom, and multiplicity of forms is prevented; yet this is no great charge or trouble, one attorney being able to tranſact the buſineſs of 40 clients. But the troubleſome and moſt expenſive attendance is that of jurors and witneſſes at the trial; which therefore is brought home to them, in the

* Hiſt. C. L. c. 12.

county where moſt of them inhabit. Fourthly, the perſons before whom they are to appear, and before whom the trial is to be held, are the judges of the ſuperior court, if it be a trial at bar; or the judges of aſſize, delegated from the courts at Weſtminſter by the king, if the trial be held in the country: perſons whoſe learning and dignity ſecure their juriſdiction from contempt, and the novelty and very parade of whoſe appearance have no ſmall influence upon the multitude. The very point of their being ſtrangers in the county is of infinite ſervice, in preventing thoſe factions and parties which would intrude in every cauſe of moment, were it tried only before perſons reſident on the ſpot, as juſtices of the peace, and the like. And the better to remove all ſuſpicion of partiality, it was wiſely provided by the ſtatutes 4 Edw. III. c. 2. 8 Ric. II. c. 2. and 33 Hen. VIII. c. 24. that no judge of aſſize ſhould hold pleas in any county wherein he was born or inhabits. And as this conſtitution prevents party and faction from intermingling in the trial of right, ſo it keeps both the rule and the adminiſtration of the laws uniform. Theſe juſtices, though thus varied and ſhifted at every aſſizes, are all ſworn to the ſame laws, have had the ſame education, have purſued the ſame ſtudies, converſe and conſult together, communicate their deciſions and reſolutions, and preſide in thoſe courts which are mutually connected, and their judgments blended together, as they are interchangeably courts of appeal or advice to each other. And hence their adminiſtration of juſtice, and conduct of trials, are conſonant and uniform; whereby that confuſion and contrariety are avoided, which would naturally ariſe from a variety of uncommunicating judges, or from any provincial eſtabliſhment. But let us now return to the aſſizes.

When the general day of trial is fixed, the plaintiff or his attorney muſt bring down the record to the aſſizes, and enter it with the proper officer, in order to its being called on in courſe.

Theſe ſteps being taken, and the cauſe called on in court, the record is then handed to the judge, to peruſe and obſerve the pleadings, and what iſſues the parties are to maintain and prove, while the jury is called and ſworn. To this end the ſheriff returns his compulſive proceſs, the writ of *habeas corpora*, or *diſtringas*, with the panel of jurors annexed, to the judge's officer in court.

The jurors contained in the panel are either ſpecial or common jurors. Special juries were originally introduced in trials at bar, when the cauſes were of too great nicety for the diſcuſſion of ordinary freeholders; or where the ſheriff was ſuſpected of partiality, though not upon ſuch apparent cauſe as to warrant an exception to him. He is in ſuch caſes, upon motion in court, and a rule granted thereupon, to attend the prothonotary or other proper officer with his freeholder's book; and the officer is to take indifferently 48 of the principal freeholders, in the preſence of the attorneys on both ſides: who are each of them to ſtrike off 12, and the remaining 24 are returned upon the panel. By the ſtatute 3 Geo. II. c. 25. either party is entitled upon motion to have a ſpecial jury ſtruck upon the trial of any iſſue, as well at the aſſizes as at bar, he paying the extraordinary expence, unleſs the judge will certify (in purſuance of the ſtatute 24 Geo. II. c. 18.) that the cauſe required ſuch ſpecial jury.

A common jury is one returned by the ſheriff according to the directions of the ſtatute 3 Geo. II. c. 25. which appoints, that the ſheriff or officer ſhall not return a ſeparate panel for every ſeparate cauſe, as formerly; but one and the ſame panel for every cauſe to be tried at the ſame aſſizes, containing not leſs than 48, nor more than 72, jurors: and that their names being written on tickets, ſhall be put into a box of glaſs; and when each cauſe is called 12 of theſe perſons, whoſe names ſhall firſt be drawn out of the box, ſhall be ſworn upon the jury, unleſs abſent, challenged, or excuſed; or unleſs a previous view of the meſſuages, lands, or place in queſtion, ſhall have been thought neceſſary by the court; in which caſe, ſix or more of the jurors returned, to be agreed on by the parties, or named by a judge or other proper officer of the court, ſhall be appointed by ſpecial writ of *habeas corpora* or *diſtringas*, to have the matters in queſtion ſhown to them by two perſons named in the writ; and then ſuch of the jury as have had the view, or ſo many of them as appear, ſhall be ſworn on the inqueſt previous to any other jurors. Theſe acts are well calculated to reſtrain any ſuſpicion of partiality in the ſheriff, or any tampering with the jurors when returned.

As the jurors appear when called, they ſhall be ſworn, unleſs challenged by either party. See the article CHALLENGE.

If by means of challenges or other cauſe, a ſufficient number of unexceptionable jurors doth not appear at the trial, either party may pray a *tales*.

A *tales* is a ſupply of ſuch men as are ſummoned upon the firſt panel, in order to make up the deficiency. For this purpoſe a writ of *decem tales*, *octo tales*, and the like, was wont to be iſſued to the ſheriff at common law, and muſt be ſtill ſo done at a trial at bar, if the jurors make default. But at the aſſizes, or *niſi prius*, by virtue of the ſtatute 35 Hen. VIII. c. 6. and other ſubſequent ſtatutes, the judge is empowered at the prayer of either party to award a *tales de circumſtantibus* of perſons preſent in court, to be joined to the other jurors to try the cauſe; who are liable, however, to the ſame challenges as the principal jurors. This is uſually done till the legal number of 12 be completed; in which patriarchal and apoſtolical number Sir Edward Coke hath diſcovered abundance of myſtery.

When a ſufficient number of perſons impanelled, or talesmen appear, they are then ſeparately ſworn, well and truly to try the iſſue between the parties, and a true verdict to give according to the evidence; and hence they are denominated "the jury," *jurata*, and "jurors," *ſc. juratores*.

The jury are now ready to hear the merits; and to fix their attention the cloſer to the facts which they are impanelled and ſworn to try, the pleadings are opened to them by counſel on that ſide which holds the affirmative of the queſtion in iſſue. For the iſſue is ſaid to lie, and proof is always firſt required upon that ſide which affirms the matter in queſtion: in which our law agrees with the civil, *ei incumbit probatio qui dicit, non qui negat; cum per rerum naturam factum negantis probatio nulla ſit.* The opening counſel briefly informs them what has been tranſacted in the court above; the parties, the nature of the action, the declaration, the plea, replication, and other proceedings; and laſtly, upon what point the iſſue is joined, which is there ſent down to be determined. Inſtead of which, formerly the whole record and proceſs of the pleadings were read to them in Engliſh by the court, and the matter of iſſue clearly explained to their capacities. The nature of the caſe, and the evidence intended to be produced, are next laid before them by counſel alſo on the ſame ſide; and when their evidence is gone through, the advocate on the other ſide opens the adverſe caſe, and ſupports it by evidence; and then the party which began is heard by way of reply. See PLEADINGS.

Evidence in the trial by jury is of two kinds; either that which is given in proof, or that which the jury may receive by their own private knowledge. The former, or *proofs*, (to which in common ſpeech the name of evidence is uſually confined) are either written or parol; that is, by word of mouth. Written proofs, or evidence, are, 1. Records; and 2. Ancient deeds of 30 years ſtanding, which prove themſelves; but, 3. Modern deeds; and, 4. Other writings, muſt be atteſted and verified by parol evidence of witneſſes. With regard to parol evidence or witneſſes; it muſt firſt be remembered, that there is a proceſs to bring them in by writ of *ſubpœna ad teſtificandum*; which commands them, laying aſide all pretences and excuſes, to appear at the trial on pain of 100 l. to be forfeited to the king; to which the ſtatute 5 Eliz. c. 9. has added a penalty of 10l. to the party aggrieved, and damages equivalent to the loſs ſuſtained by want of his evidence. But no witneſs, unleſs his reaſonable expences be tendered him, is bound to appear at all; nor, if he appears, is he bound to give evidence till ſuch charges are actually paid him; except he reſides within the bills of mortality, and is ſummoned to give evidence within the ſame. This compulſory proceſs, to bring in unwilling witneſſes, and the additional terrors of an attachment in caſe of diſobedience, are of excellent uſe in the thorough inveſtigation of truth; and, upon the ſame principle, in the Athenian courts, the witneſſes who were ſummoned to attend the trial had their choice of three things: either to ſwear to the truth of the fact in queſtion, to deny or abjure it, or elſe to pay a fine of 1000 drachmas.

All witneſſes, of whatever religion or country, that have the uſe of their reaſon, are to be received and examined, except ſuch as are infamous, or ſuch as are intereſted in the event of the cauſe. All others are competent witneſſes; though the jury from other circumſtances will judge of their credibility. Infamous perſons are ſuch as may be challenged as jurors, *propter delictum*: and therefore never ſhall be admitted to give evidence to inform that jury, with whom they were too ſcandalous to aſſociate. Intereſted witneſſes may be examined upon a *voir dire*, if ſuſpected to be ſecretly concerned in the event; or their intereſt may be proved in court. Which laſt is the only method of ſupporting an objection to the former claſs; for no man is to be examined to prove his own infamy. And no counſel, attorney, or other perſon, intruſted with the ſecrets of the cauſe by the party himſelf, ſhall be compelled, or perhaps allowed, to give evidence of ſuch converſation or matters of privacy as came to his knowledge by virtue of ſuch truſt and confidence: but he may be examined as to mere matters of fact, as the execution of a deed or the like, which might have come to his knowledge without being intruſted in the cauſe.

One witneſs (if credible) is ſufficient evidence to a jury of any ſingle fact: though undoubtedly the concurrence of two or more corroborates the proof. Yet our law conſiders that there are many tranſactions to which only one perſon is privy; and therefore does not always demand the teſtimony of two. Poſitive proof is always required, where, from the nature of the caſe, it appears it might poſſibly have been had. But, next to poſitive proof, circumſtantial evidence, or the doctrine of preſumptions, muſt take place: for when the fact itſelf cannot be demonſtratively evinced, that which comes neareſt to the proof of the fact is the proof of ſuch circumſtances which either neceſſarily or uſually attend ſuch facts; and theſe are called *preſumptions*, which are only to be relied upon till the contrary be actually proved.

The oath adminiſtered to the witneſs is not only that what he depoſes ſhall be true, but that he ſhall alſo depoſe the whole truth; ſo that he is not to conceal any part of what he knows, whether interrogated particularly to that point or not. And all this evidence is to be given in open court, in the preſence of the parties, their attorneys, the counſel, and all byſtanders; and before the judge and jury; each party having liberty to except to its competency, which exceptions are publicly ſtated, and by the judge are openly and publicly allowed or diſallowed, in the face of the country: which muſt curb any ſecret bias or partiality that might ariſe in his own breaſt.

When the evidence is gone through on both ſides, the judge, in the preſence of the parties, the counſel, and all others, ſums up the whole to the jury; omitting all ſuperfluous circumſtances, obſerving wherein the main queſtion and principal iſſue lies, ſtating what evidence has been given to ſupport it, with ſuch remarks as he thinks neceſſary for their direction, and giving them his opinion in matters of law ariſing upon that evidence.

The jury, after the proofs are ſummed up, unleſs the caſe be very clear, withdraw from the bar to conſider of their verdict; and in order to avoid intemperance and cauſeleſs delay, are to be kept without meat, drink, fire, or candle, unleſs by permiſſion of the judge, till they are unanimouſly agreed. A method of accelerating unanimity not wholly unknown in other conſtitutions of Europe, and in matters of greater concern. For by the golden bull of the empire, if after the congreſs is opened, the electors delay the election of a king of the Romans for 30 days, they ſhall be fed only with bread and water till the ſame is accompliſhed. But if our juries eat or drink at all, or have any eatables about them, without conſent of the court and before verdict, it is fineable; and if they do ſo at his charge for whom they afterwards find, it will ſet aſide the verdict. Alſo, if they ſpeak with either of the parties or their agents after they are gone from the bar, or if they receive any freſh evidence in private, or if, to prevent diſputes, they caſt lots for whom they ſhall find, any of theſe circumſtances will entirely vitiate the verdict. And it has been held, that if the jurors do not agree in their verdict before the judges are about to leave the town, though they are not to be threatened or impriſoned, the judges are not bound to wait for them, but may carry them round the circuit from town to town in a cart. This neceſſity of a total unanimity ſeems to be peculiar to our own conſtitution; or at leaſt, in the *nembda* or jury of the ancient Goths, there was required (even in criminal caſes) only the conſent of the major part; and in caſe of an equality, the defendant was held to be acquitted.

When they are all unanimouſly agreed, the jury return back to the bar; and before they deliver their verdict, the plaintiff is bound to appear in court, by himſelf, attorney, or counſel, in order to anſwer the amercement to which by the old law he is liable, in caſe he fails in his ſuit, as a puniſhment for his falſe claim. To be amerced, or *a mercie*, is to be at the king's mercy with regard to the fine to be impoſed; *in miſericordia domini regis pro falſo clamore ſuo*. The amercement is diſuſed, but the form ſtill continues; and if the plaintiff does not appear, no verdict can be given; but the plaintiff is ſaid to be nonſuit, *non ſequitur clamorem ſuum*. Therefore it is uſual for a plaintiff, when he or his counſel perceives that he has not given evidence ſufficient to maintain his iſſue, to be voluntarily nonſuited, or withdraw himſelf: whereupon the crier is ordered to call the plaintiff, and if neither he, nor any body for him, appears, he is nonſuited, the jurors are diſcharged, the action is at an end, and the defendant ſhall recover his coſts. The reaſon of this practice is that a nonſuit is more eligible for the plaintiff than a verdict againſt him: for after a nonſuit, which is only a default, he may commence the ſame ſuit again for the ſame cauſe of action; but after a verdict had, and judgment conſequent thereupon, he is for ever barred from attacking the defendant upon the ſame ground of complaint. But in caſe the plaintiff appears, the jury by their foreman deliver in their verdict.

A verdict, *vere dictum*, is either privy or public. A privy verdict is when the judge hath left or adjourned the court: and the jury, being agreed, in order to be delivered from their confinement, obtain leave to give their verdict privily to the judge out of court: which privy verdict is of no force, unleſs afterwards affirmed by a public verdict given openly in court; wherein the jury may, if they pleaſe, vary from their privy verdict. So that the privy verdict is indeed a mere nullity; and yet it is a dangerous practice, allowing time for the parties to tamper with the jury, and therefore very ſeldom indulged. But the only effectual and legal verdict is the public verdict: in which they openly declare to have found the iſſue for the plaintiff, or for the defendant; and if for the plaintiff, they aſſeſs the damages alſo ſuſtained by the plaintiff, in conſequence of the injury upon which the action is brought.

When the jury have delivered in their verdict, and it is recorded in court, they are then diſcharged; and ſo ends the trial by jury: a trial which ever has been, and it is hoped ever will be, looked upon as the glory of the Engliſh law. It is certainly the moſt tranſcendant privilege which any ſubject can enjoy or wiſh for, that he cannot be affected either in his property, his liberty, or his perſon, but by the unanimous conſent of 12 of his neighbours and equals. A conſtitution that we may venture to affirm has, under providence, ſecured the juſt liberties of this nation for a long ſucceſſion of ages. And therefore a celebrated French writer‡, who concludes, that becauſe Rome, Sparta, and Carthage, have loſt their liberties, therefore thoſe of England in time muſt periſh, ſhould have recollected, that Rome, Sparta, and Carthage at the time when their liberties were loſt, were ſtrangers to the trial by jury.

Great as this eulogium may ſeem, it is no more than this admirable conſtitution, when traced to its principles, will be found in ſober reaſon to deſerve.

The impartial adminiſtration of juſtice, which ſecures both our perſons and our properties, is the great end of civil ſociety. But if that be entirely entruſted to the magiſtracy, a ſelect body of men, and thoſe generally ſelected by the prince or ſuch as enjoy the higheſt offices in the ſtate, their deciſions, in ſpite of their own natural integrity, will have frequently an involuntary bias towards thoſe of their own rank and dignity: it is not to be expected from human nature, that the few ſhould be always attentive to the intereſts and good of the many. On the other hand, if the power of judicature were placed at random in the hands of the multitude, their deciſion would be wild and capricious, and a new rule of action would be every day eſtabliſhed in our courts. It is wiſely therefore ordered, that the principles and axioms of law, which are general propoſitions flowing from abſtracted reaſon, and not accommodated to times or to men, ſhould be depoſited in the breaſts of the judges, to be occaſionally applied to ſuch facts as come properly aſcertained before them. For here partiality can have little ſcope; the law is well known, and is the ſame for all ranks and degrees: it follows as a regular concluſion from the premiſſes of fact pre-eſtabliſhed. But in ſettling and adjuſting a queſtion of fact, when intruſted to any ſingle magiſtrate, partiality and injuſtice have an ample field to range in, either by boldly aſſerting that to be proved which is not ſo, or more artfully by ſuppreſſing ſome circumſtances, ſtretching and warping others, and diſtinguiſhing away the remainder. Here therefore a competent number of ſenſible and upright jurymen, choſen by lot from among thoſe of the middle rank, will be found the beſt inveſtigators of truth, and the ſureſt guardians of public juſtice. For the moſt powerful individual in the ſtate will be cautious of committing any flagrant invaſion of another's right, when he knows that the fact of his oppreſſion muſt be examined and decided by 12 indifferent men not appointed till the hour of trial; and that when once the fact is aſcertained, the law muſt of courſe redreſs it. This therefore preſerves in the hands of the people that ſhare which they ought to have in the adminiſtration of public juſtice, and prevents the encroachments of the more powerful and wealthy citizens.

Criminal TRIALS. The regular and ordinary method of proceeding in the courts of criminal juriſdiction may be diſtributed under 12 general heads, following each other in a progreſſive order: viz. 1. Arreſt; 2. Commitment and bail; 3. Proſecution; 4. Proceſs; 5. Arraignment, and its incidents; 6. Plea, and iſſue; 7. Trial, and conviction; 8. Clergy; 9. Judgment, and its conſequences; 10. Reverſal of judgment; 11. Reprieve, or pardon; 12. Execution. See ARREST, COMMITMENT, PRESENTMENT, INDICTMENT, INFORMATION, APPEAL, *PROCESS upon an Indictment*, ARRAIGNMENT, and PLEA; in which articles all the forms which precede the trial are deſcribed, and are here enumerated in the proper order.

The ſeveral methods of trial and conviction of offenders, eſtabliſhed by the laws of England, were formerly more numerous than at preſent, through the ſuperſtition of our Saxon anceſtors; who, like other northern nations, were extremely addicted to divination; a character which Tacitus obſerves of the ancient Germans. They therefore invented a conſiderable number of methods of purgation or trial, to preſerve innocence from the danger of falſe witneſſes, and in conſequence of a notion that God would always interpoſe miraculouſly to vindicate the guiltleſs; as, 1. By ORDEAL; 2. By CORSNED; 3. By BATTEL. See theſe articles.

4. A fourth method is that by the *peers of Great Britain*, in the *Court of* PARLIAMENT; or the *Court of the Lord High* STEWARD, when a peer is capitally indicted; for in caſe of an appeal, a peer ſhall be tried by jury. This differs little from the trial *per patriam*, or by jury; except that the peers need not all agree in their verdict; and except alſo, that no ſpecial verdict can be given in the trial of a peer; becauſe the lords of parliament, or the lord high ſteward (if the trial be had in his court), are judges ſufficiently competent of the law that may ariſe from the fact; but the greater number, conſiſting of 12 at the leaſt, will conclude, and bind the minority.

The trial by jury, or the country, *per patriam*, is alſo that trial by the peers of every Briton, which, as the great bulwark of his liberties, is ſecured to him by the great charter: *nullus liber homo capitatur, vel impriſonetur, aut exulet, aut aliquo alio modo deſtruatur, niſi per legale judicium parium ſuorum, vel per legem terræ.*

When therefore a priſoner on his ARRAIGNMENT has pleaded not guilty, and for his trial hath put himſelf upon the country, which country the jury are, the ſheriff of the county muſt return a panel of jurors, *liberos et legales homines, de viceneto*; that is, freeholders without juſt exception, and of the *viſne* or neighbourhood; which is interpreted to be of the county where the fact is committed. If the proceedings are before the court of king's bench, there is time allowed between the arraignment and the trial, for a jury to be impanelled by writ of *venire facias* to the ſheriff, as in civil cauſes; and the trial in caſe of a miſdemeanor is had at *niſi prius*, unleſs it be of ſuch conſequence as to merit a trial at bar; which is always invariably had when the priſoner is tried for any capital offence. But, before commiſſioners of oyer and terminer and gaol delivery, the ſheriff, by virtue of a general precept directed to him beforehand, returns to the court a panel of 48 jurors to try all felons that may be called upon their trial at that ſeſſion; and therefore it is there uſual to try all felons immediately or ſoon after their

‡ Monteſquieu, Spir. L. xi. 6.

arraignment. But it is not cuſtomary, nor agreeable to the general courſe of proceedings, unleſs by conſent of parties, to try perſons indicted of ſmaller miſdemeanors at the ſame court in which they have pleaded not guilty, or traverſed the indictment. But they uſually give ſecurity to the court to appear at the next aſſizes or ſeſſion, and then and there to try the traverſe, giving notice to the proſecutor of the ſame.

In caſes of high-treaſon, whereby corruption of blood may enſue (except treaſon in counterfeiting the king's coin or ſeals), or miſpriſion of ſuch treaſon, it is enacted by ſtatute 7 W. III. c. 3. firſt that no perſon ſhall be tried for any ſuch treaſon, except an attempt to aſſaſſinate the king, unleſs the indictment be found within three years after the offence committed: next, that the priſoner ſhall have a copy of the indictment (which includes the caption), but not the names of the witneſſes, five days at leaſt before the trial, that is, upon the true conſtruction of the act, before his arraignment; for then is his time to take any exceptions thereto, by way of plea or demurrer: thirdly, that he ſhall alſo have a copy of the panel of jurors two days before his trial: and, laſtly, that he ſhall have the ſame compulſive proceſs to bring in his witneſſes for him, as was uſual to compel their appearance againſt him. And by ſtatute 7 Ann. c. 21. (which did not take place till after the deceaſe of the late pretender) all perſons indicted for high-treaſon, or miſpriſions thereof, ſhall have not only a copy of the indictment but a liſt of all the witneſſes to be produced, and of the jurors impanelled, with their profeſſions and places of abode, delivered to him ten days before the trial, and in the preſence of two witneſſes, the better to prepare him to make his challenges and defence. And no perſon indicted for felony is, or (as the law ſtands) ever can be, entitled to ſuch copies before the time of his trial.

When the trial is called on, the jurors are to be ſworn as they appear, to the number of 12, unleſs they are challenged by the party.

Challenges may here be made, either on the part of the king, or on that of the priſoner: and either to the whole array, or to the ſeparate polls, for the very ſame reaſons that they may be made in civil cauſes. But in criminal caſes, or at leaſt in capital ones, there is, *in favorem vitæ*, allowed to the priſoner an arbitrary and capricious ſpecies of challenge, to a certain number of jurors, without ſhowing any cauſe at all; which is called a *peremptory* challenge; a proviſion full of that tenderneſs and humanity to priſoners for which our Engliſh laws are juſtly famous. This is grounded on two reaſons. 1. As every one muſt be ſenſible what ſudden impreſſions and unaccountable prejudices we are apt to conceive upon the bare looks and geſtures of another; and how neceſſary it is that a priſoner (when put to defend his life) ſhould have a good opinion of his jury, the want of which might totally diſconcert him; the law wills not that he ſhould be tried by any one man againſt whom he has conceived a prejudice, even without being able to aſſign a reaſon for ſuch his diſlike. 2. Becauſe, upon challenges for cauſe ſhown, if the reaſon aſſigned prove inſufficient to ſet aſide the juror, perhaps the bare queſtioning his indifference may ſometimes provoke a reſentment; to prevent all ill conſequences from which, the priſoner is ſtill at liberty, if he pleaſes, peremptorily to ſet him aſide.

The peremptory challenges of the priſoner muſt, however, have ſome reaſonable boundary; otherwiſe he might never be tried. This reaſonable boundary is ſettled by the common law to be the number of 35; that is, one under the number of three full juries.

If by reaſon of challenges or the default of the jurors, a ſufficient number cannot be had of the original panel, a tales may be awarded as in civil cauſes, till the number of 12 is ſworn, "well and truly to try, and true deliverance make, between our ſovereign lord the king and the priſoner whom they have in charge; and a true verdict to give, according to their evidence."

When the jury is ſworn, if it be a cauſe of any conſequence, the INDICTMENT is uſually opened, and the evidence marſhalled, examined, and enforced by the counſel for the crown or proſecution. But it is a ſettled rule at common law, that no counſel ſhall be allowed a priſoner upon his trial upon the general iſſue, in any capital crime, unleſs ſome point of law ſhall ariſe proper to be debated. A rule which (however it may be palliated under cover of that noble declaration of the law, when rightly underſtood, that the judge ſhall be counſel for the priſoner; that is, ſhall ſee that the proceedings againſt him are legal and ſtrictly regular) ſeems to be not at all of a piece with the reſt of the humane treatment of priſoners by the Engliſh law. For upon what face of reaſon can that aſſiſtance be denied to ſave the life of a man, which yet is allowed him in proſecutions for every petty treſpaſs? Nor indeed is it, ſtrictly ſpeaking, a part of our ancient law; for the Mirrour, having obſerved the neceſſity of counſel in civil ſuits, "who know how to forward and defend the cauſe by the rules of law, and cuſtoms of the realm," immediately afterwards ſubjoins, "and more neceſſary are they for defence upon indictments and appeals of felony, than upon other venial cauſes." And, to ſay the truth, the judges themſelves are ſo ſenſible of this defect in our modern practice, that they ſeldom ſcruple to allow a priſoner counſel to ſtand by him at the bar, and to inſtruct him what queſtions to aſk, or even to aſk queſtions for him, with regard to matters of fact; for as to matters of law ariſing on the trial, they are entitled to the aſſiſtance of counſel. But ſtill this is a matter of too much importance to be left to the good pleaſure of any judge, and is worthy the interpoſition of the legiſlature; which has ſhown its inclination to indulge priſoners with this reaſonable aſſiſtance, by enacting, in ſtatute 7 W. III. c. 3. that perſons indicted for ſuch high-treaſon as works a corruption of the blood or miſpriſion thereof (except treaſon in counterfeiting the king's coins or ſeals), may make their full defence by counſel, not exceeding two, to be named by the priſoner, and aſſigned by the court or judge; and this indulgence, by ſtatute 20 Geo. II. c. 30. is extended to parliamentary impeachments for high-treaſon, which were excepted in the former act.

When the evidence on both ſides is cloſed, the jury cannot be diſcharged (unleſs in caſes of evident neceſſity) till they have given in their VERDICT. If they find the priſoner not guilty, he is then for ever quit and diſcharged of the accuſation, except he be appealed of felony within the time limited by law. And upon ſuch his acquittal, or diſcharge for want of proſecution, he ſhall be immediately ſet at large without payment of any fee to the gaoler. But if the jury find him guilty, he is then ſaid to be convicted of the crime whereof he ſtands indicted. See the article CONVICTION; and, ſubſequent thereto, the article JUDGMENT, ATTAINDER, FORFEITURE, EXECUTION, alſo *Benefit of Clergy*, REPRIEVE, PARDON.

TRIAL, in Scotland. See *Scots Law*.

TRIANDRIA (from τρεις "three," and ανηρ "a man or huſband)," the name of the third claſs in Linnæus's ſexual ſyſtem, conſiſting of plants with hermaphrodite flowers, which have three ſtamina or male organs.

TRIANGLE, in geometry, a figure of three ſides and three angles.

TRIBE, in antiquity, a certain quantity or number of perſons, when a diviſion was made of a city or people into quarters or diſtricts.

TRIBRACHYS, in ancient poetry, a foot conſiſting of three ſyllables, and theſe all ſhort; as, *melius*.

TRIBUNAL, in general, denotes the ſeat of a judge, called in our courts *bench*.

TRIBUNE, among the ancient Romans, a magiſtrate choſen out of the commons, to protect them againſt the oppreſſions of the great, and to defend the liberty of the people againſt the attempts of the ſenate and conſuls.

The tribunes of the people were firſt eſtabliſhed in the year of Rome 259. The firſt deſign of their creation was to ſhelter the people from the cruelty of uſurers, and to engage them to quit the Aventine mount, whither they had retired in diſpleaſure.

Their number at firſt was but two; but the next year, under the conſulate of A. Poſthumius Aruncius and Caſſius Viſcellinus, there were three more added; and this number of five was afterwards increaſed by L. Trebonius to ten.

Military TRIBUNE, an officer in the Roman army, commander in chief over a body of forces, particularly the diviſion of a legion; much the ſame with our colonel, or the French maitre de camp.

TRIBUTARY, one who pays tribute to another, in order to live in peace with him or ſhare in his protection.

TRIBUTE, a tax or impoſt which one prince or ſtate is obliged to pay to another as a token of dependence, or in virtue of a treaty, and as a purchaſe of peace.

TRICEPS, in anatomy. See there, *Table of the* MUSCLES.

TRICHECUS, WALRUS; a genus of aquatic animals belonging to the claſs of *mammalia*, and order of *bruta*. This genus has no fore-teeth, when full grown: has two great tuſks in the upper jaw, which point downwards: has grinders on each ſide in both jaws, which are compoſed of furrowed bones. The body is oblong; the lips are doubled; and the hind legs are ſtretched backwards, and, as it were, bound together, forming a kind of tail fitted for ſwimming. There are three ſpecies; the roſmarus, dugon, and manatus.

1. The *roſmarus*, morſe, or ſea-horſe, has a round head; ſmall mouth; very thick lips, covered above and below with pellucid briſtles as thick as a ſtraw; ſmall fiery eyes; two ſmall orifices inſtead of ears; ſhort neck; body thick in the middle, tapering towards the tail; ſkin thick, wrinkled, with ſhort browniſh hairs thinly diſperſed; legs ſhort, five toes on each, all connected by webs, and ſmall nails on each: the hind feet are very broad; each leg looſely articulated: the hind legs generally extended on a line with the body: the tail is very ſhort; penis long: length of the animal from noſe to tail ſometimes 18 feet and 10 or 12 round in the thickeſt part: the teeth have been ſometimes found of the weight of 30 lb. each. Teeth of this ſize are only found on the coaſt of the Icy Sea, where the animals are ſeldom moleſted, and have time to attain their full growth. See Plate DX. fig. 1.

They inhabit the coaſt of Spitzbergen, Nova Zembla, Hudſon's Bay, and the gulph of St Lawrence; and the Icy Sea, as far as Cape Tſchuktſchi. They are gregarious; in ſome places appearing in herds of hundreds. They are ſhy animals, and avoid places which are much haunted by mankind; but are very fierce. If wounded in the water, they attempt to ſink the boat, either by riſing under it, or by ſtriking their great teeth into the ſides; they roar very loud, and will follow the boat till it gets out of ſight. Numbers of them are often ſeen ſleeping on an iſland of ice; if awaked, they fling themſelves with great impetuoſity into the ſea; at which time it is dangerous to approach the ice, leſt they ſhould tumble into the boat and overſet it. They do not go upon the land till the coaſt is clear of ice. At particular times they land in amazing numbers: the moment the firſt gets on ſhore, ſo as to lie dry, it will not ſtir till another comes and forces it forward by beating it with its great teeth; this is ſerved in the ſame manner by the next; and ſo in ſucceſſion till the whole is landed; continuing tumbling over one another, and forcing the foremoſt, for the ſake of quiet, to remove farther up.

They are killed for the ſake of their oil, one walrus producing about half a tun. The knowledge of this chace is of great antiquity; Octher the Norwegian, about the year 890, made a report of it to king Alfred, having, as he ſays, made the voyage beyond Norway, for *the more commoditie of fiſhing of horſe-whales, which have in their teeth bones of great price and excellency, whereof he brought ſome at his return unto the king*. In fact, it was in the northern world, in early times, the ſubſtitute to ivory, being very white and very hard. Their ſkins, Octher ſays, were good to cut into cables. M. de Buffon ſays, he has ſeen braces for coaches made of the ſkin, which were both ſtrong and elaſtic.

Hakluits's Col. Voy. i. 5.

They bring one, or at moſt two, young at a time: they feed on ſea herbs and fiſh; alſo on ſhells, which they dig out of the ſand with their teeth: they are ſaid alſo to make uſe of their teeth to aſcend rocks or pieces of ice, faſtening them to the cracks, and drawing their bodies up by that means. Beſides mankind, they ſeem to have no other enemy than the white bear, with whom they have terrible combats: but generally come off victorious, by means of their great teeth.

In Captain Cook's Voyages we have the following affecting account of their parental attachment to their young. "On the approach of the boats towards the ice, they took their young ones under their fins, and attempted to eſcape with them into the ſea. Some, whoſe cubs were killed or wounded, and left floating upon the ſurface of the water, roſe again, and carried them down, ſometimes juſt as our men were on the point of taking them into the boat; and could be traced bearing them to a conſiderable diſtance through the water, which was ſtained with their blood. They were afterwards obſerved bringing them, at intervals, above the ſurface, as if for air, and again plunging under it, with a horrid bellowing. The female, in particular, whoſe young one had been killed, and taken into the boat, became ſo furious, that ſhe even ſtruck her two tuſks through the bottom of the cutter."

2. The *dugon*, or Indian walrus, is diſtinguiſhed by the tuſks which extend out of the mouth from the upper jaw being placed near each other. It inhabits the ſeas lying between the Cape of Good Hope and the Philippine iſlands. This animal, ſo far as can be known, reſembles the morſe very much: the head is, however, more lengthened and narrower; the noſtrils are large, and placed higher; like the former ſpecies, there are no tuſks in the under jaw, but thoſe in the upper jaw, as has been already obſerved, are placed near each other, bent outwards, and reſemble cutting teeth, only that they are near ſix inches long; there are four grinders on each ſide in the upper jaw, and three in the lower; theſe laſt are diſtant from the tuſks, and are broader than thoſe of the morſe: the female has two teats on the breaſt: the chin has a briſtly beard; the ears are ſhort; the feet broad; and the legs ſo ſhort that the belly trails on the ground. When full grown, the animal is ſix ells in length; the male being rather larger than the female, which has breaſts like a woman: It feeds on a green ſea moſs or wood, which grows near the ſhore. The figure, manners,

and hiſtory of this animal, are very imperfectly known; but we are informed that its fleſh eats like beef.

3. *Manatus*, fiſh-tailed walrus, or ſea-cow, has no tuſks, and no hind feet. Of this ſpecies there are two varieties; the auſtralis or lamantin, and the borealis or whale-tailed manati. The lamantin inhabits the African and American ſeas, particularly near the mouths of rivers, which they frequently enter, ſeldom going far from the ſhore. The lamantin varies in ſize from eight to ſeventeen feet long, is ſix or ſeven in circumference, and from 500 to 800 pounds weight: the ſkin of a dark or black aſh colour; there are nine ſquare ſhaped grinders on each ſide in each jaw, which are covered with a glaſſy cruſt of enamel; the back bone has 50 joints or vertebræ: it is a thick clumſy animal, having no properly diſtinct neck, as the body continues almoſt of an equal thickneſs to the head. The female has two teats placed near the arm-pits. This animal never comes on ſhore, but frequents the mouths of large rivers, brouzing on the graſs which grows cloſe to the water. There ſeems to be two varieties, differing conſiderably in ſize. The larger frequents the ſeas near the mouths of large rivers; and the ſmaller is found higher up the ſame rivers, and in inland freſh water lakes, but never goes to the ſea.

We are told that this animal is often tamed by the native inhabitants of America, and that it delights in muſic; hence, according to ſome authors, it is probably the delphinus or dolphin of the ancients: and ſome believe, that what has been written concerning mermaids and ſirens muſt be referred to this animal. It has a voracious appetite, and is perpetually eating: it is monogamous, or lives in families of one male, one female, a half grown and a very ſmall young one; copulates in the ſpring, the female at firſt flying in various playful circles, and then throwing herſelf on her back to receive the male; when paſturing on the aquatic plants, the back is often above water; and, as the ſkin is full of a ſpecies of louſe, numbers of ſea fowls perch on them, to pick out the inſects. They bellow like bulls: their ſight is very weak, but their hearing extremely acute; the fore-feet are palmated and fin-ſhaped, almoſt like thoſe of a ſea-turtle; and inſtead of hind-feet they have a horizontal tail; they have no external ears; the noſtrils are diſtinct, and at a diſtance from each other; the females have two teats about the breaſt; the upper lip is full of ſharp, prickly, rigid briſtles. This animal has great affinity to the whale and ſeal tribes. The fleſh is very good eating.

The whale-tailed manati inhabits the north-weſt coaſt of America, the north-eaſt of Aſia, and the iſlands which lie between theſe two coaſts. This animal very often enters the mouths of the rivers; is ſometimes 23 feet long, and weighs 8000 pounds; the ſkin, while wet, is of a brown colour, but becomes black when dry. Inſtead of grinders, this ſpecies has on each ſide of each jaw, a large rugged bone. The back-bone has 60 vertebræ or joints: the body is very clumſy, and much deformed; its circumference at the ſhoulders is 12 feet, at the belly 20, and near the tail only four; the neck is near ſeven feet round, and the head only 31 inches.

They live perpetually in the water, and frequent the edges of the ſhores; and in calm weather ſwim in droves near the mouths of rivers: in the time of flood they come ſo near the land, that a perſon may ſtroke them with his hand: if hurt, they ſwim out to ſea; but preſently return again. The females oblige the young to ſwim before them, while the other old ones ſurround, and as it were guard them on all ſides. The affection between the male and female is very great: for if ſhe is attacked, he will defend her to the utmoſt: and if ſhe is killed, will follow her corpſe to the very ſhore, and ſwim for ſome days near the place it has been landed at. They copulate in the ſpring, in the ſame manner as the human kind, eſpecially in calm weather, towards the evening. The female ſwims gently about; the male purſues; till, tired with wantoning, ſhe flings herſelf on her back, and admits his embraces. Steller thinks they go with young about a year; it is certain that they bring but one young at a time, which they ſuckle by two teats placed between the breaſts. They are vaſtly voracious and gluttonous; and feed not only on the fuci that grow in the ſea, but ſuch as are flung on the edges of the ſhore. When they are filled, they fall aſleep on their backs. During their meals, they are ſo intent on their food, that any one may go among them and chooſe which he likes beſt. Peter Martyr gives an inſtance of one that lived in a lake of Hiſpaniola for 25 years, and was ſo tame as to come to the edge of the ſhore on being called; and would even perform the part of a ferry, and carry ſeveral people at a time on its back to the oppoſite ſhore.—Their back and their ſides are generally above water.

They continue in the Kamtſchatkan and American ſeas the whole year; but in winter are very lean, ſo that you may count their ribs. They are taken by harpoons faſtened to a ſtrong cord; and after they are ſtruck, it requires the united force of 30 men to draw them on ſhore. Sometimes when they are transfixed, they will lay hold of the rocks with their paws, and ſtick ſo faſt as to leave the ſkin behind before they can be forced off. When a manati is ſtruck, its companions ſwim to its aſſiſtance; ſome will attempt to overturn the boat by getting under it; others will preſs down the rope, in order to break it; and others will ſtrike at the harpoons with their tails, with a view of getting it out, in which they often ſucceed. They have not any voice; but make a noiſe by hard breathing like the ſnorting of a horſe.

The ſkin is very thick, black, and full of inequalities, like the bark of oak, and ſo hard as ſcarce to be cut with an axe, and has no hair on it: beneath the ſkin is a thick blubber, which taſtes like oil of almonds. The fleſh is coarſer than beef, and will not ſoon putrefy. The young ones taſte like veal. The ſkin is uſed for ſhoes, and for covering the ſides of boats.

TRICHOMANES, in botany; a genus of plants belonging to the claſs of *cryptogamia*, and order of *filices*. The parts of fructification are ſolitary, and terminated by a ſtyle like a briſtle, on the very edge of the leaf. There are 13 ſpecies; of which two are natives of Britain, the pixidiferum and tunbrigenſe.

1. *Pixidiferum*, or cup-trichomanes, has ſub-bipinnated leaves, the pinnæ being alternate, cloſe-lobed, and linear. It is found among ſtones in wet grounds in England. 2. *Tunbrigenſe*, or Tunbridge trichomanes, has pinnated leaves, the pinnæ being oblong, dichotomous, decurrent, and dentated. It is found in the fiſſures of moiſt rocks in Wales, and in many rocky places in Scotland.

TRICOCCEÆ (τρεις "three," and κοκκος "a grain"), the name of the 38th order in Linnæus's Fragments of a Natural Method, conſiſting of plants with a ſingle three-cornered capſule, having three cells, or internal diviſions, each containing a ſingle ſeed. See BOTANY, vol. iii. page 466.

TRICOSANTHES, in botany: A genus of plants belonging to the claſs of *monœcia*, and order of *ſyngeneſia*; and in the natural ſyſtem ranging under the 34th order, *Cucurbitaceæ*. There are four ſpecies; only one of which is cultivated in the Britiſh gardens, the *anguina* or ſnake-gourd, which is a native of China, an annual, and of the cucumber tribe.

TRIDENT, an attribute of Neptune, being a kind of ſceptre which the painters and poets put into the hands of that god, in form of a ſpear or fork with three teeth; whence the word.

TRIENNIAL, an epithet applied chiefly to officers or employments which laſt for three years.

TRIENS, in antiquity, a copper money of the value of one third of an *as*, which on one ſide bore a Janus's head, and on the other a water rat.

TRIENTALIS, Chickweed winter-green, in botany: A genus of plants belonging to the claſs of *heptandria*, and order of *monogynia*; and in the natural ſyſtem ranging under the 20th order, *Rotaceæ*. The calyx is heptaphyllous; the corolla is equal and plane, and is divided into ſeven ſegments; the berry is unilocular and dry. There is only one ſpecies, the *europæa*; which is indigenous, and the only genus of heptandria that is ſo.

The ſtalk is ſingle, five or ſix inches high, terminated with five, ſix, or ſeven, oval pointed leaves; from the centre of which ariſe on long footſtalks commonly two white ſtarry flowers, each generally conſiſting of ſeven oval and equal petals, ſucceeded by a globular dry berry, covered with a thin white rind, having one cell, and containing ſeveral angular ſeeds.

TRIERS, or Treves. See Treves.

TRIFOLIUM, Trefoil, or *Clover*, in botany: A genus of plants belonging to the claſs of *diadelphia*, and order of *decandria*; and in the natural ſyſtem ranging under the 32d order, *Papilionaceæ*. The flowers are generally in round heads; the pod is ſcarcely longer than the calyx, univalve, not opening, deciduous. The leaves are three together. According to Murray's edition of Linnæus, there are 46 ſpecies; of which 17 are natives of Britain. We ſhall deſcribe ſome of the moſt remarkable of theſe:

1. *Meliloti officinalis*, or melilot, has naked racemous pods, diſpermous, wrinkly, and acute, with an erect ſtalk. It grows in corn-fields and by the way-ſides, but not common. The ſtalk is erect, firm, ſtriated, branched, and two or three feet high: the leaves ternate, ſmooth, obtuſely oval, and ſerrated: the flowers are ſmall, yellow, pendulous, and grow in long cloſe ſpikes at the tops of the branches: the pod is very ſhort, turgid, tranſverſely wrinkled, pendulous, and contains either one or two ſeeds. The plant has a very peculiar ſtrong ſcent, and diſagreeable, bitter, acrid taſte, but ſuch, however, as is not diſagreeable to cattle. The flowers are ſweet ſcented. It has generally been eſteemed emollient and digeſtive, and been uſed in fomentations and cataplaſms, particularly in the plaſter employed in dreſſing bliſters; but is now laid aſide, as its quality is found to be rather acrid and irritating than emollient or reſolvent. It communicates a moſt loathſome flavour to wheat and other grain, ſo as to render it unfit for making bread. It grows in corn-fields.

2. *Trifolium repens* white creeping trefoil, or Dutch clover, has a creeping ſtalk, its flower gathered into an umbellar head, and its pods tetraſpermous. It is very common in fields and paſtures. It is well known to be excellent fodder for cattle; and the leaves are a good ruſtic hygrometer, as they are always relaxed and flaccid in dry weather, but erect in moiſt or rainy.

3. *Trifolium pratenſe*, purple or red clover, is diſtinguiſhed by denſe ſpikes, unequal corollas, by bearded ſtipulas, aſcending ſtalks, and by the calyx having four equal teeth. This is the botanical deſcription of this ſpecies given by Mr Afzelius, who, in a paper of the firſt volume of the Linnæan Tranſactions, has been at much pains to remove three ſpecies of the trifolium from the confuſion in which they have been long involved; namely, the pratenſe, medium, and alpeſtre. The red clover is common in meadows and paſtures, and is the ſpecies which is generally cultivated for food as cattle. It abounds in every part of Europe, in North America, and even in Siberia. It delights moſt in rich, moiſt, and ſunny places; yet flouriſhes in dry, barren, and ſhady places. For an account of the mode of cultivating it, ſee Agriculture, nº 177.

4. *Alpeſtre*, long-leaved purple trefoil, or mountain clover, is thus characterized by Mr Afzelius. The ſpikes are denſe: the corollas ſomewhat equal; the ſtipulas are briſtly and divergent; the leaflets lanceolated; the ſtalks ſtiff, ſtraight, and very ſimple. It grows in dry, mountainous, woody places, in Hungary, Auſtria, and Bohemia, &c.; but is not ſaid by Mr Afzelius to be a native of Britain.

5. The *medium*, according to Mr Afzelius, has alſo been confounded with the two ſpecies laſt mentioned; but it is to be diſtinguiſhed from them by having looſe ſpikes, corollas ſomewhat equal, ſtipulas ſubulate and connivent, and ſtalks flexuous and branched. It is found in dry elevated ſituations, eſpecially among ſhrubs, or in woods where the ſoil is chalky or clay, in England, Scotland, Sweden, Denmark, &c.

For a botanical deſcription of the other ſpecies of the trifolium, ſee Lightfoot's *Flora Scotica*, Berkenhout's Synopſis of the Natural Hiſtory of Great Britain and Ireland, and Withering's Botanical Arrangements.

TRIGA, in antiquity, denotes a kind of carr or chariot drawn by three horſes; whence the name.

TRIGLA, in ichthyology, a genus of fiſhes belonging to the order of thoracici. The head is loricated with rough lines, and there are ſeven rays in the membranes of the gills. There are 11 ſpecies; of which the principal are the gurnardus, or grey gurnard; the cuculus, or red gurnard; the lyra, or piper; and the hirundo, or ſapphirine gurnard.

TRIGLOCHIN, in botany: A genus of plants belonging to the claſs of *hexandria*, and order of *trigynia*; and in the natural ſyſtem ranging under the fifth order, *Tripetaloideæ*. The calyx is triphyllous; the petals are three; there is no ſtyle; the capſule opens at the baſe. There are three ſpecies; of which the paluſtre and maritimum are Britiſh.

1. *Paluſtre*, or arrow-headed graſs, has an oblong trilocular capſule. The ſtalk is ſimple, eight or ten inches high; the leaves long and narrow; the flowers are greeniſh, and grow at the end of a long ſpike. It is frequent in moiſt ground.

2. *Maritimum*, or ſea-ſpiked graſs, has ovate ſexlocular capſules; the ſtalk is ſhort; the ſpike long, and flowers purpliſh. It is frequent on the ſea-coaſts. Linnæus ſays that cattle eat theſe two ſpecies with avidity.

TRIGLYPHS, in architecture, a ſort of ornaments repeated at equal intervals, in the Doric freeze.

Dialing Trigon. See Dialing.

TRIGONALIS. See Pila.

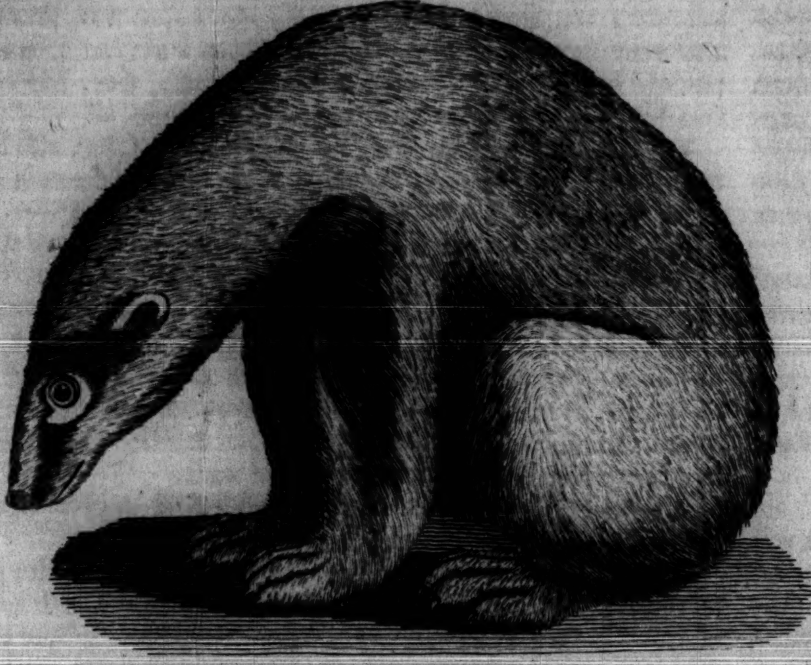
TRIGONELLA, Fenugreek, in botany: A genus of plants belonging to the claſs of *diadelphia*, and order of *decandria*; and in the natural ſyſtem arranged under the 32d order, *Papilionaceæ*. The vexillum and alæ are nearly equal and patent, reſembling a tripetalous corolla. There are 12 ſpecies; of which the moſt remarkable is the *fœnumgræcum*, or fenugreek, a native of Montpelier in France.

Fenugreek is an annual plant, which riſes with a hollow, branching, herbaceous ſtalk, a foot and a half long, garniſhed with trifoliate leaves, placed alternately, whoſe lobes are oblong, oval, indented on their edges, and have broad furrowed footſtalks.

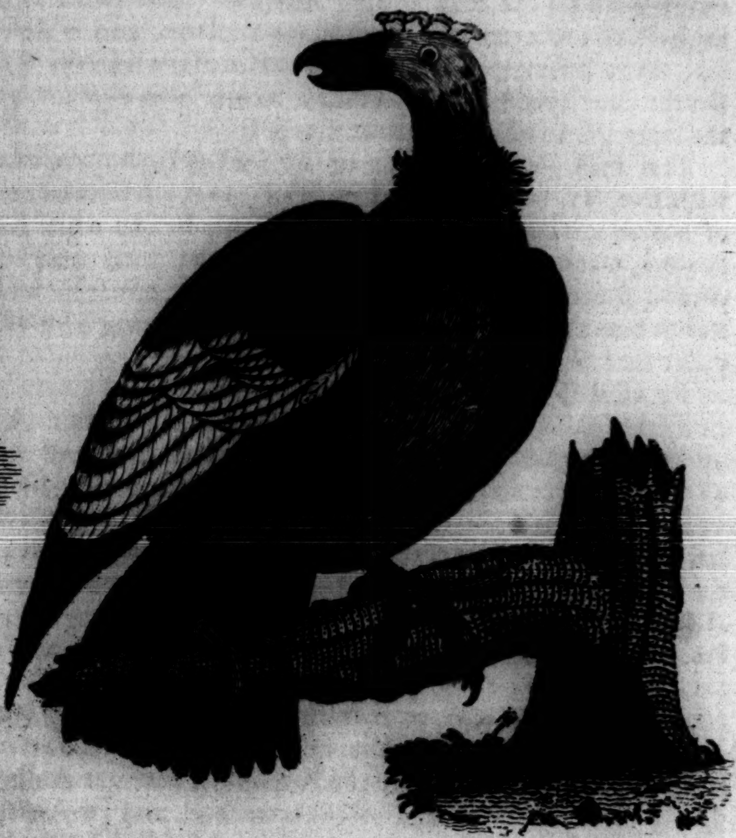
Fenugreek ſeeds have a ſtrong diſagreeable ſmell, and an unctuous farinaceous taſte accompanied with a ſlight bitteriſhneſs. The principal uſe of theſe ſeeds is in cataplaſms and fomentations, for ſoftening, maturing, and diſcuſſing tumours; and in emollient and carminative glyſters. They are an ingredient in the *oleum e mucilaginibus* of the ſhops, to which they communicate a conſiderable ſhare of their ſmell.

Plate DX

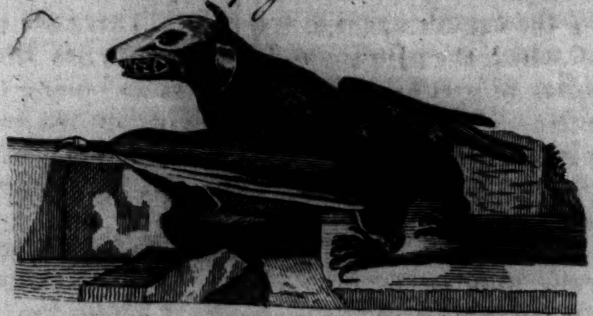
White bear



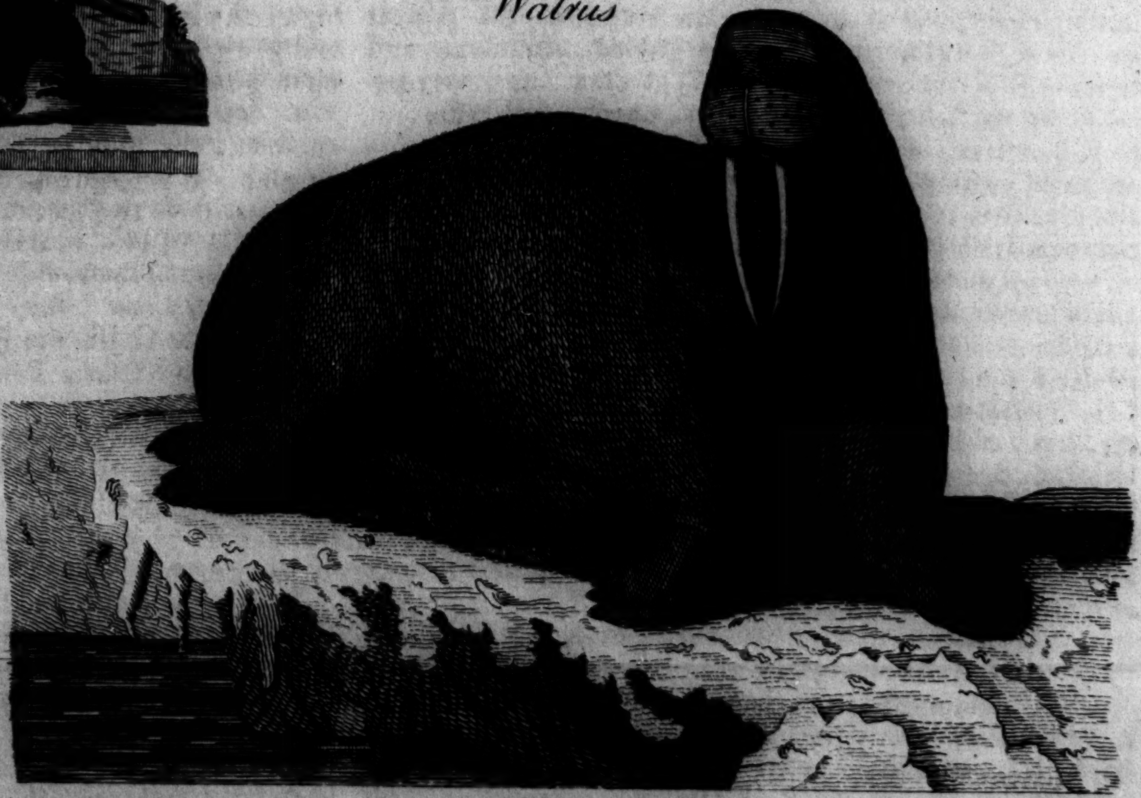
Gryphus



Vampyre



Walrus



Allardice

BRITISH MUSEUM

TRIGONOMETRY,

Plane.

THE art of meaſuring the ſides and angles of triangles, either plane or ſpherical, whence it is accordingly called either PLANE TRIGONOMETRY, or SPHERICAL TRIGONOMETRY.

Trigonometry is an art of the greateſt uſe in the mathematical ſciences, eſpecially in aſtronomy, navigation, ſurveying, dialing, geography, &c. &c. By it we come to know the magnitude of the earth, the planets and ſtars, their diſtances, motions, eclipſes, and almoſt all other uſeful arts and ſciences. Accordingly we find this art has been cultivated from the earlieſt ages of mathematical knowledge.

Trigonometry, or the reſolution of triangles, is founded on the mutual proportions which ſubſiſt between the ſides and angles of triangles; which proportions are known by finding the relations between the radius of a circle and certain other lines drawn in and about the circle, called *cords*, *ſines*, *tangents*, and *ſecants*. The ancients, Menelaus, Hipparchus, Ptolemy, &c. performed their trigonometry by means of the cords. As to the ſines, and the common theorems relating to them, they were introduced into trigonometry by the Moors or Arabians, from whom this art paſſed into Europe, with ſeveral other branches of ſcience. The Europeans have introduced, ſince the 15th century, the tangents and ſecants, with the theorems relating to them.

The proportion of the ſines, tangents, &c. to their radius, is ſometimes expreſſed in common or natural numbers, which conſtitute what we call the *tables of natural ſines, tangents, and ſecants*. Sometimes it is expreſſed in logarithms, being the logarithms of the ſaid natural ſines, tangents, &c.; and theſe conſtitute the table of *artificial ſines*, &c. Laſtly, ſometimes the proportion is not expreſſed in numbers; but the ſeveral ſines, tangents, &c. are actually laid down upon lines of ſcales; whence the *line of ſines*, *of tangents*, &c.

In trigonometry, as angles are meaſured by arcs of a circle deſcribed about the angular point, ſo the whole circumference of the circle is divided into a great number of parts: as 360 degrees, and each degree into 60 minutes, and each minute into 60 ſeconds, &c.; and then any angle is ſaid to conſiſt of ſo many degrees, minutes, and ſeconds, as are contained in the arc that meaſures the angle, or that is intercepted between the legs or ſides of the angle.

Now the ſine, tangent, and ſecant, &c. of every degree and minute, &c. of a quadrant, are calculated to the radius 1, and ranged in tables for uſe; as alſo the logarithms of the ſame; forming the triangular canon. And theſe numbers, ſo arranged in tables, from every ſpecies of right-angled triangles; ſo that no ſuch triangle can be propoſed, but one ſimilar to it may be there found, by compariſon with which the propoſed one may be computed by analogy or proportion.

PLANE TRIGONOMETRY.

THERE are uſually three methods of reſolving triangles, or the caſes of trigonometry; viz. geometrical conſtruction, arithmetical computation, and inſtrumental operation. In the 1ſt method, the triangle in queſtion is conſtructed by drawing and laying-down the ſeveral parts of their magnitudes given, viz. the ſides from a ſcale of equal parts, and the angles from a ſcale of cords or other inſtrument; then the unknown parts are meaſured by the ſame ſcales, and ſo they become known.

In the 2d method, having ſtated the terms of the proportion according to rule, which terms conſiſt partly of the numbers of the given ſides, and partly of the ſines, &c. of angles taken from the tables, the proportion is then reſolved like all other proportions, in which a 4th term is to be found from three given terms, by multiplying the 2d and 3d together, and dividing the product by the 1ſt. Or, in working with the logarithms, adding the logarithm of the 2d and 3d terms together, and from the ſum ſubtracting the logarithm of the 1ſt term; then the number anſwering to the remainder is the 4th term ſought.

To work a caſe inſtrumentally, as ſuppoſe by the logarithm lines on one ſide of the two foot ſcales: Extend the compaſſes from the 1ſt term to the 2d or 3d, which happens to be of the ſame kind with it; then that extent will reach from the other term to the 4th. In this operation, for the ſides of triangles, is uſed the line of numbers (marked Num.); and for the angles, the line of ſines or tangents (marked ſin. and tan.) according as the proportion reſpects ſines or tangents. See SECTOR.

In every caſe of plane triangles there muſt be three parts, one at leaſt of which muſt be a ſide. And then the different circumſtances, as to the three parts that may be given, admit of three caſes or varieties only; viz.

1ſt, When two of the three parts given are a ſide and its oppoſite angle. 2d, When there are given two ſides and their contained angle. 3d, And, thirdly, when the three ſides are given.

To each of theſe caſes there is a particular rule or proportion adapted for reſolving it by.

1ſt, *The Rule for the 1ſt Caſe*, or that in which, of the three parts that are given, an angle and its oppoſite ſide are two of them, is this, viz. that the ſides are proportional to the ſines of their oppoſite angles; that is,

As one ſide given :
To the ſine of its oppoſite angle : :
So is another ſide given :
To the ſine of its oppoſite angle.

Or,

As the ſine of an angle given :
To its oppoſite ſide : :
So is the ſine of another angle given :
To its oppoſite ſide.

So that, to find an angle, we muſt begin the proportion with a given ſide that is oppoſite to a given angle; and to find a ſide, we muſt begin with an angle oppoſite to a given ſide.

Example. Suppoſe in the triangle BDC (fig. 1.) there be given the ſide BC = 106, DB = 65, and the angle BCD 31° 49′ given; to find the angle BDC obtuſe and the ſide CD. Plate DXI.

1. *Geometrically by Conſtruction.*

Draw the line BC equal to 106, at C make an angle of 31° 49′ by drawing CD, take 65 in your compaſſes, and with one foot in B lay the other upon the line CD in D; draw the line BD, and it is done; for the angle D will be 120° 43′, the angle B 27° 28′, and the ſide DC 56.9 as was required.

2. *Arithmetically by Logarithms.*

As the ſide BD 65 - - log.	1.81291
Is to ſine angle C 31° 49′ - - -	9.72198
So is the ſide BC 106 - - - -	2.02531
	11.74729
	1.81291
To ſine angle D 120° 43′ - -	9.93438

To find DC.

As ſine ang. C 31° 49′	9.72198
Is to the ſide BD 65	1.81291
So is ſine ang. B 27.28	9.66392
	11.47683
	9.72198
To the ſide DC 56.88	1.75485

	180.0
The ſupp.	59.17 of ang. D.
	120.43 angle D.
	31.49 angle C.
	152.32 their ſum.
	180.0
	152.32 ſum ſubt.
	27.28 angle B.

Here it may be proper to obſerve, that if the given angle be obtuſe, the angle ſought will be acute; but when the given angle is acute, and oppoſite to a leſſer given ſide, then the required angle is doubtful, whether acute or obtuſe; it ought therefore to be determined before the operation. For it is plain the above proportion produces 59° 17′ for the required angle; but as it is obtuſe, its ſupplement to 180 degrees muſt be taken, viz. 120° 43′.

By Gunter.

"The extent from 65 to 106 on the line of numbers will reach from 31° 49′ to 59° 17′ on the line of ſines."

2dly, "The extent from 31° 49′ to 27° 28′ on the line of ſines will reach from 65 to 56.88 on the line of numbers."

Case II. When there are given two ſides and their contained angle, to find the reſt, the rule is this:

As the ſum of the two given ſides:
Is to the difference of the ſides::
So is the tangent of half the ſum of the two oppoſite angles or cotangent of half the given angle:
To tang. of half the diff. of thoſe angles.

Then the half diff. added to the half ſum, gives the greater of the two unknown angles; and ſubtracted leaves the leſs of the two angles.

Hence, the angles being now all known, the remaining 3d ſide will be found by the former caſe.

Example. The ſide BC = 109, BD = 76 (fig. 2.), and the angle CBD 101° 30′ given, to find the angle BDC or BCD, and the ſide CD.

1. *Geometrically by Conſtruction.*

Draw the line BC 109, and BD, ſo as to make an angle with BC of 101° 30′, and make BD equal to 76; join BC and BD with a right line, and it is done; for the angle D being meaſured by the cord of 60°, will be 47° 32′, angle C 30° 58′, and the ſide DC 144.8, as was required.

2. *Arithmetically by Logarithms.*

Side BC	109	-	109	-	180° 0′
BD	76	-	76	-	101 30
Their ſum	185		33 their diff.		78 30 ſum of the ang. D and C.

$\frac{1}{2}$ Sum 39 15 then

To find the angles D and C.

As the ſum of the ſides BC and BD =	185	2.26717
Is to their difference - -	33	1.51851
So is tang. of $\frac{1}{2}$ the ſum of the angles C and D	39° 15′	9.91224
		11.43075
		2.26717
To the tang of $\frac{1}{2}$ the diff. of the angles C and D	8° 17′	9.16358

To half the ſum of the angles D and C -	39° 15
Add half the difference of the angles C and D	8 17
Gives the greater angle D	47 32
Subtracted, gives the leſſer angle C	30 58

To find DC.

As ſine angle D 47° 32′ - -	9.86786
Is to the ſide BC 109 - -	2.03743
So is ſine angle B 101° 30′ - -	9.99119
	12.02862
	9.86786
To the ſide DC required 144. 8 -	2.16076

3. *By Gunter.*

1ſt, "The extent from 185 to 33 on the line of numbers will reach from 39° 15′ to 8° 17′ on the line of tangents. 2dly, The extent from angle D 47° 32′ to 78° 30′ (the ſupplement of angle B) on the line of ſines, will reach from the ſide BC 109 to 144.8, the ſide DC required, on the line of numbers."

Case III. Is when the three ſides are given, to find the three angles; and the method of reſolving this caſe is, to let a perpendicular fall from the greateſt angle upon the oppoſite ſide or baſe, dividing it into two ſegments, and the whole triangle into two ſmaller right-angled triangles: then it will be,

As the baſe or ſum of the two ſegments:
Is to the ſum of the other two ſides ::
So is the difference of thoſe ſides
To the difference of the ſegments of the baſe.

Then half this difference of the two ſegments added to the half ſum, or half the baſe, gives the greater ſegment, and ſubtracted gives the leſs. Hence, in each of the two right-angled triangles, there are given the hypothenuſe, and the baſe, beſides the right angle, to find the other angles by the firſt caſe.

Example. The ſides BC (fig. 3.) = 105, BD = 85, and CD = 50, given to find the angles BDC, BCD, or CBD.

1. *Geometrically by Conſtruction.*

Draw the line BC equal to 105, take CD 50 in your compaſſes, and with one foot in C deſcribe an arch; then take BD 85 in your compaſſes, and with one foot in B cut the former arch in D, join BD and DC, and it is done; for the angle B, being meaſured, will be found 28° 4′, angle C 53° 7′, which being added together, is 81° 11′ their ſum ſubtracted from 180, leaves angle D 98° 49′ as was required.

2. *Arithmetically by Logarithms.*

The two ſhorteſt ſides are BD (=85) and CD (= 50), the ſum of which is 135, and their difference 35. The ſegments of the baſe BC are found in this manner:

As the ſide BC	= 105	log.	2.02119
Is to the ſum of the ſides BD & DC	= 135		2.13033
So is their difference	= 35		1.54407
To the difference of the ſeg. of BC	= 45		1.65321

Thus the ſum and difference of the ſegments of the baſe BC being known, we have only to add half this ſum = $52\frac{1}{2}$ to half the difference = $22\frac{1}{2}$, and we ſhall obtain the greater ſegment, which is = 75; which ſubtracted from 105, gives 30 = the ſmaller ſegment. Then

To find the angle BDA.

As the hypothenuſe BD	= 85	log.	1.92942
Is to radius	=		10.00000
So is the greater ſegment	= 75		1.87506
To the ſum of the angle BDA	=		9.94564

The angle BDA therefore is equal to 61° 56′

Let us now find the angle ADC, which is done thus.

As the hypothenuſe DC	= 50	log.	1.69897
Is to radius	=		10.00000
So is the ſmaller ſegment	= 30		1.47712
To the ſine of ADC	=		9.77815

The angle ADC therefore is equal to 36° 53′, and the whole angle BDC = 98° 49′.

To find the angle at B, we have only to ſubtract the angle BDA (=61° 56,) from 90°, and the rem. 28° 4′ is the angle ſought. The angle at C is equal to 53° 7′.

3. *By Gunter.*

1*ſt*, 'The extent from 105 to 135, will reach from 35 to 45 on the line of numbers.' 2*dly*, 'The extent from 85 to 75, on the line of numbers, will reach from radius to 61° 56′, the angle BDA on the line of ſines.' 3*dly*, 'The extent from 50 to 30 on the line of numbers will reach from radius to angle ADC 36° 53′ on the line of ſines.'

The foregoing three caſes include all the varieties of plane triangles that can happen, both of right and oblique-angled triangles. But beſides theſe, there are ſome other theorems that are uſeful upon many occaſions, or ſuited to ſome particular forms of triangles, which are often more expeditious in uſe than the foregoing general ones; one of which, for right-angled triangles, as the caſe for which it ſerves ſo often occurs, may be here inſerted, and is as follows.

Case IV. When, in a right-angled triangle, there are given the angles and one leg, to find the other leg, or the hypothenuſe. Then it will,

As radius :
To given leg AB : :
So tang. adjacent the angle A :
To the oppoſite leg BC, and : :
So ſec. of ſame angle A :
To hypot. AC :

Example. In the triangle ABC (fig. 4.), right-angled at B,

$$\left.\begin{array}{l}\text{Given the leg AB}=162\\ \text{and the angle A}\quad=53^\circ\ 7'\ 48''\\ \text{conſeq. the angle C}=36\ 52\ 12\end{array}\right\}\ \begin{array}{l}\text{to find BC}\\ \text{and AC.}\end{array}$$

1. *Geometrically.*—Draw the leg AB=162: Erect the indefinite perpendicular BC: Make the angle A = $53^\circ\frac{1}{8}$, and the ſide AC will cut BC in C, and form the triangle ABC. Then, by meaſuring, there will be found AC=270, and BC=216.

2. *Arithmetically.*

As radius	=10 - -	log. 10·0000000
To AB	=162 - - -	2·2095150
So tang. A	=53° 7′ 48″ - -	10·1249372
To BC	=216 - -	2·3344522
So ſec. A	=53° 7′ 48″ - -	10·2218477
To AC	- =270 - - -	2·4313627

3. *By Gunter.*

Extend the compaſſes from 45° at the end of the tangents (the radius) to the tangent of $53^\circ\frac{1}{8}$; then that extent will reach, on the line of numbers, from 162 to 216, for BC. Again, extend the compaſſes from 36° 52′ to 90 on the ſines; then that extent will reach, on the line of numbers, from 162 to 270 for AC.

Note, Another method, by making every ſide radius, is often added by the authors on trigonometry, which is thus: The given right-angled triangle being ABC, make firſt the hypothenuſe AC radius, that is, with the extent of AC as a radius, and each of the centres A and C, deſcribe arcs CD and AE (fig. 5.); then it is evident that each leg will repreſent the ſine of its oppoſite angle, viz. the leg BC the ſine of the arc CD or of the angle A, and the leg AB the ſine of the arc AE or of the angle C. Again, making either leg radius, the other leg will repreſent the tangent of its oppoſite angle, and the hypothenuſe the ſecant of the ſame angle; thus, with radius AB and centre A deſcribing the arc BF, BC repreſents the tangent of that arc, or of the angle A, and the hypothenuſe AC the ſecant of the ſame; or with the radius BC and centre C deſcribing the arc BG, the other leg AB is the tangent of that arc BG or of the angle C, and the hypothenuſe CA the ſecant of the ſame.

And then the general rule for all theſe caſes is this, *viz.* that the ſides bear to each other the ſame proportions as the parts or things which they repreſent. And this is called making every ſide radius.

SPHERICAL TRIGONOMETRY.

Spherical Trigonometry is the art whereby, from three given parts of a ſpherical triangle, we diſcover the reſt; and, like plane trigonometry, is either right-angled or oblique angled. But before we give the analogies for the ſolution of the ſeveral caſes in either, it will be proper to premiſe the following theorems:

Theorem I. In all right-angled ſpherical triangles, the ſign of the hypothenuſe : radius : : ſine of a leg : ſine of its oppoſite angle. And the ſine of a leg : radius : : tangent of the other leg : tangent of its oppoſite angle.

Demonſtration. Let EDAFG (*ibid.* fig. 6.) repreſent the eighth part of a ſphere, where the quadrantal planes EDFG, EDBC. are both perpendicular to the quadrantal plane ADFB; and the quadrantal plane ADGC is perpendicular to the plane EDFG; and the ſpherical triangle ABC is right angled at B, where CA is the hypothenuſe, and BA, BC, are the legs.

To the arches GF, CB, draw the tangents HF, OB, and the ſines GM, CI, on the radii DF, DB; alſo draw BL the ſine of the arch AB, and CK the ſine of AC; and then join IK and OL. Now HF, OB, GM, CI, are all perpendicular to the plane ADFB. And HD, GK, OL, lie all in the ſame plane ADGC. Alſo FD, IK, BL, lie all in the ſame plane ADGC. Therefore the right-angled triangles HFD, CIK, ODL, having the equal angles HDF, CKI, OLB, are ſimilar. And CK : DG : : CI : GM; that is, as the ſine of the hypothenuſe : rad. : : ſine of a leg : ſine of its oppoſite angle. For GM is the ſine of the arc GF, which meaſures the angle CAB. Alſo, LB : DF : : BO : FH; that is, as the ſine of a leg : radius : : tangent of the other leg : tangent of its oppoſite angle Q. E. D.

Hence it follows, that the ſines of the angles of any oblique ſpherical triangle ACD (fig. 7.) are to one another, directly, as the ſines of the oppoſite ſides. Hence it alſo follows, that, in right-angled ſpherical triangles, having the ſame perpendicular, the ſines of the baſes will be to each other, inverſely, as the tangents of the angles at the baſes.

Theorem II. In any right-angled ſpherical triangle ABC (fig. 8.) it will be, As radius is to the co-ſine of one leg, ſo is the co-ſine of the other leg to the co-ſine of the hypothenuſe.

Hence, if two right-angled ſpherical triangles ABC, CBD (fig 7.) have the ſame perpendicular BC, the co-ſines of their hypothenuſes will be to each other, directly, as the co-ſines of their baſes.

Theorem III. In any ſpherical triangle it will be, As radius is to the ſine of either angle, ſo is the co-ſine of the adjacent leg to the co-ſine of the oppoſite angle.

Hence, in right-angled ſpherical triangles, having the ſame perpendicular, the co-ſines of the angles at the baſe will be to each other, directly, as the ſines of the vertical angles.

Theorem IV. In any right-angled ſpherical triangle it will be, As radius is to the co-ſine of the hypothenuſe, ſo is the tangent of either angle to the co-tangent of the other angle.

As the ſum of the ſines of two unequal arches is to their difference, ſo is the tangent of half the ſum of thoſe arches to the tangent of half their difference: and as the ſum of the co-ſines is to their difference, ſo is the co-tangent of half the ſum of the arches to the tangent of half the difference of the ſame arches.

Theorem V. In any ſpherical triangle ABC (fig. 9 and 10.) it will be, As the co-tangent of half the ſum of half their difference, ſo is the co-tangent of half the baſe to the tangent of the diſtance (DE) of the perpendicular from the middle of the baſe.

Since the laſt proportion, by permutation, becomes co-tang. $\frac{AC+BC}{2}$: co-tang. AE : : tang. $\frac{AC-BC}{2}$: tang. DE, and as the tangents of any two arches are, inverſely, as their co-tangents; it follows, therefore, that tang. AE : tang. $\frac{AC+BC}{2}$: : tang. $\frac{AC-BC}{2}$: tang. DE; or, that the tangent of half the baſe is to the tangent of half the ſum of the ſides, as the tangent of half the difference of the ſides to the tangent of the diſtance of the perpendicular from the middle of the baſe.

Theorem VI. In any ſpherical triangle ABC (fig. 9.) it will be, As the co-tangent of half the ſum of the angles at the baſe is to the tangent of half their difference, ſo is the tangent of half the vertical angle to the tangent of the angle which the perpendicular CD makes with the line CF biſecting the vertical angle.

The Solution of the Caſes of right-angled ſpherical Triangles, (fig. 8.).

Caſe	Given	Sought	Solution
1	The hyp. AC and one angle A	The oppoſite leg BC	As radius : ſine hyp. AC : : ſine A : ſine BC (by the former part of theor. 1.)
2	The hyp. AC and one angle A	The adjacent leg AB	As radius : co-ſine of A : : tang. AC. : tang. AB (by the latter part of theor. 1.)
3	The hyp. AC and one angle A	The other angle C	As radius : co-ſine of AC : : tang. A : co-tang. C (by theorem 4.)
4	The hyp. AC and one leg AB	The other leg BC	As co-ſine AB : radius : : co-ſine AC : co-ſine BC (by theorem 2.)
5	The hyp. AC and one leg AB	The oppoſite angle C	As ſine AC : radius : : ſine AB : ſine C (by the former part of theorem 1.)
6	The hyp. AC and one leg AB	The adjacent angle A	As tang. AC : tang. AB : : radius : co-ſine A (by theorem 1.)
7	One leg AB and the adjacent angle A	The other leg BC	As radius : ſine AB : : tangent A : tangent BC (by theorem 4.)
8	One leg AB and the adjacent angle A	The oppoſite angle C	As radius : ſine A : : co-ſine of AB : co-ſine of C (by theorem 3.)
9	One leg AB and the adjacent angle A	The hyp. AC	As co-ſine of A : radius : : tang. AB : tang. AC (by theorem 1.)
10	One leg BC and the oppoſite angle A	The other leg AB	As tang. A : tang. BC : : radius : ſine AB (by theorem 4.)
11	One leg BC and the oppoſite angle A	The adjacent angle C	As co-ſine BC : radius : : co-ſine of A : ſine C (by theorem 3.)
12	One leg BC and the oppoſite angle A	The hyp. AC	As ſine A : ſine BC : : radius : ſine AC (by theorem 1.)
13	Both legs AB and BC	The hyp. AC	As radius : co-ſine AB : : co-ſine BC : co-ſine AC (by theorem 2.)
14	Both legs AB and BC	An angle, ſuppoſe A	As ſine AB : radius : : tang. BC : tang. A (by theorem 4.)
15	Both angles A and C	A leg, ſuppoſe AB	As ſine A : co-ſine C : : radius : co-ſine AB (by theorem 3.)
16	Both angles A and C	The hyp. AC	As tang. A : co-tang. C : : radius : co ſine AC (by theorem 4.)

Note, The 10th, 11th, and 12th caſes are ambiguous; ſince it cannot be determined by the data, whether A, B, C, and AC, be greater or leſs than 90 degrees each.

Plane TRIGONOMETRY

Fig. 1

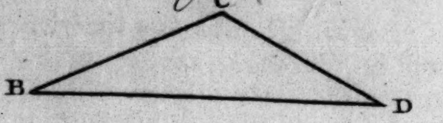


Fig. 3

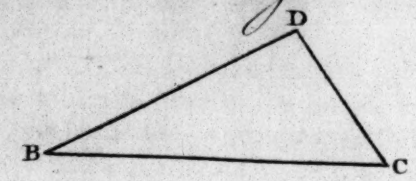


Fig. 2

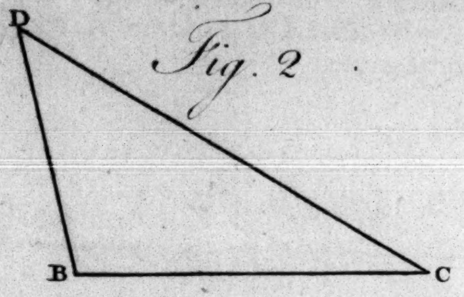


Fig. 4

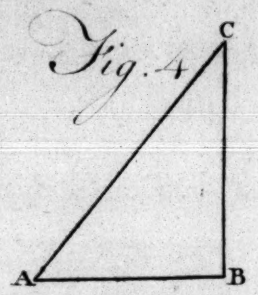
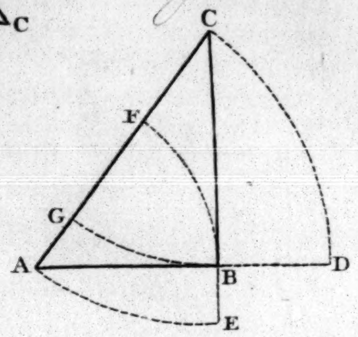
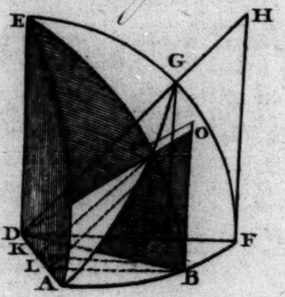


Fig. 5



Spherical TRIGONOMETRY

Fig. 6


E
H
G
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D
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A
B
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Fig. 7

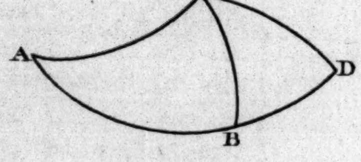


Fig. 9

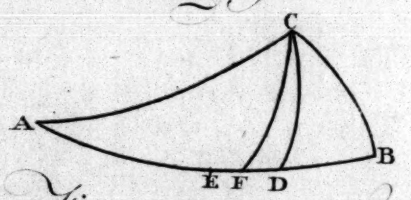


Fig. 10

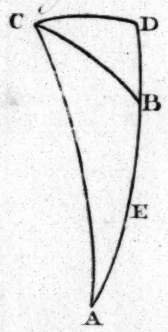


Fig. 8

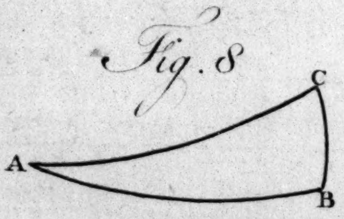


Fig. 11

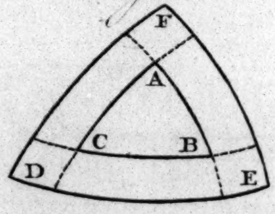
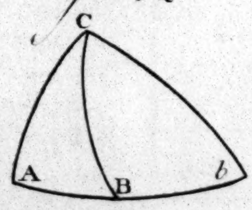


Fig. 12



TURNING

Fig. 1

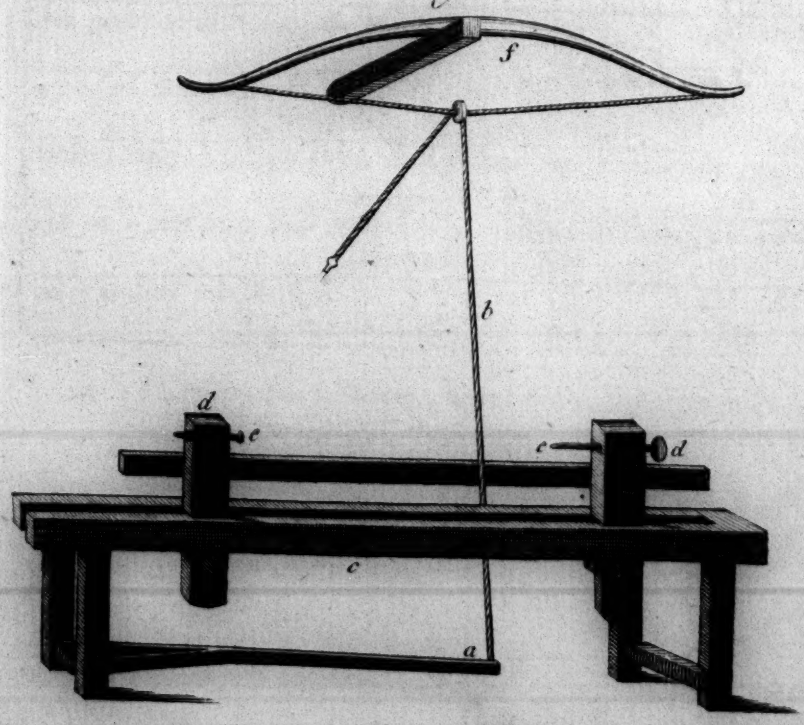


Fig. 2

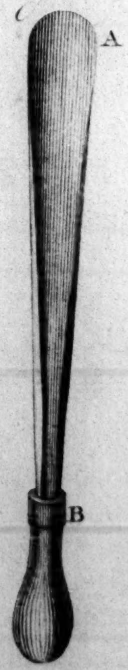


Fig. 3

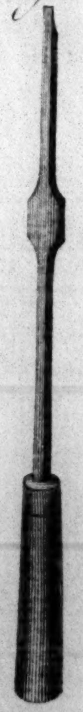


Fig. 4

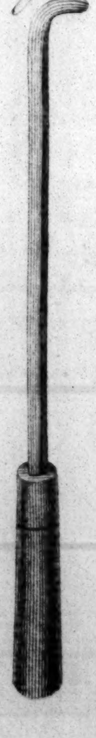
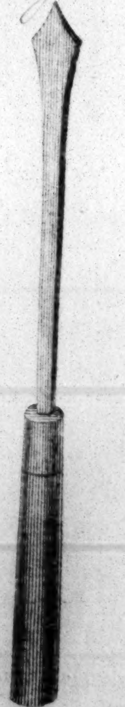


Fig. 5



Allardice sc.t

BRITISH MUSEUM

The Solution of the Cases of oblique ſpherical Triangles, (fig. 9 and 10.)

Caſe	Given	Sought	Solution
1	Two ſides AC, BC, and an angle A oppoſite to one of them	The angle B oppoſite to the other	As ſine BC : ſine A : : ſine AC : ſine B (by theorem 1.) Note, this caſe is ambiguous when BC is leſs than AC; ſince it cannot be determined from the data whether B be acute or obtuſe.
2	Two ſides AC, BC, and an angle A oppoſite to one of them	The included angle ACB	Upon AB produced (if need be) let fall the perpendicular CD; then (by theorem 4.) rad. : co-ſine AC : : tang. A : co-tang. ACD; but (by theorem 1.) as tang. BC : tang. AC : : co-ſine ACD : co-ſine BCD. Whence $ACB = ACD \pm BCD$ is known.
3	Two ſides AC, BC, and an angle oppoſite to one of them	The other ſide AB	As rad. : co-ſine A : : tang. AC : tang. AD (by theor. 1) and (by theor. 2.) as co-ſine AC : co-ſine BC : : co-ſine AD : co-ſine BD. Note, this and the laſt caſe are both ambiguous when the firſt is ſo.
4	Two ſides AC, AB, and the included angle A	The other ſide BC	As rad. : co-ſine A : : tang. AC : tang. AB (by theor. 1.) whence AD is alſo known; then (by theor. 2.) as co-ſine AD : co-ſine BD : : co-ſine AC : co-ſine BC.
5	Two ſides AC, AB, and the included angle A	Either of the other angles, ſuppoſe B	As rad. : co-ſine A : : tang. AC : tang. AD (by theor. 1.) whence BD is known; then (by theor. 4.) as ſine BD : ſine AD : : tang. A : tang. B.
6	Two angles A, ACB, and the ſide AC betwixt them	The other angle B	As rad. : co-ſine AB : : tang. A : co-tang. ACD (by theorem 4.) whence BCD is alſo known; then (by theor. 3.) as ſine ACD : ſine BCD : : co-ſine A : co-ſine B.
7	Two angles A, ACB, and the ſide AC betwixt them	Either of the other ſides, ſuppoſe BC	As rad. : co-ſine AC : : tang. A : co-tang. ACD (by theorem 4.) whence BCD is alſo known; then, as co-ſine BCD : co-ſine ACD : : tang. AC : tang. BC (by theor. 1.)
8	Two angles A, B, and a ſide AC oppoſite to one of them	The ſide BC oppoſite the other	As ſine B : ſine AC : : ſine A : ſine BC (by theorem 1.)
9	Two angles A, B, and a ſide AC oppoſite to one of them	The ſide AB betwixt them	As rad. : co-ſine A : : tang. AC : tang. AD (by theor. 1.) and as tang. B. : tang. A : : ſine AD : ſine BD (by theorem 4.) whence AB is alſo known.
10	Two angles A, B, and a ſide AC oppoſite to one of them	The other angle ACB	As rad. : co-ſine AC : : tang. A : co-tang. ACD (by theorem 4.) and as co-ſine A : co-ſine B : : ſine ACD : ſine BCD (by theor. 3.) whence ACB is alſo known.
11	All the three ſides AB, AC, and BC	An angle, ſuppoſe A	As tang. $\frac{1}{2}$AB : tang. $\frac{AC+BC}{2}$: : tang. $\frac{AC-BC}{2}$: tang. DE, the diſtance of the perpendicular from the middle of the baſe (by theorem 6.) whence AD is known: then, as tang. AC : tang. AD : : rad. : co-ſine A (by theor. 1.)
12	All the three angles A, B, and ACB	A ſide, ſuppoſe AC	As co-tang. $\frac{ABC+A}{2}$: tang. $\frac{ABC-A}{2}$: : tang. $\frac{ACB}{2}$: tan. of the angle included by the perpendicular and a line biſecting the vertical angles; whence ACD is alſo known: then (by theorem 5.) as tang. A : co-tang. ACD : : rad. : co-ſine AC.

Hutton's Mathematical Dictionary. The following propoſitions and remarks, concerning ſpherical triangles (ſelected and communicated to Dr Hutton by the reverend Nevil Maſkelyne, D. D. Aſtronomer Royal, F. R. S.), will alſo render the calculation of them perſpicuous, and free from ambiguity.

1. A ſpherical triangle is equilateral, iſoſcelar, or ſcalene, according as it has its three angles all equal, or two of them equal, or all three unequal; and *vice verſa*.

2. The greateſt ſide is always oppoſite the greateſt angle, and the ſmalleſt ſide oppoſite the ſmalleſt angle.

3. Any two ſides taken together are greater than the third.

4. If the three angles are all acute, or all right, or all obtuſe; the three ſides will be, accordingly, all leſs than 90°, or equal to 90°, or greater than 90°; and *vice verſa*.

5. If from the three angles A, B, C, of a triangle ABC, as poles, there be deſcribed, upon the ſurface of the ſphere, three arches of a great circle DE, DF, FE, forming by their interſections a new ſpherical triangle DEF; each ſide of the new triangle will be the ſupplement of the angle at its pole; and each angle of the ſame triangle will be the ſupplement of the ſide oppoſite to it in the triangle ABC. Fig. 11.

6. In any triangle ABC, or A*b*C, right-angled in A, *1ſt*, The angles at the hypothenuſe are always of the ſame kind Fig. 12.

as their oppoſite ſides; *2dly*, The hypothenuſe is leſs or greater than a quadrant, according as the ſides including the right angle are of the ſame or different kinds; that is to ſay, according as theſe ſame ſides are either both acute or both obtuſe, or as one is acute and the other obtuſe. And *vice verſa*, *1ſt*, The ſides including the right angle are always of the ſame kind as their oppoſite angles: *2dly*, The ſides including the right angle will be of the ſame or different kinds, according as the hypothenuſe is leſs or more than 90°; but one at leaſt of them will be of 90°, if the hypothenuſe is ſo.

TRIHILATÆ, from *tres* "three," and *hilum* "an external mark on the ſeed;" the name of the 23d claſs in Linnæus's Fragments of a Natural Method; conſiſting of plants with three ſeeds, which are marked with an external cicatrix or ſcar, where they are faſtened within the fruit. See Botany, Sect. 6.

TRIM, implies in general the ſtate or diſpoſition by which a ſhip is beſt calculated for the ſeveral purpoſes of navigation.

Thus the trim of the hold denotes the moſt convenient and proper arrangement of the various materials contained therein relatively to the ſhip's motion or ſtability at ſea. The trim of the maſts and ſails is alſo their moſt appoſite ſituation with regard to the conſtruction of the ſhip and the effort of the wind upon her ſails. See Seamanship.

TRINGA, Sandpiper; a genus of birds belonging to the order of *grallæ*. The bill is ſomewhat tapering, and of the length of the head; the noſtrils are ſmall; the toes are four in number and divided, the hind toe being frequently raiſed from the ground. According to Dr Latham there are 45 ſpecies, of which 18 are Britiſh. We ſhall deſcribe ſome of the moſt remarkable.

1. *Vanellus*, lapwing, or tewit, is diſtinguiſhed by having the bill, crown of the head, creſt, and throat, of a black colour; there is alſo a black line under each eye; the back is of a purpliſh green; the wings and tail are black and white, and the legs red: the weight is 8 ounces and the length 13 inches. It lays four eggs, making a ſlight neſt with a few bents. The eggs have an olive caſt, and are ſpotted with black. The young, as ſoon as hatched, run like chickens: the parents ſhow remarkable ſolicitude for them, flying with great anxiety and clamour near them, ſtriking at either men or dogs that approach, and often fluttering along the ground like a wounded bird, to a conſiderable diſtance from their neſt, to delude their purſuers; and to aid the deceit, they become more clamorous when moſt remote from it: the eggs are held in great eſteem for their delicacy, and are ſold by the London poulterers for three ſhillings the dozen. In winter, lapwings join in vaſt flocks; but at that ſeaſon are very wild: their fleſh is very good, their food being inſects and worms. During October and November, they are taken in the fens in nets, in the ſame manner that ruffs are; but are not preſerved for fattening, being killed as ſoon as caught.

2. *Pugnax*. The male of this ſpecies is called *ruff*, and the female *reeve*. The name *ruff* is given to the males becauſe they are furniſhed with very long feathers, ſtanding out in a remarkable manner, not unlike the ruff worn by our anceſtors. The ruff is of as many different colours as there are males; but in general it is barred with black; the weight is ſix or ſeven ounces; the length, one foot. The female, or *reeve*, has no ruff; the common colour is brown; the feathers are edged with a very pale colour; the breaſt and belly white. Its weight is about four ounces.

Theſe birds appear in the fens in the earlieſt ſpring, and diſappear about Michaelmas. The reeves lay four eggs in a tuft of graſs, the firſt week in May, and ſit about a month. The eggs are white, marked with large ruſty ſpots. Fowlers avoid in general the taking of the females; not only becauſe they are ſmaller than the males, but that they may be left to breed.

Soon after their arrival, the males begin to hill, that is, to collect on ſome dry bank near a ſplaſh of water, in expectation of the females, who reſort to them. Each male keeps poſſeſſion of a ſmall piece of ground, which it runs round till the graſs is worn quite away, and nothing but a naked circle is left. When a female lights, the ruffs immediately fall to fighting. It is a vulgar error, that ruffs muſt be fed in the dark leſt they ſhould deſtroy each other by fighting on admiſſion of light. The truth is, every bird takes its ſtand in the room as it would in the open fen. If another invades its circle, an attack is made, and a battle enſues. They make uſe of the ſame action in fighting as a cock, place their bills to the ground and ſpread their ruffs. Mr Pennant ſays, he has ſet a whole room-full a-fighting, by making them move their ſtations; and after quitting the place, by peeping through a crevice, ſeen them reſume their circles and grow pacific.

When a fowler diſcovers one of thoſe hills, he places his net over night, which is of the ſame kind as thoſe that are called *clap* or *day nets*; only it is generally ſingle, and is about 14 yards long and four broad. The fowler reſorts to his ſtand at day-break, at the diſtance of one, two, three, or four hundred yards from the nets, according to the time of the ſeaſon; for the later it is, the ſhyer the birds grow. He then makes his firſt pull, taking ſuch birds as he finds within reach; after that he places his ſtuffed birds or ſtales to entice thoſe that are continually traverſing the fen. When the ſtales are ſet, ſeldom more than two or three are taken at a time. A fowler will take 40 or 50 dozen in a ſeaſon.—Theſe birds are found in Lincolnſhire, the iſle of Ely, and in the Eaſt Riding of York. They viſit a place called *Martin-Mere* in Lancaſhire the latter end of March or beginning of April; but do not continue there above three weeks; where they are taken in nets, and fattened for the table with bread and milk, hempſeed, and ſometimes boiled wheat; but if expedition is required, ſugar is added, which will make them in a fortnight's time a lump of fat: they then ſell for two ſhillings or half a crown a-piece. They are dreſſed like the woodcock, with their inteſtines; and when killed at the critical time, ſay the Epicures, are the moſt delicious of all morſels.

3. *Canutus*, or knot, has the forehead, chin, and lower part of the neck, brown, inclining to aſh-colour; the back and ſcapulars deep brown, edged with aſh-colour; the coverts of the wings white, the edges of the lower order deeply ſo, forming a white bar; the breaſt, ſides, and belly white, the two firſt ſtreaked with brown; the coverts of the tail marked with white and duſky ſpots alternately; the tail aſh coloured, the outmoſt feather on each ſide white; the legs of a bluiſh grey; and the toes, as a ſpecial mark, divided to the very bottom; the weight four ounces and a

half.—Theſe birds, when fattened, are preferred by ſome to the ruffs themſelves. They are taken in great numbers on the coaſts of Lincolnſhire, in nets ſuch as are employed in taking ruffs; with two or three dozens of ſtales of wood painted like the birds, placed within; 14 dozens have been taken at once. Their ſeaſon is from the beginning of Auguſt to that of November. They diſappear with the firſt froſts. Camden ſays they derive their name from king Canute, Knute, or Knout, as he is ſometimes called; probably becauſe they were a favourite diſh with that monarch. We know that he kept the feaſt of the purification of the Virgin Mary with great pomp and magnificence at Ely; and this being one of the fen-birds, it is not unlikely but he met with it there.

4. The *hypoleucos*, or common ſandpiper, except in pairing time, is a ſolitary bird: it is never found near the ſea, but frequents rivers, lakes, and other freſh waters. Its head is brown, ſtreaked with downward black lines; the neck an obſcure aſh-colour; the back and coverts of the wings brown, mixed with a gloſſy green, elegantly marked with tranſverſe duſky lines; the breaſt and belly are of a pure white; the quill-feathers and the middle feathers of the tail are brown; the legs of a dull pale green.

5. The *alpina*, or dunling ſandpiper, is at once diſtinguiſhed from the others by the ſingularity of its colours. The back, head, and upper part of the neck, are ferruginous, marked with large black ſpots; the lower part of the neck white, marked with ſhort duſky ſtreaks; the coverts of the wings aſh-colour; the belly white, marked with large black ſpots, or with a black creſcent pointing towards the thighs; the tail is aſh-coloured; legs black; toes divided to their origin. In ſize it is ſuperior to that of a lark. Theſe birds are found on our ſea-coaſts; but may be reckoned among the more rare kinds. They lay four eggs of a dirty white colour, blotched with brown round the thicker end, and marked with a few ſmall ſpots of the ſame colour on the ſmaller end. They are common on the Yorkſhire coaſts, and eſteemed a great delicacy.

6. The *cinclus*, purre, or ſtint, is in length 7½ inches; The head and hind part of the neck are aſh-coloured, marked with duſky lines; a white ſtroke divides the bill and eyes; the back is of a browniſh aſh-colour; the breaſt and belly white; the coverts of the wings and tail a dark brown, edged with light aſh-colour or white; the upper part of the quill-feathers duſky, the lower white; the legs of a duſky green; the toes divided to their origin. The bill an inch and a half long, ſlender, and black; irides duſky.—Theſe birds come in prodigious flocks on our ſea-coaſts during the winter: in their flight they perform their evolutions with great regularity; appearing like a white or a duſky cloud, as they turn their backs or their breaſts towards you. They leave our ſhores in ſpring, and retire to ſome unknown place to breed. They were formerly a well known diſh at our tables.

TRINIDAD, an iſland in the gulf of Mexico, ſeparated from New Andaluſia, in Terra Firma, by a ſtrait, about three miles over. The ſoil is fruitful, producing ſugar, cotton, Indian corn, fine tobacco, and fruits; but the air is unhealthy. It was taken by Sir Walter Raleigh in 1595, and by the French in 1676, who plundered the iſland and then left it. It is about 62 miles in length, and 45 in breadth; and was diſcovered by Chriſtopher Columbus in 1498. There is a bituminous lake in this iſland; for an account of which, ſee the article PETROLEUM, p. 252. note B.

TRINITARIANS, thoſe who believe in the Trinity; thoſe who do not believe therein being called *Antitrinitarians*.

TRINITY, in theology, the ineffable myſtery of three perſons in one God; Father, Son, and Holy Spirit. See THEOLOGY, nº 61.

Trinity-Houſe. See LONDON, nº 49.

Trinity-Sunday, a feſtival obſerved on the Sunday next after Whitſunday, in honour of the holy Trinity. The obſervation of this feſtival was firſt enjoined in the council of Arles, anno 1260.

TRINOBANTES, (anc. geog.) a people of Britain, ſuppoſed to have occupied Middleſex and Eſſex.

TRIO, in muſic, a part of a concert wherein three perſons ſing; or, more properly, a muſical compoſition conſiſting of three parts.

TRIPHTHONG, in grammar, an aſſemblage or concourſe of three vowels in one ſyllable; as *quæ*.

TRIPLE, in muſic, is one of the ſpecies of meaſure or time. See MUSIC.

TRIPOD, in antiquity, a famed ſacred ſeat or ſtool, ſupported by three feet, whereon the prieſts and ſybils were placed to render oracles. It was on the tripod that the gods were ſaid to inſpire the Pythias with that divine fury and enthuſiaſm wherewith they were ſeized at the delivery of their predictions.

TRIPOLI, a country of Africa, in Barbary; bounded on the north by the Mediterranean ſea; on the ſouth, by the country of the Beriberies; on the weſt, by the kingdom of Tunis, Biledulgerid, and a territory of the Gadamis; and on the eaſt, by Egypt. It is about 925 miles along the ſea coaſt; but the breadth is various. Some parts of it are pretty fruitful; but that towards Egypt is a ſandy deſert. It had the title of a *kingdom*; but is now a republic, governed by a dey. He is not abſolute, for a Turkiſh baſhaw reſides here, who receives his authority from the grand ſeignior, and has a power of controling the dey, and levying taxes on the people. The dey is elected by the ſoldiers, who make no ſcruple of depoſing him when they pleaſe.

TRIPOLI, a conſiderable town of Africa, and capital of a republic of the ſame name in Barbary, and under protection of the grand ſeignior, with a caſtle and a fort. It is pretty large, and the inhabitants are noted pirates. It was taken by Charles V. who ſettled the knights of Malta there; but they were driven away by the Turks in 1551. It was formerly very flouriſhing; and has now ſome trade in ſtuffs, ſaffron, corn, oil, wool, dates, oſtrich feathers, and ſkins: but they make more of the Chriſtian ſlaves which they take at ſea; for they either ſet high ranſoms upon them, or make them perform all ſorts of work. It is ſeated on the coaſt of the Mediterranean, in a ſandy ſoil, and ſurrounded by a wall, ſtrengthened by other fortifications. E. Long. 13. 12. N. Lat. 32. 34.

TRIPOLI, called *Tripolis* of *Syria*, to diſtinguiſh it from Tripoli in *Barbary*, received its name from its being anciently formed of three cities at a ſmall diſtance from each other, one of which belonged to the Aradians, or ancient kingdom of Arad, the ſecond to the Sidonians, and the third to the Tyrians, perhaps as a common mart to thoſe maritime powers. The preſent town of Tripoli is built at the diſtance of a mile and a half from the other, upon the declivity of a hill facing the ſea, in 34° 20′ north latitude, and in 35° 50′ eaſt longitude from Greenwich. It is ſurrounded with walls, fortified with ſeven high ſtrong towers, and a caſtle, all of Gothic architecture; but the ſtreets are narrow, and the houſes low. The city contains about 8000 houſes, and near 60,000 inhabitants, conſiſting of Turks, Chriſtians, and Jews. The baſha, or pacha, who reſides in the caſtle, where there is a garriſon of 200 janizaries, governs the adjacent territory, in which there is plenty of fruit, and a great number of mulberry-trees, which enable the inhabitants to carry on a ſilk manufacture, from which they draw conſiderable profit.

All the environs of Tripoli are laid out in orchards, where the mopal grows ſpontaneouſly, and the white-mulberry is cultivated for the ſilk-worm; the pomegranate, orange, and lemon trees for their fruit, which is here very fine. The country, though delightful to the eye, is unhealthy; from July to September, epidemic fevers, like thoſe of Scanderoon and Cyprus, prevail, and are principally cauſed by the artificial inundations made for the purpoſe of watering the mulberry trees, to enable them to throw out their ſecond leaves, and from a want of free circulation of air, the city being open only to the weſtward.

Tripoli, a genus of argillaceous earth, much uſed in the poliſhing of metals. It has its name from Tripoli in Barbary, from whence it was formerly brought to us, and has the following properties: 1. It does not efferveſce with any of the acids. 2. It hardens in the fire; and by a conſiderable heat, its ſurface becomes vitrified. 3. Every kind of it, excepting that found in England, becomes red by calcination. 4. It is fuſible by mixture with calcareous earth, as well as by means of borax and microcoſmic ſalt. 5. Generally no ſalt can be extracted by waſhing, though ſometimes the marine and vitriolic acid may be extracted by diſtillation. 6. When crude it imbibes water, but is not diffuſible in it. 7. It taſtes like common chalk, and feels ſandy between the teeth, though no ſand can by any means be extracted from it.

Tripoli is found of two different kinds: 1. Solid, and of a rough texture; brown, yellowiſh, and ſpotted like marble. 2. Friable and compact; granulated, brown, or yellowiſh; this laſt being the kind met with in England. This laſt kind has alſo been found in Scotland; but the rotten ſtone found in Derbyſhire, and likewiſe much uſed in poliſhing, is quite another ſubſtance. According to Ferber, the rotten ſtone is tripoli mixed with a calcareous earth. In the memoirs of the academy at Paris, for 1769, it is aſſerted, that tripoli is a volcanic product. In proof of this, we are there informed, that a coal-mine at St Eſtienne having accidentally taken fire, and the fire having extended to ſome beds of ſchiſtus and bitumen, tripoli was found in the burnt parts of the ſtrata, but nowhere elſe. Cronſtedt is of opinion, that 100 parts of it contain 90 of ſiliceous earth, 7 of argill, and 3 of iron; but the red ſort probably contains more iron.

TRIPTOLEMUS, laws of. See Myſteries, n° 74.

TRIQUETROUS, among botaniſts, expreſſes a fruit or leaf that has three ſides or faces all flat.

TRIREMIS, in antiquity, a galley with three ranks of oars on a ſide.

TRISMEGISTUS, an epithet or ſurname given to one of the two Hermeſes. See Thoth.

TRISMUS, the locked jaw. See Medicine, n° 280.

TRISSYLLABLE, in grammar, a word conſiſting of three ſyllables.

TRITICUM, wheat, in botany: A genus of plants belonging to the claſs of *triandria*, and order of *digynia;* and in the natural ſyſtem ranging under the 4th order, *Gramina.* The calyx is bivalve, ſolitary, and generally containing three florets; the corolla is bivalve, one valve being bluntiſh, the other acute. There are 15 ſpecies; the *æſtivum*, ſummer or ſpring wheat; *hybernum*, winter Lammas, or common wheat; *compoſitum, turgidum*, or cone-wheat; *polonium*, or Poliſh wheat; *ſpelta*, or ſpelt-wheat; *monococcum*, or one-grained wheat; *proſtratum*, or trailing wheat-graſs; *pumilum*, or dwarf wheat-graſs; *junceum*, or ruſh wheat-graſs; *repens*, or couch-graſs; *tenellum*, or tender wheat-graſs; *maritimum*, or ſea wheat-graſs; *unilaterale*, or ſpiked ſea-wheat; *unioloides*, or linear ſpiked wheat-graſs.—Of what country the firſt ſix ſpecies are natives, cannot now be determined: the proſtratum is a native of Siberia; the junceum, repens, unilaterale, and maritimum, are natives of Britain; the tenellum is a native of Spain; and the unioloides is a native of Italy. It may alſo be obſerved, that the firſt nine are annuals, the reſt are perennials. See Agriculture, n° 122; and Husbandry. Part I.

Linnæus comprehends the different kinds of wheat cultivated at preſent under ſix ſpecies; but cultivation has produced a great many varieties from theſe.

1. *Triticum æſtivum*, or ſpring-wheat, hath four flowers in a calyx, three of which moſtly bear grain. The calyces ſtand pretty diſtant from each other on both ſides a flat ſmooth receptacle. The leaves of the calyx are keel ſhaped, ſmooth, and they terminate with a ſhort ariſta. The glumes of the flowers are ſmooth and bellying, and the outer leaf of three of the glumes in every calyx is terminated by a long ariſta, but the three inner ones are beardleſs. The grain is rather longer and thinner than the common wheat. It is ſuppoſed to be a native of ſome part of Tartary. The farmers call it *Spring Wheat*, becauſe it will come to the ſickle with the common wheat, though it be ſown in February or March. The varieties of it are: *Triticum æſtivum ſpica et grana rubente.* Spring wheat, with a red ſpike and grain. *Triticum æſtivum rubrum, ſpica alba.* Red ſpring wheat, with a white ſpike. *Triticum æſtivum, ſpica et grana alba.* Spring wheat, with a white ſpike and grain.—2. *Triticum hybernum*, winter or common wheat, has alſo four flowers in a calyx, three of which are moſtly productive. The calyces ſtand on each ſide a ſmooth flat receptacle, as in the former ſpecies, but they are not quite ſo far aſunder. The leaves of the calyx are bellying, and ſo ſmooth that they appear as if poliſhed, but they have no ariſta. The glumes of the flowers too are ſmooth, and the outer ones near the top of the ſpike are often tipped with ſhort ariſtæ. The grain is rather plumper than the former, and is the ſort moſt generally ſown in England; whence the name of *common wheat.* Its varieties are: *Triticum hybernum, ſpica et grana rubente.* Common wheat, with a red ſpike and grain. *Triticum hybernum rubrum, ſpica alba.* Common red wheat, with a white ſpike. *Triticum hybernum, ſpica et grana alba.* Common wheat, with a white ſpike and grain.—3. *Triticum turgidum*, thick ſpiked or cone-wheat, is eaſily diſtinguiſhed from either of the former; for though it has four flowers in a calyx after the manner of them, yet the whole calyx and the edges of the glumes are covered with ſoft hairs. The calyces too ſtand thicker on the receptacle, which make the ſpike appear more turgid. Some of the outer glumes near the top of the ſpike are terminated by ſhort ariſtæ, like thoſe of the common wheat. The grain is ſhorter, plumper, and more convex on the back than either of the former ſpecies. Its varieties are numerous, and have various appellations in different counties, owing to the great affinity of ſeveral of them. Thoſe moſt eaſily to be diſtinguiſhed are: *Triticum turgidum conicum album.* White cone wheat. *Triticum turgidum conicum rubrum.* Red cone wheat. *Triticum turgidum ariſtiſerum.* Bearded cone wheat. *Triticum turgidum, ſpica multiplici.* Cone wheat, with many ears. The third variety is what the farmers call *clog wheat, ſquare wheat*, and *rivets.* The grain of this is remarkably convex on one ſide, and when ripe the awns generally break in pieces and fall off. This ſort is very productive, but it yields an inferior flour to what the former two ſpecies do.—4. *Triticum Polonicum*, or Poliſh wheat, has ſome reſemblance to the turgidum,

dum, but both grain and ſpike are longer. The calyx contains only two flowers, and the glumes are furniſhed with very long ariſtæ; the teeth of the midrib are bearded. As this ſort is ſeldom ſown in England, there is no telling what varieties it produces.—5. *Triticum Spelta*, ſpelt or German wheat. At firſt view this has a great reſemblance to barley, but it has no involucrum. The calyx is truncated; that is, it appears as if the ends were ſnipped off, and it contains four flowers, two of which are hermaphrodite and the glumes bearded, but the intermediate ones are neuter. There are two rows of grain as in barley, but they are ſhaped like wheat. It is much cultivated in France, Germany, and Italy. 6. *Triticum monococcum*, St Peter's corn, or one-grained wheat, has three flowers in each calyx alternately bearded, and the middle one neuter. The ſpike is ſhining, and has two rows of grain in the manner of barley. Where it grows naturally is not known, but it is cultivated in Germany; and in conjunction with ſpelt wheat is there made into bread, which is coarſe, and not ſo nouriſhing as that made of common wheat. Malt made of any of our wheats is often put into beer, and a ſmall quantity of it will give a large brewing a fine brown tranſparent tincture.

TRITON, a ſea demigod, held by the ancients to be an officer or trumpeter of Neptune, attending on him, and carrying his orders from ſea to ſea.

TRITURATION, the act of reducing a ſolid body into a ſubtile powder; called alſo *pulveriſation* and *levigation*.

TRIUMPH, in Roman antiquity, a public and ſolemn honour conferred by the Romans on a victorious general by allowing him a magnificent entry in the city.

The greater triumph, called alſo *curulis*, or ſimply the *triumph*, was decreed by the ſenate to a general, upon the conquering of a province or gaining a ſignal victory. The day appointed for the ceremony being arrived, ſcaffolds were erected in the forum and circus, and all the other parts of the city where they could beſt behold the pomp: the ſenate went to meet the conqueror without the gate called *Capena* or *Triumphalis*, and marched back in order to the Capitol; the ways being cleared and cleanſed by a number of officers and tipſtaffs, who drove away ſuch as thronged the paſſage or ſtraggled up and down. The general was clad in a rich purple robe, interwoven with figures of gold, ſetting forth his great exploits; his buſkins were beſet with pearl; and he wore a crown, which at firſt was only laurel, but afterwards gold; in one hand he bore a branch of laurel, and in the other a truncheon. He was carried in a magnificent chariot, adorned with ivory and plates of gold, drawn uſually by two white horſes; though ſometimes by other animals, as that of Pompey when he triumphed over Africa, by elephants; that of Marc Anthony by lions; that of Heliogabalus by tigers; that of Aurelian by deer, &c. His children were at his feet, and ſometimes on the chariot-horſes. The proceſſion was led up by the muſicians, who played triumphal pieces in praiſe of the general: theſe were followed by young men who led the victims to the ſacrifice, with their horns gilded, and their heads adorned with ribands and garlands; next came the carts and waggons, loaded with all the ſpoils taken from the enemy, with their horſes, chariots, &c.; theſe were followed by the kings, princes, and generals, who had been taken captives, loaded with chains: after theſe appeared the triumphal chariot, before which, as it paſſed, they all along ſtrewed flowers, and the people with loud acclamations called out, *Io triumphe!* The chariot was followed by the ſenate clad in white robes; and the ſenate by ſuch citizens as had been ſet at liberty or ranſomed; and the proceſſion was cloſed by the prieſts and their officers and utenſils, with a white ox led along for the chief victim. In this order they proceeded through the triumphal gate, along the via ſacra, to the Capitol, where the victims were ſlain. In the mean time all the temples were open, and all the altars loaded with offerings and incenſe; games and combats were celebrated in the public places, and rejoicings appeared every where.

TRIUMVIR, one of the three perſons who govern abſolutely, and with equal authority, in a ſtate. It is chiefly applied to the Roman government: Cæſar, Pompey, and Craſſus, were the firſt triumvirs who divided the government among them. There were alſo other officers ſo called; as the triumviri or treſviri capitales, who were the keepers of the public goal: they had the office of puniſhing malefactors; for which purpoſe they kept eight lictors under them.

TROAS, a country of Phrygia in Aſia Minor, of which Troy was the capital. When Troas is taken for the whole kingdom of Priam, it may be ſaid to contain Myſia and Phrygia Minor; but if only applied to that part of the country where Troy was ſituated, its extent is confined within very narrow limits. Troas was anciently called Dardania. See TROJA.

TROCHÆUS, in proſody, a foot conſiſting of a long and ſhort ſyllable.

TROCHANTER, in anatomy. See there, n° 58.

TROCHE, in pharmacy, a ſort of medicine made of glutinous ſubſtances into little cakes, and afterwards exſiccated. See PHARMACY, n° 560—569.

TROCHILUS, HUMMING BIRD, a genus of birds belonging to the order of *picæ*. The roſtrum is ſubulate, filiform, and longer than the head, the apex being tubular; the upper mandible ſheaths the lower. The tongue is filiform and tubulous, the two threads coaleſcing; the feet are ſlender and fit for walking; the tail has ten feathers. There are 65 ſpecies, none of which are natives of Britain. They are all remarkable for the beauty of their colours, and moſt of them for the ſmallneſs of their ſize, though ſome are eight or nine inches in length.—They are divided into two families, viz. thoſe with crooked bills, and thoſe with ſtraight bills. Of theſe we ſhall deſcribe the four following ſpecies:

1. The *exilis*, or little humming-bird, has a crooked bill, is an inch and a half in length; frequently weighing leſs than 50 grains. The bill is black, and half an inch in length: the body greeniſh brown, with a red, ſhining, inimitable gloſs: the head is creſted with a ſmall tuft, green at bottom, but of a ſparkling gold colour at top: quills and tail fine black. It is a native of Guiana; and the velocity of it in flying is ſo great, that the eye can ſcarce keep pace with its motion.

2. The *moſchitus*, or ruby-necked humming bird, according to Marcgrave is the moſt beautiful of the whole genus. Its length is three inches four lines; the bill ſtraight, eight lines long, and blackiſh: the top of the head and hind part of the neck are as bright as a ruby, and of the ſame colour: the upper parts of the body are brown, with a faint mixture of green and gold: the throat and fore parts of the neck are the colour of the moſt brilliant topaz: the belly, ſides, and thighs are brown; but on the lower part of the belly, on each ſide, is a ſpot of white: the tail is rufous purple, inclining to violet at the ends; the two middle feathers are ſhorteſt: the legs and claws blackiſh. The female has only a daſh of golden or topaz on the breaſt and fore part of the neck; the reſt of the under parts are greyiſh white. This ſpecies is found in Brazil, Curaſſoa, Guiana, and Surinam.

3. The *minimus*, or leaſt humming-bird, is exceeded, both in weight and dimenſions, by ſeveral ſpecies of bees. The total length is one inch and a quarter; and when killed,

weighs no more, according to Sir Hans Sloan, than 20 grains. The bill is ſtraight and black, three lines and a half in length: the upper parts of the head and body are of a greeniſh gilded brown, in ſome lights appearing reddiſh: the under parts are greyiſh white; the wings are violet-brown; the tail of a bluiſh black, with a gloſs of poliſhed metal; but the outer feather except one on each ſide, is grey from the middle to the tip, and the outer one wholly grey; legs and claws brown. The female is leſs than the male: the whole upper ſide of a dirty brown, with a ſlight gloſs of green; the under parts of a dirty white. Theſe birds are found in various parts of South and North America and the adjacent iſlands.—Our author received it from Jamaica.

4. *Superciliosſus*, white-ſhaft, or ſupercilious humming-bird, has a bill twenty lines long; the feathers of the tail next the two long ſhafts, are alſo the longeſt, and the lateral ones continually decreaſe to the two outermoſt which are the ſhorteſt, and this gives the tail a pyramidical ſhape: its quills have a gold gloſs on a grey and blackiſh ground, with a whitiſh edge at the point, and the two ſhafts are white through the whole projecting portions; all the upper ſide of the back and head gold colour; the wing violet brown; and the under ſide of the body white-grey.

Theſe birds ſubſiſt on the nectar or ſweet juice of flowers: they frequent thoſe moſt which have a long tube; particularly the *impatiens noli me tangere*, the *monarda* with crimſon flowers, and thoſe of the convolvulus tribe. They never ſettle on the flower during the action of extracting the juice, but flutter continually like bees, moving their wings very quick, and making a humming noiſe: whence their name. They are not very ſhy, ſuffering people to come within a foot or two of the place where they are, but on approaching nearer, fly off like an arrow out of a bow. They often meet and fight for the right to a flower, and this all on the wing: in this ſtate they often come into rooms where the windows ſtand open, fight a little, and go out again. When they come to a flower which is juiceleſs, or on the point of withering, they pluck it off as it were in anger, by which means the ground is often quite covered with them. When they fly againſt each other, they have, beſides the humming, a ſort of chirping noiſe like a ſparrow or chicken. They do not feed on inſects nor fruit; nor can they be kept long in cages, though they have been preſerved alive for ſeveral weeks together by feeding them with water in which ſugar had been diſſolved.

This bird moſt frequently builds in the middle of a branch of a tree, and the neſt is ſo ſmall that it cannot be ſeen by a perſon who ſtands on the ground; any one therefore deſirous of ſeeing it, muſt get up to the branch, that he may view it from above: it is for this reaſon that the neſts are not more frequently found. The neſt is of courſe very ſmall, and quite round: the outſide, for the moſt part, is compoſed of green moſs, common on old pales and trees; the inſide of ſoft down, moſtly collected from the leaves of the great mullein, or the ſilk-graſs; but ſometimes they vary the texture, making uſe of flax, hemp, hairs, and other ſoft materials: they lay two eggs of the ſize of a pea, which are white, and not bigger at one end than the other.

The above account of the manners will in general ſuit all the birds of this genus; for as their tongues are made for ſuction, it is by this method alone that they can gain nouriſhment: no wonder, therefore, they can ſcarcely be kept alive by human artifice. Captain Davies, however, informed our author, that he kept theſe birds alive for four months by the following method:—He made an exact imitation of ſome of the tubular flowers with paper, faſtened round a tobacco-pipe, and painted them of a proper colour; theſe were placed in the order of nature, in the cage wherein theſe little creatures were confined; the bottoms of the tubes were filled with a mixture of brown ſugar and water as often as emptied; and he had the pleaſure of ſeeing them perform every action; for they ſoon grew familiar, and took the nouriſhment in the ſame manner as when ranging at large, though cloſe under his eye.

TROGLODYTES, in ancient geography, a people of Ethiopia, ſaid to have lived in caves under ground. Pomponius Mela gives a ſtrange account of the Troglodites: he ſays, they did not ſo properly ſpeak as ſhriek; and that they lived on ſerpents.

TROGUS, (Pompeius), Latin univerſal hiſtorian to the time of Auguſtus Cæſar, of whom we have only an abridgement by Juſtin, flouriſhed about 41 B. C.

TROJA, the capital city of Troas, or, according to others, a country of which Ilium was the capital. It was built on a ſmall eminence near Mount Ida, and the promontory of Sigæum, at the diſtance of about four miles from the ſea-ſhore. Dardanus the firſt king of the country built it, and called it *Dardania*, and from Tros one of his ſucceſſors it was called *Troja*, and from Ilus *Ilion*. This city has been celebrated by the poems of Homer and Virgil; and of all the wars which have been carried on among the ancients, that of Troy is the moſt famous.

A deſcription of the plan of Troy has been lately publiſhed in French in the 3d volume of the Philoſophical Tranſactions of the Royal Society of Edinburgh, written by M. Chevalier. The city of Troy, according to him, ſtood on the preſent ſite of the modern village of Bounarbachi, diſtant four leagues from the ſea, and which is the reſidence of an Agá, ruling with abſolute ſway the inhabitants of the Trojan plain, and the inferior Agas, to whom they are immediately ſubject. Bounarbaci is ſituated on the ſide of an eminence, expoſed to every wind, at the termination of a ſpacious plain, the ſoil of which is rich and of a blackiſh colour. Cloſe to the village is to be ſeen a marſh covered with tall reeds; and the ſituation is impregnable on all ſides except at Erin (Homer's ερινεος), *the hill of wild fig trees*, which extended between the Scæan gate and the ſources of the Scamander. Theſe circumſtances, agreeing with Homer's deſcriptions, ſtrongly ſupport M. Chevalier's opinion concerning the ſituation of Troy. A very intereſting part of this work is the account of conical mounds or barrows, ſeveral of them 100 feet in diameter at the baſe; and which the author maintains to be the identical tombs raiſed over the aſhes of the heroes of the Trojan war: ſome of them he deems more ancient. He deſcribes particularly the tombs of Eſyetes, Ilus, Ajax, Hector, Achilles, Patroclus, and Antilochus.

This diſſertation, which runs to the length of 92 quarto pages, is replete with erudition and ingenious reaſoning, and is illuſtrated and embelliſhed by maps of the plan of Troy and ſeveral tables of inſcriptions. It has been tranſlated with much accuracy and care by Mr Dazel profeſſor of Greek in the Univerſity at Edinburgh, and accompanied with large notes and illuſtrations.

TSOLLIUS, Globe-flower, or *Lucken Gowan*, in botany: A genus of plants belonging to the claſs of *polyandria* and order of *polygynia*; and in the natural ſyſtem ranging under the 26th order, *Multiſiliquæ*. The calyx is wanting; there are about 14 petals; the capſules are very numerous, ovate, and monoſpermous. There are two ſpecies, the aſiaticus and europæus; the latter of which is a Britiſh plant.

Europæus, or European globe-flower, has its corollets connivent, and from 9 to 16 nectaria, of the length of the ſtamina, linear, plane, incurvated, and perforated at the inſide of the baſe. The leaves are divided firſt into five ſegments down to the baſe; the ſegments are again divided, each about half way, into two or three lobes, which are ſharply indented on the edges. The ſtalk is a foot high, and ſcarcely branched: the flower is yellow, globoſe, and ſpacious. It grows at the foot of mountains, and by the ſides of rivulets. The country people in Sweden ſtrew their floors and pavements on holidays with the flowers, which have a pleaſant ſmell, and are ornamental in gardens.

TROMP (Martin Happertz Van), a celebrated Dutch admiral, was born at the Baille, in Holland. He raiſed himſelf by his merit, after having diſtinguiſhed himſelf on many occaſions, eſpecially at the famous engagement near Gibraltar in 1607. He paſſed for one of the greateſt ſeamen that had till that time appeared in the world; and was declared admiral of Holland, even by the advice of the prince of Orange. He in that character defeated a large Spaniſh fleet in 1630, and gained 32 other victories at ſea; but was killed when under deck, in an engagement with the Engliſh in 1653. The ſtates-general cauſed medals to be ſtruck to his honour, and lamented him as one of the greateſt heroes of their republic. Van Tromp, in the midſt of the greateſt glory, conſtantly diſcovered a remarkable modeſty; for he never aſſumed a higher character than that of a burgher, and that of being the father of the ſailors.

TRONAGE, an ancient cuſtomary duty or toll, for weighing of wool. According to Fleta, *trona* is a beam to weigh with, mentioned in the ſtat. Weſtm. 2. cap. 25. And tronage was uſed for the weighing wool in a ſtaple or public mart, by a common trona or beam; which, for the tronage of wool in London, was fixed at Leaden-Hall. The mayor and commonalty of London are ordained keepers of the beams and weights for weighing merchants commodities, with power to aſſign clerks and porters, &c. of the great beam and balance; which weighing of goods and wares is called *tronage;* and no ſtranger ſhall buy any goods in London before they are weighed at the king's beam, on pain of forfeiture.

TRONE-WEIGHT, the moſt ancient of the different weights uſed in Scotland; and, though now forbidden by ſeveral ſtatutes, is ſtill uſed by many for home-commodities, and that in a very irregular manner; for the pound varies in different places, and for different purpoſes, from 20 to 24 Dutch ounces. The common allowance is 21 ½ oz. for wool, 20 ½ for butter and cheeſe, 20 for tallow, lint, hemp, and hay. It is divided into 16 of its own ounces, and 16 pounds make a ſtone.

TROOP, a ſmall body of horſe or dragoons, about 50 or 60, ſometimes more, ſometimes leſs, commanded by a captain, lieutenant, cornet, quarter-maſter, and three corporals, who are the loweſt officers of a troop.

TROPE. See Oratory, n° 52—66.

TROPHONIUS cave, or *Oracle* (anc. geog.), a cave near Lebadia in Bœotia, between Helicon and Chæronea (Strabo): ſo called from Trophonius, an enthuſiaſtic diviner; who, deſcending into this cave, pretended to give anſwers and pronounce oracles; and was hence called *Jupiter Trophonius*. Such as went down to this cave never after ſmiled; hence the proverbial ſaying of a man who has loſt his mirth, That he is come out of Trophonius's cave. Though Pauſanias, who writes from experience, contradicts this; affirming that perſons came out of the cave affected indeed with a ſtupor, but that they ſoon after recovered themſelves. See Oracle.

TROPHY (*Tropæum*), among the ancients, a monument of victory.

TROPIC-Bird. See Phæton.

TROPICS. See Geography, n° 40.

TROUBADOURS, poets that flouriſhed in Provence during the 12th century. They wrote poems on love and gallantry; on the illuſtrious characters and remarkable events of the times; ſatires which were chiefly directed againſt the clergy and monks; and a few didactic pieces. The troubadours were great favourites in different courts, diffuſed a taſte for their language and for poetry over Europe, which was about that time ſunk in ignorance and rudeneſs; they diſappeared in the 14th century. A hiſtory of the troubadours in 3 volums 12mo, was begun by M. de Sainte Palaie, and finiſhed by the Abbé Millot. See Music, n° 23.

TROVER, in law, an action that a man hath againſt one that, having found any of his goods, refuſeth to deliver them upon demand.

TROUT. See Salmo.

TROY. See Troja,

Troy-Weight, one of the moſt ancient of the different kinds uſed in Britain. The ounce of this weight was brought from Grand Cairo in Egypt, about the time of the cruſades, into Europe, and firſt adopted in *Troyes* a city of Champagne; whence the name.

The pound *Engliſh* Troy contains 12 ounces, or 5760 grains. It was formerly uſed for every purpoſe; and is ſtill retained for weighing gold, ſilver, and jewels; for compounding medicines; for experiments in natural philoſophy; and for comparing different weights with each other.

Scots Troy-Weight was eſtabliſhed by James VI. in the year 1618, who enacted, that only one weight ſhould be uſed in Scotland, viz. the French Troy ſtone of 16 pounds, and 16 ounces in the pound. The pound contains 7600 grains, and is equal to 17 oz. 6 dr. avoirdupois. The cwt. or 112 lb. avoirdupois, contains only 103 lb. 2½ oz. of this weight, though generally reckoned equal to 104 lb. This weight is nearly, if not exactly, the ſame as that of Paris and Amſterdam; and is generally known by the name of *Dutch weight*. Though prohibited by the articles of union, it is ſtill uſed in weighing iron, hemp, flax, moſt Dutch and Baltic goods, meal, butcher-meat, unwrought pewter and lead, and ſome other articles.

TRUE-love, in botany. See Paris.

TRUFFLES. See Lycoperdon.

TRUMPET, a muſical inſtrument, the moſt noble of all portable ones of the wind kind; uſed chiefly in war, among the cavalry to direct them in the ſervice. Each troop of cavalry has one. The cords of the trumpets are of crimſon, mixed with the colours of the facings of the regiments.

As to the invention of the trumpet, ſome Greek hiſtorians aſcribe it to the Tyrrhenians; but others, with greater probability, to the Egyptians; from whom it might have been tranſmitted to the Iſraelites. The trumpet was not in uſe among the Greeks at the time of the Trojan war; though it was in common uſe in the time of Homer. According to Potter (*Arch. Græc.* vol. ii. cap. 9.), before the invention of trumpets, the firſt ſignals of battle in primitive wars were lighted torches; to theſe ſucceeded ſhells of fiſhes, which were ſounded like trumpets. And when the trumpet became common in military uſe, it may well be imagined to have ſerved at firſt only as a rough and noiſy ſignal of battle, like that at preſent in Abyſſinia and New Zealand, and perhaps with only one ſound. But, even when more notes were produced from it, ſo noiſy an inſtrument muſt have been an unfit accompaniment for the voice and poetry; ſo that it is probable the trumpet was the firſt ſolo inſtrument in uſe among the ancients.

Trumpet, *articulate*, comprehends both the *ſpeaking* and the *hearing* trumpet, is by much the moſt valuable inſtrument, and has, in one of its forms, been uſed by people among whom we ſhould hardly have expected to find ſuch improvements.

That the *ſpeaking trumpet*, of which the object is to increaſe the force of articulate ſounds, ſhould have been known to the ancient Greeks, can excite no wonder; and therefore we eaſily admit the accounts which we read of the horn or trumpet, with which Alexander addreſſed his army, as well as of the whiſpering caverns of the Syracuſan tyrant. But that the natives of Peru were acquainted with this inſtrument, will probably ſurpriſe many of our readers. The fact however ſeems incontrovertible.

In the Hiſtory of the Order of Jeſuits, publiſhed at Naples in 1601 by Beritaria, it is ſaid, that in the year 1595 a ſmall convent of that order in Peru, ſituated in a remote corner, was in danger of immediate deſtruction by famine. One evening the ſuperior Father Samaniac, implored the help of the cacique; next morning, on opening the gate of the monaſtery, he found it ſurrounded by a number of women, each of whom carried a ſmall baſket of proviſions. He returned thanks to heaven for having miraculouſly interpoſed, by inſpiring the good people with pity for the diſtreſs of his friars. But when he expreſſed to them his wonder how they came all to be moved as if by mutual agreement with theſe benevolent ſentiments, they told him it was no ſuch thing; that they looked on him and his countrymen as a pack of infernal magicians, who by their ſorceries had enſlaved the country, and had bewitched their good cacique, who hitherto had treated them with kindneſs and attention, as became a true worſhipper of the ſun; but that the preceding evening at ſunſet he had ordered the inhabitants of ſuch and ſuch villages, about ſix miles off, to come that morning with proviſions to this neſt of wizzards.

The ſuperior aſked them in what manner the governor had warned ſo many of them in ſo ſhort a time, at ſuch a diſtance from his own reſidence? They told him that it was by the trumpet; and that every perſon heard at their own door the diſtinct terms of the order. The father had heard nothing; but they told him that none heard the trumpet but the inhabitants of villages to which it was directed. This is a piece of very curious information; but, after allowing a good deal to the exaggeration of the reverend Jeſuits, it cannot, we think, be doubted, but that the Peruvians actually poſſeſſed this ſtentorophonic art. For we may obſerve that the effect deſcribed in this narration reſembles what we *now know* to be the effect of ſpeaking trumpets, while it is unlike what the inventor of ſuch a tale would naturally and ignorantly ſay. Till ſpeaking trumpets were really known, we ſhould expect the ſound to be equally diffuſed on all ſides, which is not the caſe; for it is much ſtronger in the line of the trumpet than in any direction very oblique to it.

About the middle of the laſt century, Athanaſius Kircher turned his attention to the philoſophy of ſound, and in different works threw out many uſeful and ſcientific hints on the conſtruction of ſpeaking trumpets (ſee ACOUSTICS and KIRCHER); but his mathematical illuſtrations were ſo vague, and his own character of inattention and credulity ſo notorious, that for ſome time theſe works did not attract the notice to which they were well intitled.

About the year 1670 Sir Samuel Morland, a gentleman of great ingenuity, ſcience, and order, took up the ſubject, and propoſed as a queſtion to the Royal Society of London, What is the beſt form for a ſpeaking trumpet? which he called a ſtentorophonic horn. He accompanied his demand with an account of his own notions on the ſubject (which he acknowledged to be very vague and conjectural), and an exhibition of ſome inſtruments conſtructed according to his views. They were in general very large conical tubes, ſuddenly ſpreading at the very mouth to a greater width. Their effect was really wonderful. They were tried in St James's park; and his Majeſty K. Charles II. ſpeaking in his ordinary colloquial pitch of voice through a trumpet only 5½ feet long, was clearly and moſt diſtinctly heard at the diſtance of a thouſand yards. Another perſon, ſelected we ſuppoſe for the loudneſs and diſtinctneſs of his voice, was perfectly underſtood at the diſtance of four miles and a half. The fame of this ſoon ſpread; Sir Samuel Morland's principles were refined, conſidering the novelty of the thing, and differ conſiderably from father Kircher's. The aerial undulations (for he ſpeaks very accurately concerning the nature of ſound) endeavour to diffuſe themſelves in ſpheres, but are ſtopped by the tube, and therefore redundulate towards the axis like waves from a bank, and, meeting in the axis, they form a ſtrong undulation a little farther advanced along the tube, which again ſpreads, is again reflected, and ſo on, till it arrives at the mouth of the tube greatly magnified, and then it is diffuſed through the open air in the ſame manner, as if all proceeded from a *very* ſonorous point in the centre of the wide end of the trumpet. The author diſtinguiſhes with great judgment between the prodigious reinforcement of ſound in a ſpeaking trumpet and that in the muſical trumpet, bugle-horn, conch-ſhell, &c.; and ſhows that the difference conſiſts only in the violence of the firſt ſonorous agitation, which can be produced by us only on a very ſmall extent of ſurface. The mouth-piece diameter therefore of the muſical trumpet muſt be very ſmall, and the force of blaſt very conſiderable. Thus one ſtrong but ſimple undulation will be excited, which muſt be ſubjected to the modifications of harmony, and will be augmented by uſing a conical tube (A). But a ſpeaking trumpet muſt make no change on the nature of the firſt undulations; and each point of the mouth-piece muſt be equally conſidered as the centre of ſonorous undulations, all of which muſt be reinforced in the ſame degree, otherwiſe all diſtinctneſs of articulation will be loſt. The mouth-piece muſt therefore take in the whole of the mouth of the ſpeaker.

When Sir Samuel Morland's trumpet came to be generally known on the continent, it was ſoon diſcovered that the ſpeaker could be heard at a great diſtance only in the line of the trumpet; and this circumſtance was by a Mr Caſſegrain (*Journ. des Sçavans* 1672, p. 131.) attributed to a defect in the principle of its conſtruction, which he ſaid was not according to the laws of ſonorous undulations. He propoſed a conoid formed by the revolution of a hyperbola round its aſſymptote as the beſt form. A Mr Haſe of Wirtemberg, on the other hand, propoſed a parabolic conoid, having the mouth of the ſpeaker placed in the focus. In this conſtruction he plainly went on the principle of a reflection ſimilar to that of the rays of light; but this is by no means the caſe. The effect of the parabola will be to give one reflection, and in this all the circular undulations will be converted into plain waves which are at right angles to the axis of the trumpet. But nothing hinders their ſubſequent diffuſions; for it does not appear that the ſound will be enforced, becauſe the agitation of the particles on each wave is not augmented.

The ſubject is exceedingly difficult. We do not fully comprehend on what circumſtance the affection or agitation of our organ, or ſimply of the membrana tympani, depends. A more violent agitation of the ſame air, that is, a wider oſcillation of its particles, cannot fail to increaſe the impulſe on this membrane. The point therefore is to find what

concourſe

(A) Accordingly the ſound of the bugle-horn, of the muſical trumpet, or the French horn, is prodigiouſly loud, when we conſider the ſmall paſſage through which a moderate blaſt is ſent by the trumpeter.

concourſe of feeble undulations will produce or be equivalent to a great one. The reaſonings of all theſe reſtorers of the ſpeaking trumpet are almoſt equally ſpecious, and each point out ſome phenomenon which ſhould characteriſe the principle of conſtruction, and thus enable us to ſay which is moſt agreeable to the procedure of nature.—Yet there is hardly any difference in the performance of trumpets of equal dimenſions made after theſe different methods.

The propagation of light and of elaſtic undulations ſeem to require very different methods of management. Yet the ordinary phenomena of echoes are perfectly explicable by the acknowledged laws either of optics or acouſtics; ſtill however there are ſome phenomena of ſound which are very unlike the genuine reſults of elaſtic undulations. If ſounds are propagated ſpherically, then what comes into a room by a ſmall hole ſhould diffuſe itſelf from that hole as round a centre, and it ſhould be heard equally well at twelve feet diſtance from the hole in every direction. Yet it is very ſenſibly louder when the hearer is in the ſtraight line drawn from the ſonorous body through the hole. A perſon can judge of the direction of the ſounding body with tolerable exactneſs. Cannon diſcharged from the different ſides of a ſhip are very eaſily diſtinguiſhed, which ſhould not be the caſe by the Newtonian theory; for in this the two pulſes on the ear ſhould have no ſenſible difference.

The moſt important fact for our purpoſe is this: An echo from a ſmall plane ſurface in the midſt of an open field is not heard, unleſs we ſtand in ſuch a ſituation that the angle of reflected ſound may be equal to that of incidence. But by the uſual theory of undulations, this ſmall ſurface ſhould become the centre of a new undulation, which ſhould ſpread in all directions. If we make an analogous experiment on watery undulations, by placing a ſmall flat ſurface ſo as to project a little above the water, and then drop in a ſmall pebble at a diſtance, ſo as to raiſe one circular wave, we ſhall obſerve, that when this wave arrives at the projecting plane, it is diſturbed by it, and this diſturbance ſpreads from it on all ſides. It is indeed ſenſibly ſtronger in that line which is drawn from it at equal angles with the line drawn to the place where the pebble was dropped. But in the caſe of ſound, it is a fact, that if we go to a very ſmall diſtance on either ſide of the line of reflection, we ſhall hear nothing.

Here then is a fact, that whatever may be the nature of the elaſtic undulations, ſounds are reflected from a ſmall plane in the ſame manner as light. We may avail ourſelves of this fact as a mean for enforcing ſound, though we cannot explain it in a ſatisfactory manner. We ſhould expect from it an effect ſimilar to the hearing of the original ſound, along with another original ſound coming from the place from which this reflected ſound diverges. If therefore the reflected ſound or echo arrives at the ear in the ſame inſtant with the original ſound, the effect will be doubled; or at leaſt it will be the ſame with two ſimultaneous original ſounds. Now we know that this is in ſome ſenſe equivalent to a ſtronger ſound. For it is a fact that a number of voices uttering the ſame or equal ſounds are heard at a much greater diſtance than a ſingle voice. We cannot perhaps explain how this happens by mechanical laws, nor aſſign the exact proportion in which 10 voices exceed the effect of one voice; nor the proportion of the diſtances at which they ſeem equally loud. We may therefore, for the preſent, ſuppoſe that two equal voices at the ſame diſtance are twice as loud, three voices three times as loud, &c. Therefore if, by means of a ſpeaking trumpet, we can make 10 equal echoes arrive at the ear at the ſame moment, we may ſuppoſe its effect to be to increaſe the audibility 10 times; and we may expreſs this ſhortly, by calling the ſound 10 times louder or more intenſe.

But we cannot do this preciſely. We cannot by any contrivance make the ſound of a momentary ſnap, and thoſe of its echoes, arrive at the ear in the ſame moment, becauſe they come from different diſtances. But if the original noiſe be a continued ſound, a man's voice, for example, uttering a continued uniform tone, the firſt echo may reach the ear at the ſame moment with the ſecond vibration of the larynx; the ſecond echo along with the third vibration, and ſo on. It is evident, that this will produce the ſame effect. The only difference will be, that the articulations of the voice will be made indiſtinct, if the echoes come from very different diſtances. Thus if a man pronounce the ſyllable *taw*, and the 10 ſucceſſive echoes are made from places which are 10 feet farther off, the 10th part of a ſecond (nearly) will intervene between hearing the firſt and the laſt. This will give it the ſound of the ſyllable *thaw*, or perhaps *raw*, becauſe *r* is the repetition of *t*. Something like this occurs when, ſtanding at one end of a long line of ſoldiers, we hear the muſkets of the whole line diſcharged in one inſtant. It ſeems to us the ſound of a runningfire.

The aim therefore in the conſtruction of a ſpeaking trumpet may be, to cauſe as many echoes as poſſible to reach a diſtant ear without any perceptible interval of time. This will give diſtinctneſs, and ſomething equivalent to loudneſs. *Pure* loudneſs ariſes from the violence of the ſingle aerial undulation. To increaſe this may be the aim in the conſtruction of a trumpet; but we are not ſufficiently acquainted with the mechaniſm of theſe undulations to bring this about with certainty and preciſion; whereas we can procure this accumulation of echoes without much trouble, ſince we know that echoes are, *in fact*, reflected like light. We can form a trumpet ſo that many of theſe lines of reflected ſound ſhall paſs through the place of the hearer. We are indebted to Mr Lambert of Berlin for this ſimple and popular view of the ſubject; and ſhall here give an abſtract of his moſt ingenious Diſſertation on Acouſtic Inſtruments, publiſhed in the Berlin Memoirs for 1763.

Sound naturally ſpreads in all directions; but we know that echoes or reflected ſounds proceed almoſt ſtrictly in certain limited directions. If therefore we contrive a trumpet in ſuch a way that the lines of echo ſhall be confined within a certain ſpace, it is reaſonable to ſuppoſe that the ſound will become more audible in proportion as this diffuſion is prevented. Therefore if we can oblige a ſound which, in the open air, would have diffuſed itſelf over a hemiſphere, to keep within a cone of 120 degrees, we ſhould expect it to be twice as audible within this cone. This will be accompliſhed, by making the reflections ſuch that the lines of reflected ſound ſhall be confined within this cone. *N. B.* We here ſuppoſe that nothing is loſt in the reflection. Let us examine the effect of a cylindrical trumpet.

Plate DXII.

Let the trumpet be a cylinder ABED (fig. 1.), and let C be a ſounding point in the axis. It is evident that all the ſound in the cone BCE will go forward without any reflection. Let CM be any other line of ſound, which we may, for brevity's ſake, call a *ſonorous* or *phonic line*. Being reflected in the points M, N, O, P, it is evident that it will at laſt eſcape from the trumpet in a direction PQ, equally diverging from the axis with the line CM. The ſame muſt be true of every other ſonorous line. Therefore the echoes will all diverge from the mouth of the trumpet in the ſame manner as they would have proceeded from C without any trumpet. Even ſuppoſing, therefore, that the echoes are as ſtrong as the original ſound, no advantage is gained by ſuch a trumpet, but that of bringing the ſound forward from C to *e*. This is quite trifling when the hearer is at a diſtance. Yet we ſee that ſounds may be heard at a very great diſtance, at the end of long, narrow, cylindrical, or priſmatical galleries. It is known that a voice may be diſtinctly heard at the diſtance of ſeveral hundred feet in the Roman aqueducts, whoſe ſides are perfectly ſtraight and ſmooth, being plaſtered with ſtucco. The ſmooth ſurface of the ſtill water greatly contributes to this effect. Cylindrical or priſmatical trumpets muſt therefore be rejected.

Let the trumpet be a cone BCA (fig. 2.), of which CN is the axis, DK a line perpendicular to the axis, and DFHI the path of a reflected ſound in the plane of the axis. The laſt angle of reflection IHA is equal to the laſt angle of incidence FHC. The angle BFH, or its equal CFD, is equal to the angles FHD, and FCH; that is, the angle of incidence CFD exceeds the next angle of incidence FHC by the angle FCD; that is, by the angle of the cone. In like manner FDH exceeds CFD by the ſame angle FCD. Thus every ſucceeding angle, either of incidence or reflection, exceeds the next by the angle of the cone. Call the angle of the cone a, and let b be the firſt angle of incidence PDC. The ſecond, or DFC, is $b-a$. The third, or FHC, is $b-2\,a$, &c.; and the nth angle of incidence or reflection is $b-n\,a$, after n reflections. Since the angle diminiſhes by equal quantities at each ſubſequent reflection, it is plain, that whatever be the firſt angle of incidence, it may be exhauſted by this diminution; namely, when n times a exceeds or is equal to b. Therefore to know how many reflections of a ſound, whoſe firſt incidence has the inclination b, can be made in an infinitely extended cone, whoſe angle is a, divide b by a; the quotient will give the number n of reflections, and the remainder, if any, will be the laſt angle of incidence or reflection leſs than a. It is very plain, that when an angle of reflection IHA is equal to or leſs than the angle BCA of the cone, the reflected line HI will no more meet with the other ſide CB of the cone.

We may here obſerve, that the greateſt angle of incidence is a right angle, or 90°. This ſound would be reflected back in the ſame line, and would be incident on the oppoſite ſide in an angle $= 90° - a$, &c.

Thus we ſee that a conical trumpet is well ſuited for confining the ſound: for by prolonging it ſufficiently, we can keep the lines of reflected ſound wholly within the cone. And when it is not carried to ſuch a length as to do this, when it allows the ſounding line GH, for example, to eſcape without farther reflection, the divergency from the axis is leſs than the laſt angle of reflection BGH by half the angle BCA of the cone. Let us ſee what is the connection between the length and the angle of ultimate reflection.

We have $\text{ſin.}\,\overline{b-a} : \text{ſin.}\,b = \text{CD} : \text{CF}$, and $\text{CF} = \text{CD} \times \frac{\text{ſin.}\,b}{\text{ſin.}\,\overline{b-a}}$, and $\text{ſin.}\,\overline{b-2\,a} : \text{ſin.}\,\overline{b-a} = \text{CF} : \text{CH}$, and

$$\text{CH} = \text{CF} \times \frac{\text{ſin.}\,b-a}{\text{ſin.}\,\overline{b-2\,a}} = \text{CD} \times \frac{\text{ſin.}\,b}{\text{ſin.}\,\overline{b-a}} \times \frac{\text{ſin.}\,\overline{b-a}}{\text{ſin.}\,\overline{b-2a}}, = \text{CD} \times \frac{\text{ſin.}\,b}{\text{ſin.}\,\overline{b-2\,a}}, \text{ \&c.}$$

Therefore if we ſuppoſe X to be the length which will give us n reflections, we ſhall have $\text{X} = \text{CD} \times \frac{\text{ſin.}\,b}{\text{ſin.}\,\overline{b-n\,a}}$. Hence we ſee that the length increaſes as the angle $\overline{b-n\,a}$ diminiſhes; but is not infinite, unleſs $n\,a$ is equal to b. In this caſe, the immediately preceding angle of reflection muſt be a, becauſe theſe angles have the common difference a. Therefore the laſt reflected ſound was moving parallel to the oppoſite ſide of the cone, and cannot again meet it. But though we cannot aſſign the length which will give the nth reflection, we can give the length which will give the one immediately preceding, whoſe angle with the ſide of the cone is a. Let Y be this length. We have $\text{Y} = \text{CD} \times \frac{\text{ſin.}\,b}{\text{ſin.}\,a}$. This length will allow every line of ſound to be reflected as often, ſaving once, as if the tube were infinitely long. For ſuppoſe a ſonorous line to be traced backwards, as if a ſound entered the tube in the direction $i\,b$, and were reflected in the points b, f, d, δ, D, the angles will be continually augmented by the conſtant angle a. But this augmentation can never go farther than $90° + \frac{1}{2}\,a$. For if it reaches that value at D, for inſtance, the reflected line DK will be perpendicular to the axis CN; and the angle ADK will be equal to the angle DKB, and the ſound will come out again. This remark is of importance on another account.

Now ſuppoſe the cone to be cut off at D by a plane perpendicular to the axis, KD will be the diameter of its mouth piece; and if we ſuppoſe a mouth completely occupying this circle, and every point of the circle to be ſonorous, the reflected ſounds will proceed from it in the ſame manner as light would from a flame which completely occupies its area, and is reflected by the inſide of the cone. The angle FDA will have the greateſt poſſible ſine when it is a right angle, and it never can be greater than ADK, which is $= 90 + \frac{1}{2}\,a$. And ſince between $90° + \frac{1}{2}\,a$, and $90 - \frac{1}{2}\,a$, there muſt be ſome multiple of a; call this multiple b. Then, in order that every ſound may be reflected as often as poſſible, ſaving once, we muſt make the length of it $\text{X} = \text{CD} \times \frac{\text{S},\,b}{\text{S},\,a}$.

Now ſince the angle of the cone is never made very great, never exeeeding 10 or 12 degrees, b can never differ from 90 above a degree or two, and its ſine cannot differ much from unity. Therefore X will be very nearly equal to $\frac{\text{CD},}{\text{S},\,a}$ which is alſo very nearly equal to $\frac{\text{CD}}{2\,\text{S},\,\frac{1}{2}\,a}$; becauſe a is ſmall, and the ſines of ſmall arches are nearly equal and proportional to the arches themſelves. There is even a ſmall compenſation of errors in this formula. For as the ſine of 90° is ſomewhat too large, which would give X too great, $2\,\text{S},\,\frac{1}{2}\,a$ is alſo larger than the ſine of a. Thus let a be 12°: then the neareſt multiple of a is 84 or 96°, both of which are as far removed as poſſible from 90°, and the error is as great as poſſible, and is nearly $\frac{1}{180}$th of the whole.

This approximation gives us a very ſimple conſtruction. Let CM be the required length of the trumpet, and draw ML perpendicular to the axis in O. It is evident that S, MCO : rad. = MO : CM, and CM; or $\text{X} = \frac{\text{MO}}{\text{S},\frac{1}{2}\,a,} = \frac{\text{LM}}{2\,\text{S},\,\frac{1}{2}\,a}$, but $\text{X} = \frac{\text{CD}}{2\,\text{S},\,\frac{1}{2}a}$, and therefore LM is equal to CD.

If therefore the cone be of ſuch a length, that its diameter at the mouth is equal to the length of the part cut off, every line of ſound will have at leaſt as many reflections, ſave one, as if the cone were infinitely long; and the laſt reflected line will either be parallel to the oppoſite ſide of the cone, or lie nearer the axis than this parallel; conſequently ſuch a cone will confine all the reflected ſounds within a cone whoſe angle is $2\,a$, and will augment the ſound in the proportion of the ſpherical baſe of this cone to a complete hemiſpherical ſurface. Deſcribe the circle DKT round C, and making DT an arch of 90, draw the chord DT. Then ſince the circles deſcribed with the radii

DK, DT, are equal to the ſpherical ſurfaces generated by the revolution of the arches DK and DKT round the axis CD, the ſound will be condenſed in the proportion of DK^2 to DT^2.

This appears to be the beſt general rule for conſtructing the inſtrument; for, to procure another reflection, the tube muſt be prodigiouſly lengthened, and we cannot ſuppoſe that one reflection more will add greatly to its power.

It appears, too, that the length depends chiefly on the angle of the cone; for the mouth-piece may be conſidered as nearly a fixed quantity. It muſt be of a ſize to admit the mouth when ſpeaking with force and without conſtraint. About an inch and a half may be fixed on for its diameter. When therefore we propoſe to confine the ſound to a cone of twice the angle of the trumpet, the whole is determined by that angle. For ſince in this caſe LM is equal to CD, we have DK : CD = LM (or CD) : CM and $CM = \frac{CD^2}{DK}$.

But $2\,S,\frac{1}{2}a : 1 = DK : CD$,
and $2\,S,\frac{1}{2}a : 1 = CD : CM$;
therefore $4\,S,^2\frac{1}{2}a : 1 = DK : CM$,

And $CM = \frac{DK}{4\,S,^2\frac{1}{2}a}, = \frac{DK}{S,^2 a}$ very nearly. And ſince DK is an inch and a half, we get the length in inches, counted from the apex of the cone $= \frac{1\frac{1}{2}}{S,^2 a}$, or $\frac{3}{2\,S,^2 a}$. From this we muſt cut off the part CD, which is $= \frac{\frac{1}{2}DK}{S,\frac{1}{2}a}$, or very nearly $\frac{DK}{S,a}$, or $\frac{3}{2\,S,a}$, meaſured in inches, and we muſt make the mouth of the ſame width $\frac{3}{2\,S,a}$.

On the other hand, if the length of the trumpet is fixed on, we can determine the angle of the cone. For let the length (reckoned from C) be L; we have $2\,S,^2 a = \frac{3}{L}$, or $S,^2 a = \frac{3}{2L}$, and $S,a = \sqrt{\frac{3}{2L}}$.

Thus let 6 feet or 72 inches be choſen for the length of the cone, we have $S,a = \sqrt{\frac{3}{144}} = \sqrt{\frac{1}{48}}, = 0{,}14434$, = ſin 8° 17′ for the angle of the cone; and the width at the mouth is $\frac{3}{2,S,a} = 10{,}4$ inches. This being taken from 72, leaves 61,6 inches for the length of the trumpet.

And ſince this trumpet confines the reflected ſounds to a cone of 16° 34′, we have its magnifying power $= \frac{DT^2}{DK^2} = \frac{\frac{1}{2}DT^2}{\frac{1}{2}DK^2} = \frac{S,^2 45°}{S,^2 4°8'\frac{1}{2}} = 96$ nearly. It therefore condenſes the ſound about 96 times; and if the diſtribution were uniform, it would be heard $\sqrt{96}$, or nearly ten times farther off. For the loudneſs of ſounds is ſuppoſed to be inverſely as the ſquare of the diſtance from the centre of undulation.

But before we can pronounce with preciſion on the performance of a ſpeaking trumpet, we muſt examine into the manner in which the reflected ſounds are diſtributed over the ſpace in which they are all confined.

Let BKDA (fig. 3.) be the ſection of a conical trumpet by a plane through the axis; let C be the vertex of the cone, and CW its axis: let TKV be the ſection of a ſphere, having its centre in the vertex of the cone; and let P be a ſonorous point on the ſurface of the ſphere, and P *a f e l* the path of a line of ſound lying in the plane of the ſection.

In the great circle of the ſphere take KQ = KP, DR = DQ, and KS = KR. Draw Q B *b*; alſo draw Q *d n* parallel to DA; and draw PB, P *d*, PA.

1. Then it is evident that all the lines drawn from P, within the cone APB, proceed without reflection, and are diffuſed as if no trumpet had been uſed.

2. All the ſonorous lines which fall from P on KB are reflected from it as if they had come from Q.

3. All the ſonorous lines between BP and *d* P have ſuffered all but one reflection; for *d n* will no more meet DAA′ ſo as to be reflected again.

4. All the lines which have been reflected from KB, and afterwards from DA, proceed as if they had come from R. For the lines reflected from KB proceed as if they had come from Q; and lines coming from Q and reflected by DA, proceed as if they had come from R. Therefore draw RA *v*, and alſo draw R *g m* parallel to KB, and draw Q *c* A *q*, Q *b g*, P *c*, and P *b*. Then,

5. All the lines between *b* P and *c* P have been twice reflected.

Again, draw SB *p*, B *r* R, *r u* Q, S *x* A, R *y x*, Q *z y*.

6. All the lines between *u* P and *z* P have ſuffered three reflections.

Draw the tangents TA *t*, VB *v*, croſſing the axis in W.

7. The whole ſounds will be propagated within the cone *v* W *t*. For to every ſonorous point in the line KD there correſponds a point ſimilar to Q, regulating the firſt reflection from KB; and a point ſimilar to R, regulating the ſecond reflection from DA; and a point S regulating the third reflection from KB, &c. And ſimilar points will be found regulating the firſt reflection from DA, the ſecond from KB, and the third from DA, &c.; and lines drawn from all theſe through A and B muſt lie within the tangents TA and VB.

8. Thus the centres of reflection of all the ſonorous lines which lie in planes paſſing through the axis, will be found in the ſurface of this ſphere; and it may be conſidered as a ſonorous ſphere, whoſe ſounds firſt concentrate in W, and are then diffuſed in the cone *v* W *t*.

It may be demonſtrated nearly in the ſame manner, that the ſonorous lines which proceed from P, but not in the plane paſſing through the axis, alſo proceed, after various reflections, as if they had come from points in the ſurface of the ſame ſphere. The only difference in the demonſtration is, that the centres Q, R, S of the ſucceſſive reflections are not in one plane, but in a ſpiral line winding round the ſurface of the ſphere according to fixed laws. The foregoing concluſions are therefore general for all the ſounds which come in all directions from every point in the area of the mouth-piece.

Thus it appears, that a conical trumpet is well fitted for increaſing the force of ſounds by diminiſhing their final divergence. For had the ſpeaker's mouth been in the open air, the ſounds which are now confined within the cone *v* W *t* would have been diffuſed over a hemiſphere: and we ſee that prolonging the trumpet muſt confine the ſounds ſtill more, becauſe this will make the angle BWA ſtill ſmaller; a longer tube muſt alſo occaſion more reflections, and conſequently ſend more ſonorous undulations to the ear at a diſtance placed within the cone *v* W *t*.

We have now obtained a very connected view of the whole effect of a conical trumpet. It is the ſame as if the whole ſegment TKDV were ſounding, every part of it with an intenſity proportional to the denſity of the points Q, R, S. &c. correſponding to the different points P of the mouth-piece. It is eaſy to ſee that this cannot be uniform, but muſt be much rarer towards the margin of the ſegment. It would require a good deal of diſcuſſion to ſhow the denſity of theſe fictitious ſounding points; and we ſhall content ourſelves with giving a very palpable view of the diſtribution of the ſonorous rays, or the denſity (ſo to ſpeak) of the echoes, in the different ſituations in which a hearer may be placed.

We may obſerve, in the mean time, that this ſubſtitution of a ſounding ſphere for the ſounding mouth-piece has an exact parallel in Optics, by which it will be greatly illuſtrated. Fig. 3. Suppoſe the cone BKDA to be a tube poliſhed in the inſide, fixed in a wall B α, perforated in BA, and that the mouth-piece DK is occupied completely by a flat flame. The effect of this on a ſpectator will be the ſame if he is properly placed in the axis, as if he were looking at a flame as big as the whole ſphere. This is very evident.

It is eaſy to ſee that the line *l e* S is equal to the line *l e f a* P; therefore the reflected ſounds alſo come to the ear in the ſame moments as if they had come from their reſpective points on the ſurface of the ſubſtituted ſphere. Unleſs, therefore, this ſphere be enormouſly large, the diſtinctneſs of articulation will not be ſenſibly affected, becauſe the interval between the arrival of the different echoes of the ſame ſnap will be inſenſible.

Our limits oblige us to content ourſelves with exhibiting this evident ſimilarity of the progreſs of echo from the ſurface of this phonic ſphere, to the progreſs of light from the ſame luminous ſphere ſhining through a hole of which the diameter is AB. The direct inveſtigation of the intenſity of the ſound in different directions and diſtances would take up much room, and give no clearer conception of the thing. The intenſity of the ſound in any point is preciſely ſimilar to the intenſity of the illumination of the ſame point; and this is proportional to the portion of the luminous ſurface ſeen from this point through the hole directly, and to the ſquare of the diſtance inverſely. The intelligent reader will acquire a diſtinct conception of this matter from fig. 4. which repreſents the diſtribution of the ſonorous lines, and by conſequence the degree of loudneſs which may be expected in the different ſituations of the hearer.

As we have already obſerved, the effect of the cone of the trumpet is perfectly analogous to the reflection of light from a poliſhed concave, conical mirror. Such an inſtrument would be equally fitted for illuminating a diſtant object. We imagine that theſe would be much more powerful than the ſpherical or even parabolic mirrors commonly uſed for this purpoſe. Theſe laſt, having the candle in the focus, alſo ſend forward a cylinder of light of equal width with the mirror. But it is well known, that oblique reflections are prodigiouſly more vivid than thoſe made at greater angles. Where the inclination of the reflected light to the plane of the mirror does not exceed eight or ten degrees, it reflects about three-fourths of the light which falls on it. But when the inclination is 80, it does not reflect one fourth part.

We may alſo obſerve, that the denſity of the reflected ſounds by the conical trumpet ABC (fig. 4.) is preciſely ſimilar to that of the illumination produced by a luminous ſphere TDV, ſhining through a hole AB. There will be a ſpace circumſcribed by the cone formed by the lines TB*t* and VA *v*, which is uniformly illuminated by the whole ſphere (or rather by the ſegment TDV), and on each ſide there is a ſpace illuminated by a part of it only, and the illumination gradually decreaſes towards the borders. A ſpectator placed much out of the axis, and looking through the hole AB, may not ſee the whole ſphere. In like manner, he will not hear the whole ſounding ſphere: He may be ſo far from the axis as neither to ſee nor hear any part of it. Fig. 3.

Aſſiſting our imagination by this compariſon, we perceive that beyond the point *w* there is no place where *all* the reflected ſounds are heard. Therefore, in order to preſerve the magnifying power of the trumpet at any diſtance, it is neceſſary to make the mouth as wide as the ſonorous ſphere. Nay, even this would be an imperfect inſtrument, becauſe its power would be confined to a very narrow ſpace; and if it be not accurately pointed to the perſon liſtening, its power will be greatly diminiſhed. And we may obſerve by the way, that we derive from this circumſtance a ſtrong confirmation of the juſtneſs of Mr Lambert's principles; for the effects of ſpeaking trumpets are really obſerved to be limited in the way here deſcribed.—Parabolic trumpets have been made, and they fortify the ſound not only in the cylindrical ſpace in the direction of the axis, but alſo on each ſide of it, which ſhould not have been the caſe had their effect depended only on the undulations formed by the parabola in planes perpendicular to the axis. But to proceed.

Let BCA (fig. 5.) be the cone, ED the mouth-piece, TEDV the equivalent ſonorous ſphere, and TBAV the circumſcribed cylinder. Then CA or CB is the length of cone that is neceſſary for maintaining the magnifying power at all diſtances. We have two conditions to be fulfilled. The diameter ED of the mouth-piece muſt be of a certain fixed magnitude, and the diameter AB of the outer end muſt be equal to that of the equivalent ſonorous ſphere. Theſe conditions determine all the dimenſions of the trumpet and its magnifying power. And, firſt, with reſpect to the dimenſions of the trumpet.

The ſimilarity of the triangles ECG and BCF gives $CG : ED = CF : AB$; but $CG = BF, = \frac{1}{2} AB$, and $CF = CG + GF, = GF + \frac{1}{2} AB$; therefore $\frac{1}{2} AB : ED = GF + \frac{1}{2} AB : AB$, and $AB : ED = 2\,GF + AB : AB$; therefore $2\,GF \times ED + AB \times ED = AB^2$, and $2\,GF \times ED = AB^2, - AB \times ED, = AB \times \overline{AB - ED}$, and $GF = \frac{AB \times \overline{AB - ED}}{2\,ED}$. And, on the other hand, becauſe $AB^2 - \times EBAD = 2\,GF \times ED$, we have $AB^2 - AB \times ED + \frac{1}{4} ED^2 = 2\,GF \times ED + \frac{1}{4} ED^2$, or $\overline{AB - \frac{1}{2} ED}^2 = 2\,GF \times ED + \frac{1}{4} ED^2$, and $AB = \sqrt{2\,GF \times ED + \frac{1}{4} ED^2} + \frac{1}{2} ED$.

Let *x* repreſent the length of the trumpet, *y* the diameter at the great end, and *m* the diameter of the mouth-piece. Then $x = \frac{y \times \overline{y - m}}{2\,m}$, and $y = \sqrt{2 x m + \frac{1}{4} m^2} + \frac{1}{2} m$. Thus the length and the great diameter may be had reciprocally. The uſeful caſe in practice is to find the diameter for a propoſed length, which is gotten by the laſt equation.

Now if we take all the dimenſions in inches, and fix *m* at an inch and a half, we have $2\,x\,m = 3\,x$, and $\frac{1}{4} m^2 = 0{,}5625$, and $\frac{1}{2}\,m = 0{,}75$; ſo that our equation becomes $y = \sqrt{3\,x + 0{,}5625} + 0{,}75$. The following table gives the dimenſions of a ſufficient variety of trumpets. The firſt column is the length of the trumpet in feet; the ſecond column is the diameter of the mouth in inches; the third column is the number of times that it magnifies the ſound; and the fourth column is the number of times that it increaſes the diſtance at which a man may be diſtinctly heard by its means; the fifth contains the angle of the cone.

GF

GF feet.	AB inches.	Magnifying.	Extending.	ACB.
				° ′
1	6,8	42,6	6,5	24.53
2	9,3	77,8	8,8	18.23
3	11,2	112,4	10,6	15.18
4	12,8	146,6	12,1	13.24
5	14,2	180,4	13,4	12.04
6	15,5	214,2	14,6	11.05
7	16,6	247,7	15,7	10.18
8	17,7	281,3	16,8	9.40
9	18,8	314,6	17,7	9.08
10	19,8	347,7	18,6	8.42
11	20,7	380,9	19,5	8.18
12	21,5	414,6	20,4	7.58
15	24,	513,6	22,7	7.09
18	26,2	612,3	24,7	6.33
21	28,3	711,2	26,6	6.05
24	30,2	810,1	28,5	5.42
ED in all is = 1,5.				

The two laſt columns are conſtructed on the following conſiderations: We conceive the hearer placed within the cylindrical ſpace whoſe diameter is BA. In this ſituation he receives an echo coming apparently from the whole ſurface TGV; and we account the effect of the trumpet as equivalent to the united voices of as many mouths as would cover this ſurface. Therefore the quotient obtained by dividing the ſurface of the hemiſphere by that of the mouthpiece will expreſs the magnifying power of the trumpet. If the chords g E, g T, be drawn, we know that the ſpherical ſurfaces T g V, E g D, are reſpectively equal to the circles deſcribed with the radii T g, E g, and are therefore as T g^2 and E g^2. Therefore the audibility of the trumpet, when compared with a ſingle voice, may be expreſſed by $\frac{\text{T}g^2}{\text{E}g^2}$. Now the ratio of T g^2 to E g^2 is eaſily obtained. For if E f be drawn parallel to the axis, it is plain that B $f = \frac{\text{BA}-\text{ED}}{2}$, and that E f is to f B as radius to the tangent of BCF; which angle we may call a. Therefore tan. $a = \frac{y-m}{2x}$, and thus we obtain the angle a. But if the radius CE be accounted 1, T g is $= \sqrt{2}$, and E g is $= 2 \text{ ſin.} \frac{a}{2}$. Therefore $\frac{\text{T}g}{\text{E}g} = \frac{\sqrt{2}}{2 \text{ ſin.} \frac{a}{2}}$, and the magnifying power of the trumpet is $= \frac{2}{4 \text{ ſin.}^2 \frac{a}{2}}, = \frac{1}{2 \text{ ſin.}^2 \frac{a}{2}}$. The numbers, therefore, in the third column of the table are each $= \frac{1}{2 \text{ ſin.}^2 \frac{a}{2}}$.

But the more uſual way of conceiving the power of the trumpet is, by conſidering how much farther it will enable us to hear a voice equally well. Now we ſuppoſe that the audibility of ſounds varies in the inverſe duplicate ratio of the diſtance. Therefore if the diſtance d, at which a man may be diſtinctly heard, be increaſed to z, in the proportion of EG to T g, the ſound will be leſs audible, in the proportion of T g^2 to EG^2. Therefore the trumpet will be as well heard at the diſtance z as the ſimple voice is heard at the diſtance d. Therefore $\frac{z}{d}$ will expreſs the *extending power* of the trumpet, which is therefore $= \frac{\sqrt{2}}{2 \text{ ſin.} \frac{a}{2}}$.

In this manner were the numbers computed for the fourth column of the table.

When the angle BCA is ſmall, which is always the caſe in ſpeaking trumpets, we may, without any ſenſible error, conſider EG as $= \frac{\text{ED}}{2}, = \frac{m}{2}$. And TG = TC × $\sqrt{2}, = \frac{\text{AB}}{2} \sqrt{2} = \frac{\text{AB}}{\sqrt{2}} = \frac{y}{\sqrt{2}}$. This gives a very eaſy computation of the extending and magnifying powers of the trumpet.

The extending power is $= \sqrt{2} \frac{y}{m}$

The magnifying power is $= 2 \frac{y^2}{m^2}$.

We may alſo eaſily deduce from the premiſes, that if the mouth-piece be an inch and a half in diameter, and the length x be meaſured in inches, the extending power is very nearly $= \sqrt{\tfrac{8}{3} x}$ and the magnifying power $= \tfrac{8}{3} x$.

An inconvenience ſtill attends the trumpet of this conſtruction. Its complete audibility is confined to the cylindrical ſpace in the direction of the axis, and it is more faintly heard on each ſide of it. This obliges us to direct the trumpet very exactly to the ſpot where we wiſh it to be heard. This is confirmed by all the accounts we have of the performance of great ſpeaking trumpets. It is evident, that by lengthening the trumpet, and therefore enlarging its mouth, we make the lines TB t and VA v expand (fig. 4.); and therefore it will not be ſo difficult to direct the trumpet.

But even this is confined within the limits of a few degrees. Even if the trumpet were continued without end, the ſounds cannot be reinforced in a wider ſpace than the cone of the trumpet. But it is always advantageous to increaſe its length; for this makes the extreme tangents embrace a greater portion of the ſonorous ſphere, and thus increaſes the ſound in the ſpace where it is all reflected. And the limiting tangents TB, VA, expand ſtill more, and thus the ſpace of full effect is increaſed. But either of theſe augmentations is very ſmall in compariſon of the augmentation of ſize. If the trumpet of fig. 5. were made an hundred times longer, its power would not be increaſed one half.

We need not therefore aim at much more than to produce a cylindrical ſpace of full effect; and this will always be done by the preceding rules, or table of conſtructions. We may give the trumpet a third or a fourth part more length, in order to ſpread a little the ſpace of its full effect, and thereby make it more eaſily directed to the intended object. But in doing this we muſt be careful to increaſe the diameter of the mouth as much as we increaſe the length; otherwiſe we produce the very oppoſite effect, and make the trumpet greatly inferior to a ſhorter one, at all diſtances beyond a certain point. For by increaſing the length while the part CG remains the ſame, we cauſe the tangents TB and VA to meet on ſome diſtant point, beyond which the ſound diffuſes prodigiouſly. The conſtruction of a ſpeaking trumpet is therefore a problem of ſome nicety; and as the trials are always made at ſome conſiderable diſtance, it may frequently happen that a trumpet, which is not heard at a mile's diſtance, may be made very audible two miles off by cutting off a piece at its wide end.

After this minute conſideration of the conical trumpet, we might proceed to conſider thoſe of other forms. In particular, the hyperbolic, propoſed by Caſſegrain, and the parabolic, propoſed by Haaſe, ſeem to merit conſideration. But if we examine them merely as reflectors of echoes, we ſhall find them inferior to the conical.

With reſpect to the hyperbolic trumpet, its inaptitude is evident at firſt ſight. For it muſt diſſipate the echoes more than a conical trumpet. Indeed Mr Caſſegrain proceeds on quite different principles, depending on the mechaniſm of the aerial undulations: his aim was to increaſe the agitation in each pulſe, ſo that it may make a more forcible impulſe on the ear. But we are too imperfectly acquainted with this ſubject to decide *a priori*; and experience ſhows that the hyperbola is not a good form.

With reſpect to the parabolic trumpet, it is certain that if the mouth-piece were but a point, it would produce the moſt favourable reflection of all the ſounds; for they would all proceed parallel to the axis. But every point of an open mouth muſt be conſidered as a centre of ſound, and none of it muſt be kept out of the trumpet. If this be all admitted, it will be found that a conical trumpet, made by the preceding rules, will diſſipate the reflected ſounds much leſs than the parabolic.

Thus far have we proceeded on the fair conſequences of the well known fact, that echoes are reflected in the ſame manner as light, without engaging in the intricate inveſtigation of aerial undulations. Whoever conſiders the Newtonian theory of the propagation of ſound with intelligence and attention, will ſee that it is demonſtrated ſolely in the caſe of a ſingle row of particles; and that all the general corollaries reſpecting the lateral diffuſion of the elaſtic undulations are little more than ſagacious gueſſes, every way worthy of the illuſtrious author, and beautifully confirmed by what we can moſt diſtinctly and accurately obſerve in the circular waves on the ſurface of ſtill water. But they are by no means fit for becoming the foundation of any doctrine which lays the ſmalleſt claim to the title of accurate ſcience. We really know exceedingly little of the theory of aerial undulations; and the conformity of the phenomena of ſound to theſe gueſſes of Sir Iſaac Newton has always been a matter of wonder to every eminent and candid mathematician: and no other ſhould pretend to judge of the matter. This wonder has always been acknowledged by Daniel Bernoulli; and he is the only perſon who has made any addition to the ſcience of ſounds that is worth mentioning. For ſuch we muſt always eſteem his doctrine of the ſecondary undulations of muſical cords, and the ſecondary pulſes of air in pipes. Nothing therefore is more unwarrantable, or more plainly ſhows the precipitant preſumption of modern ſcioliſts, than the familiar uſe of the general theory of aerial undulations in their attempts to explain the abſtruſe phenomena of nature (ſuch as the communication of ſenſation from the organ to the ſenſorium by the vibrations of a nervous fluid, the reciprocal communication of the volitions from the ſenſorium to the muſcle, nay, the whole phenomena of mind), by vibrations and vibratiunculæ.

Such attempts equally betray ignorance, preſumption, and meanneſs of ſoul. Ignorance of the extent to which the Newtonian theory may be logically carried, is the neceſſary conſequence of ignorance of the theory itſelf. It is preſumption to apply it to the phenomena of the intellectual world; and ſurely he has an abject ſoul who hugs and cheriſhes the humble thought, that his mind is an undulating fluid, and that its all-graſping comprehenſion, and all its delightful emotions, are nothing more than an etherial tune.—"Pol. me occidiſtis amentes." This whim is older than Hartley: It may be found in Robinet's *Syſteme de la Nature*. This by the by made its firſt appearance as a diſcourſe delivered by Brother Orateur in the lodge of the grand Orient at Lyons; from which ſource have proceeded all the coſmopolitical ſocieties in Europe, and that illumination by which reaſon is to triumph over revelation, and liberty and equality over civil government. We crave pardon of our readers for this ebullition of ſpleen; and we hope for it from all thoſe who can read Newton, and who eſteem his modeſty.

Thoſe who have endeavoured to improve the ſpeaking trumpet on mechanical principles, have generally aimed at increaſing the violence of the elaſtic undulations, that they may make a more forcible impulſe on the ear. This is the object in view in the parabolic trumpet. All the undulations are converted into others which are in planes perpendicular to the axis of the inſtrument; ſo that the ſame little maſs of air is agitated again and again in the ſame direction. From this it is obvious to conclude, that the total agitation will be more violent. But, in the firſt place, theſe violent agitations muſt diffuſe themſelves laterally as ſoon as they get out of the trumpet, and thus be weakened, in a proportion that it is perhaps impoſſible for the moſt expert analyſt to determine. But, moreover, we are not ſufficiently acquainted with the mechaniſm of the very firſt agitations, to be able to perceive what conformation of the trumpet will cauſe the reflected undulations to increaſe the firſt undulations, or to check them. For it muſt happen during the production of a continued ſound in a trumpet, that a parcel of air, which is in a ſtate of progreſſive agitation, as it makes a pulſe of one ſound, may be in a ſtate of retrograde agitation, as it is part of a pulſe of air producing another ſound. We cannot (at leaſt no mathematician has yet done it) diſcriminate, and then combine theſe agitations, with the intelligence and preciſion that are neceſſary for enabling us to ſay what is the ultimate accumulated effect. Mr Lambert therefore did wiſely in abſtaining from this intricate inveſtigation; and we are highly obliged to him for deducing ſuch a body of demonſtrable doctrine from the acknowledged, but ill underſtood, fact of the reflection of echoes.

We know that two ſounds actually croſs each other without any mutual diſturbance; for we can hear either of them diſtinctly, provided the other is not ſo loud as to ſtun our ears, in the ſame manner as the glare of the ſun dazzles our eyes. We may therefore depend on all the conſequences which are legitimately deduced from this fact, in the ſame manner as we depend on the ſcience of catoptrics, which is all deduced from a fact perfectly ſimilar and as little underſtood.

But the preceding propoſitions by no means explain or comprehend all the reinforcement of ſound which is really obtained by means of a ſpeaking trumpet. In the firſt place, although we cannot tell in what degree the aerial undulations are increaſed, we cannot doubt that the reflections which are made in directions which do not greatly deviate from the axis, do really increaſe the agitation of the particles of air. We ſee a thing perfectly ſimilar to this in the waves on water. Take a long ſlip of lead, about two inches broad, and having bent it into the form of a parabola, ſet it into a large flat trough, in which the water is about an inch deep. Let a quick ſucceſſion of ſmall drops of water fall preciſely on the focus of the parabola. We ſhall ſee the circular waves proceeding from the focus all converted into waves perpendicular to the axis; and we ſhall frequently ſee theſe ſtraight waves conſiderably augmented in their height and force. We ſay generally, for we have ſometimes obſerved that theſe reflected waves were not ſenſibly ſtronger than the circular or original waves. We do not exactly know to what this difference muſt be aſcribed: we are diſpoſed to attribute it to the frequency of the drops. This may be ſuch, that the interval of time between each drop is preciſely equal, or at leaſt commenſurable, to the time in which the waves run over their own breadth. This is a pretty experiment; and the ingenious mechanician may make others of the ſame kind which will greatly illuſtrate ſeveral difficult points in the ſcience of ſounds. We may conclude, in general, that the reflection of ſounds, in a trumpet of the uſual ſhapes, is accompanied by a real increaſe of the aerial agitations; and in ſome particular caſes we find the ſounds prodigiouſly increaſed. Thus, when we blow through a muſical trumpet, and allow the air to take that uniform undulation which can be beſt maintained in it, namely, that which produces its muſical tone, where the whole tube contains but one or two undulations, the agitation of a particle muſt then be very great; and it muſt deſcribe a very conſiderable line in its oſcillations. When we ſuit our blaſt in ſuch a manner as to continue this note, that is, this undulation, we are certain that the ſubſequent agitations conſpire with the preceding agitation, and augment it. And accordingly we find that the ſound is increaſed to a prodigious degree. A cor de chaſſe, or a bugle horn, when properly winded, will almoſt deafen the ear; and yet the exertion is a mere nothing in compariſon with what we make when bellowing with all our force, but with not the tenth part of the noiſe. We alſo know, that if we ſpeak through a ſpeaking trumpet in the key which correſponds with its dimenſions, it is much more audible than when we ſpeak in a different pitch. Theſe obſervations ſhow, that the loudneſs of a ſpeaking trumpet ariſes from ſomething more than the ſole reflection of echoes conſidered by Mr Lambert—the very echoes are rendered louder.

In the next place, the ſounds are increaſed by the vibrations of the trumpet itſelf. The elaſtic matter of the trumpet is thrown into tremors by the undulations which proceed from the mouth-piece. Theſe tremors produce pulſes in the contiguous air, both in the inſide of the trumpet, and on that which ſurrounds it. Theſe undulations within the trumpet produce original ſounds, which are added to the reflected ſounds: for the tremor continues for ſome little time, perhaps the time of three or four or more pulſes. This muſt increaſe the loudneſs of the ſubſequent pulſes. We cannot ſay to what degree, becauſe we do not know the force of the tremor which the part of the trumpet acquires: but we know that theſe ſounds will not be magnified by the trumpet to the ſame degree as if they had come from the mouth-piece; for they are reflected as if they had come from the ſurface of a ſphere which paſſes through the agitated point of the trumpet. In ſhort, they are magnified only by that part of the trumpet which lies without them. The whole ſounds of this kind, therefore, proceed as if they came from a number of concentric ſpherical ſurfaces, or from a ſolid ſphere, whoſe diameter is twice the length of the trumpet cone.

All theſe agitations ariſing from the tremors of the trumpet tend greatly to hurt the diſtinctneſs of articulation; becauſe, coming from different points of a large ſphere, they arrive at the ear in a ſenſible ſucceſſion; and thus change a momentary articulation to a lengthened ſound, and give the appearance of a number of voices uttering the ſame words in ſucceſſion. It is in this way that, when we clap our hands together near a long rail, we get an echo from each poſt, which produces a chirping ſound of ſome continuance. For theſe reaſons it is found advantageous to check all tremors of the trumpet by wrapping it up in woollen liſts. This is alſo neceſſary in the muſical trumpet.

With reſpect to the undulations produced by the tremors of the trumpet in the air contiguous to its outſide, they alſo hurt the articulation. At any rate, this is ſo much of the ſonorous momentum uſeleſsly employed; becauſe they are diffuſed like common ſounds, and receive no augmentation from the trumpet.

Hearing Trumpet.

It is evident, that this inſtrument may be uſed (and accordingly was ſo) for aiding the hearing; for the ſonorous lines are reflected in either direction. We know that all tapering cavities greatly increaſe external noiſes; and we obſerve the brutes prick up their ears when they want to hear uncertain or faint ſounds. They turn them in ſuch directions as are beſt ſuited for the reflection of the ſound from the quarter whence the animal imagines that it comes.

Let us apply Mr Lambert's principle to this very intereſting caſe, and examine whether it be poſſible to aſſiſt dull hearing in like manner as the optician has aſſiſted imperfect ſight.

The ſubject is greatly ſimplified by the circumſtances of the caſe; for the ſounds to which we liſten generally come in nearly one direction, and all that we have to do is to produce a conſtipation of them. And we may conclude, that the audibility will be proportional to this conſtipation.

Therefore let ACB, fig. 6. be the cone, and CD its axis. The ſound may be conceived as coming in the direction RA, parallel to the axis, and to be reflected in the points A, *b*, *c*, *d*, *e*, till the angle of incidence increaſes to 90°; after which the ſubſequent reflections ſend the ſound out again. We muſt therefore cut off a part of the cone; and, becauſe the lines increaſe their angle of incidence at each reflection, it will be proper to make the angle of the cone an aliquot part of 90°, that the leaſt incidence may amount preciſely to that quantity. What part of the cone ſhould be cut off may be determined by the former principles. Call the angle ACD, *a*. We have $\text{C}\,e = \frac{\text{CA} \cdot \text{ſin.}\,a}{\text{ſin.}\,(2\,n+1)\,a}$, when the ſound gets the laſt uſeful reflection. Then we have the diameter of the mouth $\text{AB} = 2\,\text{CA} \cdot \text{ſin.}\,a$, and that of the other end $e\,f = \text{C}\,e \cdot 2\,\text{ſin.}\,a$. Therefore the ſounds will be conſtipated in the ratio of CA^2 to $\text{C}\,e^2$, and the trumpet will bring the ſpeaker nearer in the ratio of CA to C*e*.

When the lines of reflected ſound are thus brought together, they may be received into a ſmall pipe perfectly cylindrical, which may be inſerted into the external ear. This will not change their angles of inclination to the axis nor their denſity. It may be convenient to make the internal diameter of this pipe $\frac{1}{3}$ of an inch. Therefore $\text{C}\,e \cdot \text{ſin.}\,a$ is $= \frac{1}{6}$ of an inch. This circumſtance, in conjunction with the magnifying power propoſed, determines the other dimenſions of the hearing trumpet. For $\text{C}\,e = \frac{1}{6\,\text{ſin.}\,a} = \frac{\text{CA} \cdot \text{ſin.}\,a}{\text{ſin.}\,(2\,n+1)\,a}$, and $\text{CA} = \frac{\text{ſin.}\,(2\,n+1)\,a}{6\,\text{ſin.}^2\,a}$.

Thus the relation of the angle of the cone and the length of the inſtrument is aſcertained, and the ſound is brought nearer in the ratio of CA to C *e*, or of ſin. $(2\,n+1)\,a$ to ſin. *a*. And ſeeing that we found it proper to make $(2\,n+1)\,a = 90°$, we obtain this very ſimple analogy, $1 : \text{ſin.}\,a = \text{CA} : \text{C}\,e$. And the ſine of $\frac{1}{2}$ the angle of the cone is to radius as 1 to the approximating power of the inſtrument.

Thus let it be required that the ſound may be as audible as if the voice were 12 times nearer. This gives $\frac{\text{CA}}{\text{C}\,e} = 12$. This gives ſin. $a = \frac{1}{12}$, and $a = 4°\,47'$, and the angle of the cone $= 9.34$. Then $\text{CA} = \frac{1}{6\,\text{ſin.}^2\,a} = \frac{1}{6\frac{1}{144}} = \frac{144}{6}, = 24$. Therefore the length of the cone is 24 inches. From this take C $e = \frac{CA}{12} = 2$, and the length of the trumpet is 22 inches. The diameter at the mouth is 2 C e, $= 4$ inches. With this inſtrument one voice ſhould be as loud as 144.

If it were required to approximate the ſound only four times, making it 16 times ſtronger than the natural voice at the ſame diſtance, the angle ACB muſt be 29°; A e muſt be 2 inches, AB muſt be $1\frac{1}{3}$d inches, and $e\,f$ muſt be $\frac{1}{3}$d of an inch.

It is eaſy to ſee, that when the ſize of the ear-end is the ſame in all, the diameters at the outer end are proportional to the approximating powers, and the length of the cones are proportional to the magnifying powers.

We ſhall find the parabolic conoid the preferable ſhape for an acouſtic trumpet; becauſe the ſounds come into the inſtrument in a direction parallel to the axis, they are reflected ſo as to paſs through the focus. The parabolic conoid muſt therefore be cut off through the focus, that the ſounds may not go out again by the ſubſequent reflections; and they muſt be received into a cylindrical pipe of $\frac{1}{3}$d of an inch in diameter. Therefore the parameter of this parabola is $\frac{1}{6}$th of an inch, and the focus is $\frac{1}{12}$th of an inch from the vertex. This determines the whole inſtrument; for they are all portions of one parabolic conoid. Suppoſe that the inſtrument is required to approximate the ſound 12 times, as in the example of the conical inſtrument. The ordinate at the mouth muſt be 12 times the 6th of an inch, or 2 inches; and the mouth diameter is 4 inches, as in the conical inſtrument. Then, for the length, obſerve, that DC in fig. 7. is $\frac{1}{6}$th of an inch, and MP is 2 inches, and AC is $\frac{1}{12}$th of an inch, and $DC^2 : MP^2 = AC : AP$. This will give $AP = 12$ inches, and $CP = 11\frac{11}{12}$ths; whereas in the conical tube it was 22. In like manner an inſtrument which approximates the ſounds 4 times, is only $1\frac{1}{3}$d inches long, and $1\frac{1}{3}$d inches diameter at the big end. Such ſmall inſtruments may be very exactly made in the parabolic form, and are certainly preferable to the conical. But ſince even theſe are of a very moderate ſize when intended to approximate the ſound only a few times, and as they can be accurately made by any tin-man, they may be of more general uſe. One of 12 inches long, and 5 inches wide at the big end, ſhould approximate the ſound at leaſt 9 times.

A general rule for making them.—Let m expreſs the approximating power intended for the inſtrument. The length of the inſtrument in inches is $\frac{m \times \overline{m-1}}{6}$, and the diameter at the mouth is $\frac{m}{3}$. The diameter at the ſmall end is always $\frac{1}{3}$d of an inch.

In trumpets for aſſiſting the hearing all reverberation of the trumpet muſt be avoided. It muſt be made thick, of the leaſt elaſtic materials, and covered with cloth externally. For all reverberation laſts for a ſhort time, and produces new ſounds which mix with thoſe that are coming in.

We muſt alſo obſerve, that no acouſtic trumpet can ſeparate thoſe ſounds to which we liſten from others that are made in the ſame direction. All are received by it, and magnified in the ſame proportion. This is frequently a very great inconvenience.

There is alſo another imperfection, which we imagine cannot be removed, namely, an odd confuſion, which cannot be called indiſtinctneſs, but a feeling as if we were in the midſt of an echoing room. The cauſe ſeems to be this: Hearing gives us ſome perception of the direction of the ſounding object, not indeed very preciſe, but ſufficiently ſo for moſt purpoſes. In all inſtruments which we have deſcribed for conſtipating ſounds, the laſt reflections are made in directions very much inclined to the axis, and inclined in many different degrees. Therefore they have the appearance of coming from different quarters; and inſtead of the perception of a ſingle ſpeaker, we have that of a ſounding ſurface of great extent. We do not know any method of preventing this, and at the ſame time increaſing the ſound.

There is an obſervation which it is of importance to make on this theory of acouſtic inſtruments. Their performance does not ſeem to correſpond to the computations founded on the theory. When they are tried, we cannot think that they magnify ſo much: Indeed it is not eaſy to find a meaſure by which we can eſtimate the degrees of audibility. When a man ſpeaks to us at the diſtance of a yard, and then at the diſtance of two yards, we can hardly think that there is any difference in the loudneſs; though theory ſays, that it is four times leſs in the laſt of the two experiments: and we cannot but adhere to the theory in this very ſimple caſe, and muſt attribute the difference to the impoſſibility of meaſuring the loudneſs of ſounds with preciſion. And becauſe we are familiarly acquainted with the ſound, we can no more think it four times leſs at twice the diſtance, than we can think the viſible appearance of a man four times leſs when he is at a quadruple diſtance. Yet we can completely convince ourſelves of this, by obſerving that he covers the appearance of four men at that diſtance. We cannot eaſily make the ſame experiment with voices.

But, beſides this, we have compared two hearing trumpets, one of which ſhould have made a ſound as audible at the diſtance of 40 feet as the other did at 10 feet diſtance; but we thought them equal at the diſtance of 40 and 18. The reſult was the ſame in many trials made by different perſons, and in different circumſtances. This leads us to ſuſpect ſome miſtake in Mr Lambert's principle of calculation; and we think him miſtaken in the manner of eſtimating the intenſity of the reflected ſounds. He conceives the proportion of intenſity of the ſimple voice and of the trumpet to be the ſame with that of the ſurface of the mouth-piece to the ſurface of the ſonorous hemiſphere, which he has ſo ingeniouſly ſubſtituted for the trumpet. But this ſeems to ſuppoſe, that the whole ſurface, generated by the revolution of the quadrantal arch TEG round the axis CG (fig. 4.), is equally ſonorous. We are aſſured that it is not: For even if we ſhould ſuppoſe that each of the points Q, R, and S (fig. 3.), are equally ſonorous with the point P, theſe points of reflection do not ſtand ſo denſe on the ſurface of the ſphere as on the ſurface of the mouth-piece. Suppoſe them arranged at equal diſtances all over the mouth-piece, they will be at equal diſtances alſo on the ſphere, only in the direction of the arches of great circles which paſs through the centre of the mouth-piece. But in the direction perpendicular to this, in the circumference of ſmall circles, having the centre of the mouth-piece for their pole, they muſt be rarer in the proportion of the ſine of their diſtance from this pole. This is certainly the caſe with reſpect to all ſuch ſounds as have been reflected in the planes which paſs through the axis of the trumpet; and we do not ſee (for we have not examined this point) that any compenſation is made by the reflection which is not in planes paſſing through the axis. We therefore imagine, that the trumpet does not increaſe the ſound in the proportion of $g\,E^2$ to $g\,T^2$ (fig. 5.), but in that of $\frac{g\,E^2}{GE}$ to $\frac{g\,T^2}{CT}$.

Mr Lambert ſeems aware of ſome error in his calculation, and propoſes another, which leads nearly to this concluſion,

Fig. 1.

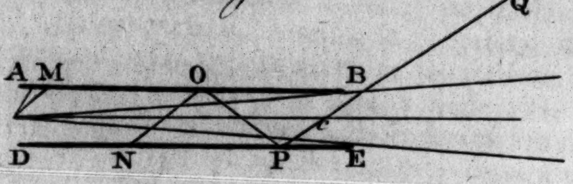

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Fig. 2.

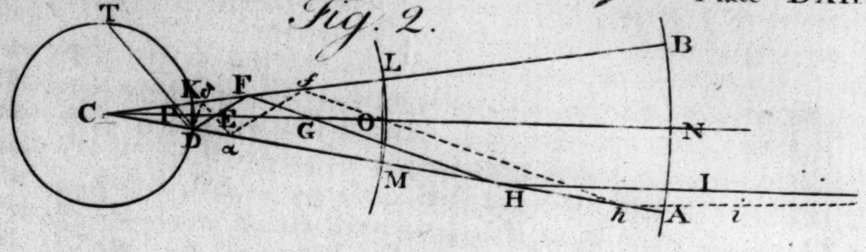
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Fig. 3.

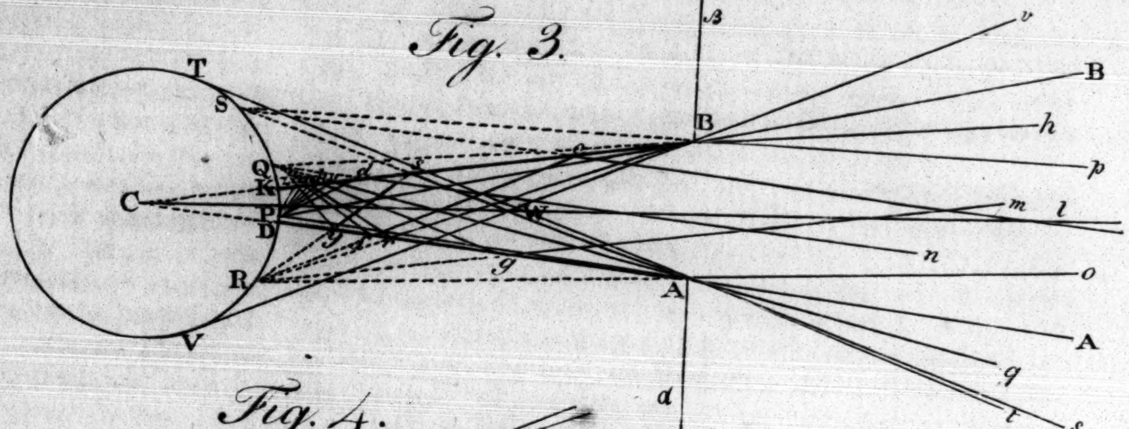
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Fig. 4.

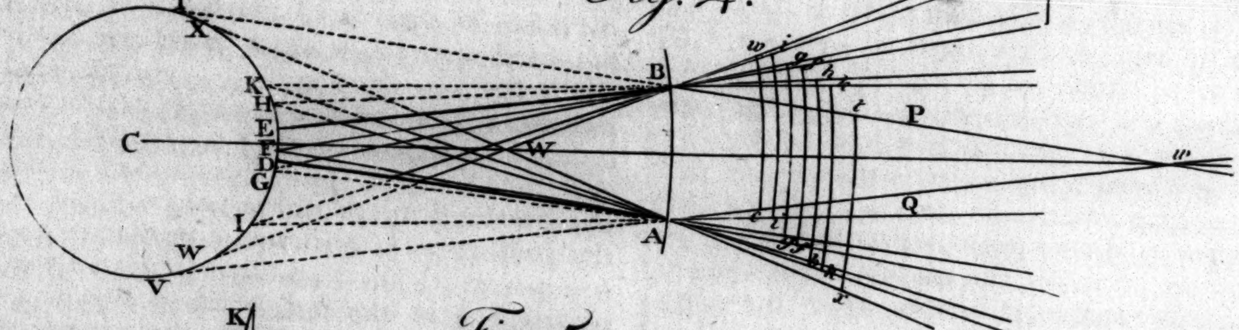
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Fig. 5.

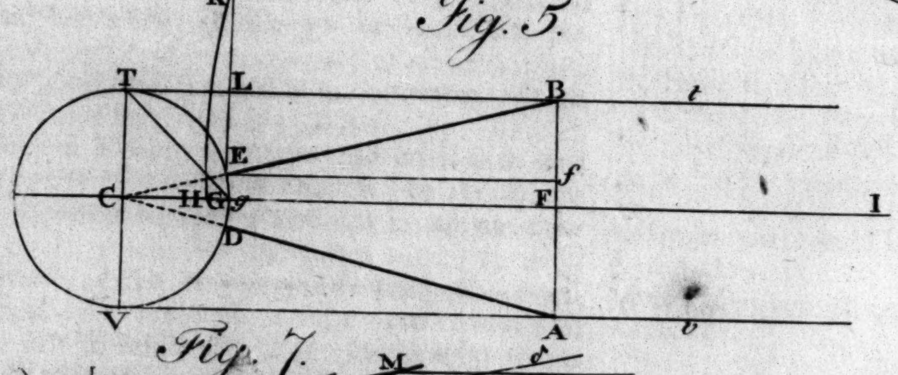
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Fig. 7.

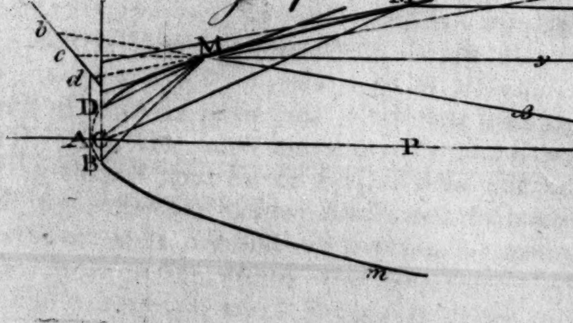
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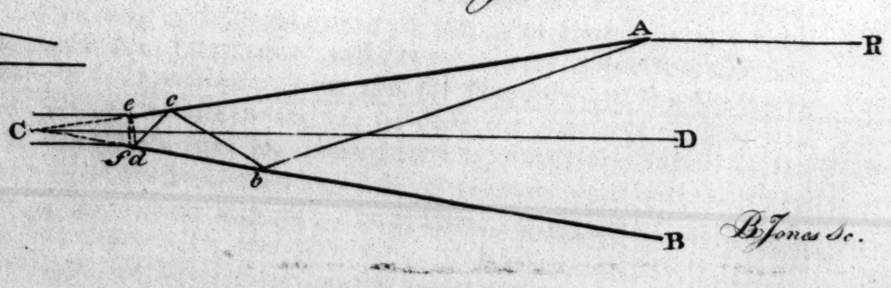
Fig. 6.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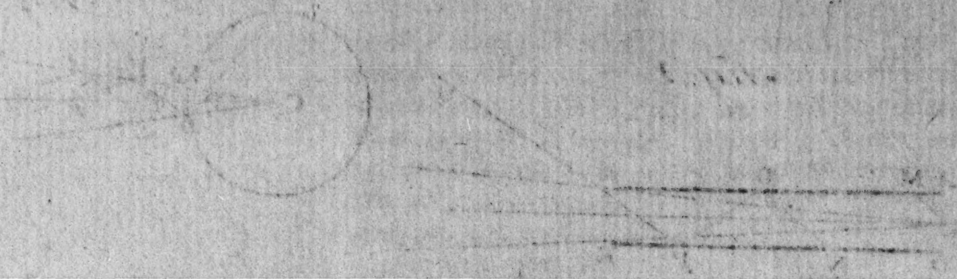
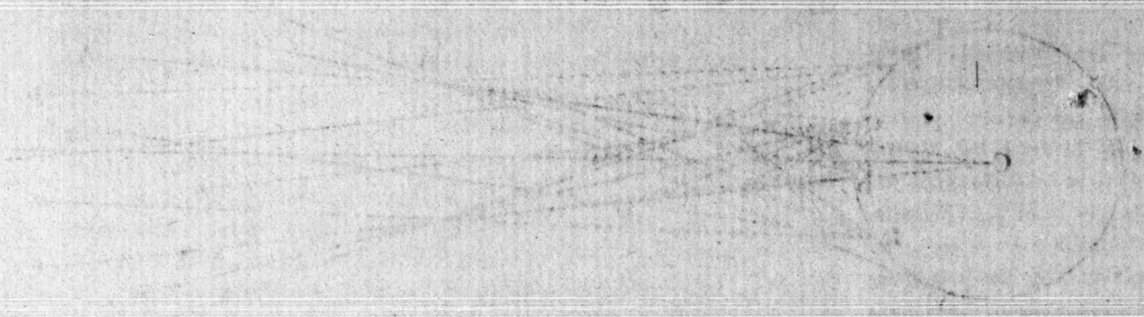
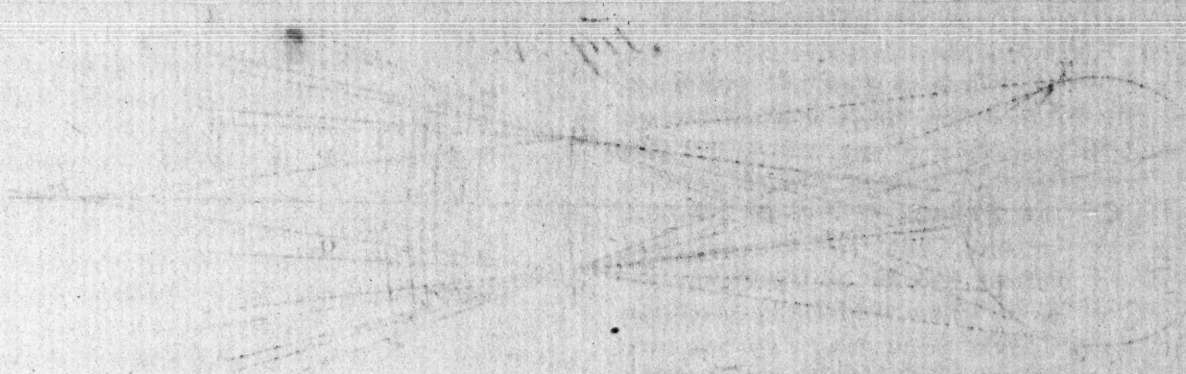
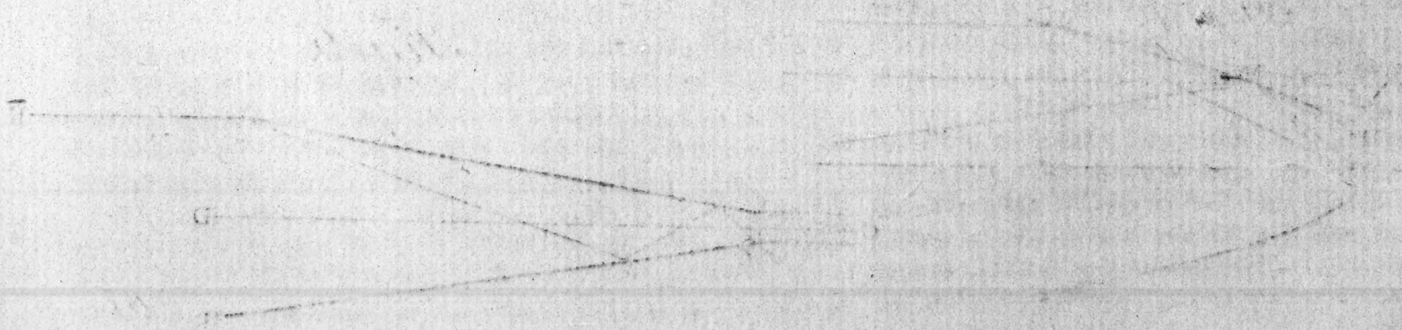






BRITISH MUSEUM



but founded on a principle which we do not think in the leaſt applicable to the caſe of ſounds.

Trumpet, Marine, is a muſical inſtrument conſiſting of three tables, which form its triangular body. It has a very long neck with one ſingle ſtring, very thick, mounted on a bridge, which is firm on one ſide, but tremulous on the other. It is ſtruck by a bow with one hand, and with the other the ſtring is preſſed or ſtopped on the neck by the thumb.

It is the trembling of the bridge, when ſtruck, that makes it imitate the ſound of a trumpet, which it does to that perfection, that it is ſcarce poſſible to diſtinguiſh the one from the other. And this is what has given it the denomination of trumpet-marine, though, in propriety, it be a kind of monochord. Of the ſix diviſions marked on the neck of the inſtrument, the firſt makes a fifth with the open chord, the ſecond an octave, and ſo on for the reſt, correſponding with the intervals of the military trumpet.

Trumpet-Flower. See Bignonia.

TRUMPETER. See Psophia.

TRUNCATED, in general, is an appellation given to ſuch things as have, or ſeem to have, their points cut off: thus, we ſay, a truncated cone, pyramid, leaf, &c.

TRUNCHEON, a ſhort ſtaff or baton uſed by kings, generals, and great officers, as a mark of their command.

TRUNDLE, a ſort of carriage with low wheels, whereon heavy and cumberſome burdens are drawn.

TRUNK, among botaniſts, that part of the herb which ariſes immediately from the root, and is terminated by fructification; the leaves, buds, and auxiliary parts of the herb not entering in its deſcription.

TRUNNIONS, or Trunions, of a piece of ordnance, are thoſe knobs or bunches of metal which bear her up on the cheeks of the carriage.

TRUSS, a bundle, or certain quantity of hay, ſtraw, &c. A truſs of hay, contains 56 pounds, or half an hundred weight: 36 truſſes make a load.

Truss is alſo uſed for a ſort of bandage or ligature made of ſteel, or the like matter, therewith to keep up the parts in thoſe who have hernias or ruptures.

Truss, in a ſhip, a machine employed to pull a yard home to its reſpective maſt, and retain it firmly in that poſition.

TRUSTEE, one who has an eſtate, or money, put or truſted in his hands for the uſe of another.

TRUTH, a term uſed in oppoſition to falſehood, and applied to propoſitions which anſwer or accord to the nature and reality of the thing whereof ſomething is affirmed or denied.

TRYPHIODORUS, an ancient Greek poet, who lived ſome time between the reigns of Severus and Anaſtaſius. His writings were very numerous; yet none of them have come down to us, except an epic poem, on which Mr Addiſon has made ſome entertaining remarks in the Spectator, N° 63.

The firſt edition of this extraordinary work was publiſhed by Aldus at Venice, with Quintus Calaber's Paralipomena, and Coluthus's poem on the rape of Helen. It has been ſince reprinted at ſeveral places, particularly at Francfort in 1580 by Friſchlinus; who not only corrected many corrupt paſſages, but added two Latin verſions, one in verſe and the other in proſe. That in verſe was reprinted in 1742, with the Greek, at Oxford, in 8vo, with an Engliſh tranſlation in verſe, and Notes, by Mr Merrick.

TUAM, a town of Ireland, in the province of Connaught, and county of Galway, with an archbiſhop's ſee. It was once a famous city, though now it is reduced to a village; yet it ſtill retains the title of a city, as being an archiepiſcopal ſee. It is ſeven miles from the borders of Mayo. W. Long. 8. 46. N. Lat. 53. 33.

TUB, in commerce, denotes an indetermined quantity or meaſure: thus, a tub of tea contains about 60 pounds; and a tub of camphor from 56 to 86 pounds.

TUBE, in general, a pipe, conduit, or canal; a cylinder, hollow within-ſide, either of lead, iron, glaſs, wood, or other matter, for the air or ſome other matter to have a free conveyance through it.

Auricular Tube, or inſtrument to facilitate hearing. See *Articulate* Trumpet.

TUBERCLES, among phyſicians, denote little tumors which ſuppurate and diſcharge pus; and are often found in the lungs, eſpecially of conſumptive perſons.

TUCUMAN, a province of South America, in Paraguay; bounded on the north by the provinces of Los-Chicas and Chaco; on the eaſt by Chaco and Rio-de-la-Plata, on the ſouth by the country of Chicuitos and Pampes, and on the weſt by the biſhopric of St Jago. The air is hot, and the earth ſandy: however, ſome places are fruitful enough, and the original natives have a good character. The Spaniards poſſeſs a great part of this country.

TUFA, a ſtone conſiſting of volcanic aſhes concreted together with various other ſpecies of ſtone. It is of various colours, blackiſh grey, bluiſh grey, and yellow; every colour having a different mixture and ſolidity: but all of them have the bad quality of mouldering down on long expoſure to the weather; notwithſtanding which, they have been uſed in buildings both ancient and modern. The yellow kind reſiſts the air leſs than any other.

TULIPA, Tulip, in botany: A genus of plants belonging to the claſs of *hexandria*, and order of *monogynia*; and in the natural ſyſtem ranging under the 10th order *Coronariæ*. The corolla is hexapetalous and campanulated, and there is no ſtyle. The ſpecies of this genus are four; the *ſylveſtris*, or Italian yellow tulip, a native of the ſouth of Europe; the *geſneriana*, or common tulip, a native of the Levant; the *breyniana*, or cape tulip, a native of the Cape of Good Hope; and the *biflora*.

1. The *ſylveſtris*, or wild European tulip, hath an oblong bulbous root, ſending up long narrow ſpear-ſhaped leaves; and a ſlender ſtalk, ſupporting at top a ſmall yellow flower, nodding on one ſide, having acute petals.

2. The *geſneriana*, Geſner's Turky tulip of Cappadocia, or common garden-tulip, hath a large, oblong, tunicated, ſolid, bulbous root, covered with a brown ſkin, ſending up long oval ſpear-ſhaped leaves; an upright round ſtalk, from half a foot to a yard high, garniſhed with a few leaves, and its top crowned with a large bell-ſhaped erect hexapetalous flower, of almoſt all colours and variegations in the different varieties.

This tulip, and its vaſt train of varieties, is the ſort ſo generally cultivated for the ornament of our gardens, and ſo much admired by all for its great variety and beautiful appearance: It grows freely in the open ground in any common ſoil of a garden, and proves a very great decoration to the beds and borders of the pleaſure ground for ſix weeks or two months in ſpring, by different plantings of early and late ſorts; planting the principal part in autumn, and the reſt towards Chriſtmas, and in January or February. The autumn plantings will come earlieſt into bloom, and flower the ſtrongeſt: and the others will ſucceed them in flowering. In ſummer, when the flowering is paſt, and the leaves and ſtalks aſſume a ſtate of decay, the bulbs of the choiceſt varieties are generally taken up, the offſets ſeparated, and the whole cleaned from filth; then put up to dry till October or November, and then planted again for the future year's bloom.

Of this ſpecies, which is the floriſt's delight, the varieties may be divided into two principal claſſes, *viz.* 1. Early or dwarf ſpring tulips (*præcocea*). 2. Late flowering tall tulips (*ſerotina*). 1. *Early tulips.* The early tulips are among floriſts diſtinguiſhed by the appellation of *præcoces* (early), becauſe they flower early in the ſpring, a month or more before the others: are much ſhorter ſtalked, and the flowers ſmaller; but are in greater reputation for their early bloom and their gay lively colours, both of ſelf-colours, and broken into flaked variegations; ſuch as reds, crimſon, ſcarlet, carnation, violets, purples, yellow, &c. with flowers of each, edged and flaked with red, yellow, and white, in many diverſities. 2. *Late-flowering common tulips.*—This claſs is denominated *late-flowering*, and by the floriſts called *ſerotines*, becauſe they blow later in the ſpring, a month or more, than the præcoces, *i. e.* not coming into flower before the end of April, May, and June. They are all of tall growth, ſupporting large flowers, and furniſh an almoſt endleſs variety in the vaſt diverſity of colours, after they break from whole blowers into variegations and ſtripes, exceeding all others of the tulip kind in beauty and elegance of flower.

Both theſe ſpecies of tulipa are hardy perennials, durable in root, or at leaſt, although the old bulb decays annually, it perpetuates its ſpecies by off-ſets, and is annual in leaf and ſtalk; which riſing from the bulb early in the ſpring, arrives to a flowering ſtate in April and May. All the varieties are ſucceeded by plenty of ripe ſeed in July and Auguſt, contained in an oblong capſule of three cells, having the ſeeds placed on each other in double rows. By the ſeeds many new varieties may be raiſed, which however will not attain a flowering ſtate till they are ſeven or eight years old; and after that will require two or three years or more to break into variegations, when the approved varieties may be marked, and increaſed by off-ſets of the root, as directed in their propagation.

The colours in greateſt eſtimation in variegated tulips, are the blacks, golden yellows, purple-violets, roſe, and vermilion, each of which being variegated various ways; and ſuch as are ſtriped with three different colours diſtinct and unmixed, with ſtrong regular ſtreaks, but with little or no tinge of the breeder, may be called the moſt perfect tulips. It is rare to meet with a tulip poſſeſſing all theſe properties.

As to the manner of obtaining this wonderful variety of colours in tulips, it is often accompliſhed by nature alone, but is ſometimes aſſiſted and forwarded by ſome ſimple operations of art; ſuch as that, in the firſt place, when the ſeedling bulbs of the whole blower or breeder are arrived to full ſize, and have flowered once, to tranſplant them into beds of any poor dry barren ſoil, in order that by a defect of nutriment in the earth the natural luxuriance of the plant may be checked, and cauſe a weakneſs in their general growth, whereby they generally in this weakened or infirm ſtate gradually change and break out into variegations, ſome the firſt year, others not till the ſecond or third; and according as they are thus broke, they ſhould be planted in beds of good earth.

Another method to aſſiſt nature in effecting the marvellous work of breaking the breeding tulips into diverſified colours, is to make as great a change as poſſible in the ſoil; if they were this year in a light poor ſoil, plant them the next in a rich garden mould, and another year in a compoſt of different earths and dung; or tranſplant them from one part of the garden to another, or into different gardens, &c. or from one country to another; all of which contributes in aſſiſting nature in producing this deſirable diverſity of colours and variegations.

The double tulip is alſo a variety of the common tulip, and is very beautiful, though not in ſuch eſtimation among the floriſts as the common ſingle variegated ſorts, not poſſeſſing ſuch a profuſion of variegations in the colours and regularity of ſtripes: they however exhibit an elegantly ornamental appearance, as they riſe with an upright, talliſh, firm ſtem, crowned with a very large double flower compoſed of numerous petals, multiplied in ſeveral ſeries one within another like a double peony, but far more beautiful in their diverſity of colours, variegations, and ſtripes of white and red, yellow and red, &c. ſo that they highly deſerve culture, both in beds alone near the other ſorts to increaſe their variety, alſo to plant in patches about the borders, in aſſemblage with the late variegated tulips, as they blow nearly about the ſame time, *i. e.* April and May.

Tulip-roots are ſold in full collection, conſiſting of numerous varieties, at moſt of the nurſeries and ſeeds-mens, who both propagate them themſelves by off-ſets, and ſeed, and import vaſt quantities annually from Holland; the Dutch being famous for raiſing the grandeſt collections of the fineſt tulips, and other bulbous flowers, in the greateſt perfection for the ſupply of almoſt all the other European gardens; diſtinguiſhing every variety in their vaſt collections by ſome pompous name or other, arranged in regular catalogues, charging prices in proportion to their eſtimation; which formerly was ſo great, among the Hollanders themſelves in particular, that there are accounts of a ſingle root being ſold for from 2000 to 5500 guilders; but ſome time ago they were more plentiful, and were ſold at from 5s. or 10s. to ſo many pounds *per* hundred, and even *per* root for very ſcarce capital ſorts.

Tulip-Tree. See Liriodendron.

TULL (Jethro), an Oxfordſhire gentleman who farmed his own land, and introduced a new method of culture, to raiſe repeated crops of wheat from the ſame land without the neceſſity of manure: the principles of which he publiſhed about 30 years ſince, in A Treatiſe on Horſe-hoeing Huſbandry.

TUMBRELL, Tumbrellum, or *Turbichetum*, is an engine of puniſhment, which uſed to be in every liberty that had the view of frank-pledge, for the correction of ſcolds and unquiet women.

TUMEFACTION, the act of ſwelling or riſing into a tumor.

TUMOR, in medicine and ſurgery, a preternatural riſing or eminence in any part of the body.

Tumors, in farriery. See there, § 26.

TUN, a large veſſel or caſk, of an oblong form, biggeſt in the middle, and diminiſhing towards its two ends, girt about with hoops, and uſed for ſtowing ſeveral kinds of merchandiſe for convenience of carriage; as brandy, oil, ſugar, ſkins, hats, &c.

Tun is alſo the name of a meaſure. A tun of wine is four hogſheads; of timber, a ſquare of 40 ſolid feet; and of coals, 20 cwt.

Tun is alſo a certain weight whereby the burden of ſhips, &c. are eſtimated.

TUNBRIDGE, a town of Kent in England, ſituated on a branch of the river Medway, over which there is a bridge. It is a large well built place, noted for the mineral waters four or five miles ſouth of the town. E. Long. 0. 20. N. Lat. 51. 14.

TUNE. See Music and Tone.

TUNGSTEN, or lapis ponderosus; a genus of calcareous earth. It contains about one half its weight of calcareous earth, and the remainder iron, and a peculiar acid of an earthy appearance, now known by the name of the *tungſten acid.* When pure, it is of a grey colour and lamellated texture; its ſpecific gravity being from 4,99 to 5,8.

TUNICA, a kind of waiſtcoat or under garment, in uſe among the Romans. They wore it within doors by itſelf, and abroad under the gown. The common people could not afford the toga, and ſo went in their tunics; whence Horace calls them *populus tunicatus*.

Tunica, in anatomy, is applied to the membranes which inveſt the veſſels, and divers others of the leſs ſolid parts of the body; thus the inteſtines are formed of five tunics or coats.

TUNIS, a large and celebrated town of Africa, in Barbary, and capital of a kingdom of the ſame name. It is ſeated on the point of the Gulph of Goletta, about eight miles from the place where the city of Carthage ſtood. It is in the form of a long ſquare, and is about four miles in circumference, with 10 large ſtreets, 5 gates, and 35 moſques. The houſes are all built with ſtone, though but one ſtory high; but the walls are very lofty, and flanked with ſeveral ſtrong towers. It has neither ditches nor baſtions, but a good citadel, built on an eminence on the weſt ſide of the city. It is ſaid to contain 300,000 inhabitants, of whom 30,000 are Jews. The divan, or council of ſtate, aſſembles in an old palace; and the dey is the chief of the republic, who reſides there. The harbour of Tunis has a very narrow entrance, through a ſmall canal. In the city they have no water but what is kept in ciſterns, except one well kept for the baſhaw's uſe. It is a place of great trade, and is 10 miles from the ſea. E. Long. 10. 16. N. Lat. 36. 42.

See Obſerv. on the City of Tunis by Mr Stanley, in the Edin. Mag. vol. iv. p. 28.

Tunis, a country of Africa, bounded on the north and eaſt by the Mediterranean Sea and the kingdom of Tripoli, on the ſouth by ſeveral tribes of the Arabs, and on the weſt by the kingdom of Algiers and the country of Eſab; being 300 miles in length from eaſt to weſt, and 250 in breadth from north to ſouth. This country was formerly a monarchy; but a difference ariſing between a king and his ſon, one of whom was for the protection of the Chriſtians, and the other for that of the Turks, in 1574 the inhabitants ſhook off the yoke of both. From this time it became a republic under the protection of the Turks, and pays a certain tribute to the baſhaw who reſides at Tunis. The air in general is healthy; but the ſoil in the eaſtern parts is indifferent for want of water. Towards the middle the mountains and valleys abound in fruits; but the weſtern part is the moſt fertile, becauſe it is watered with rivers. The environs of Tunis are very dry, upon which account corn is generally dear. The inroads of the Arabs oblige the inhabitants to ſow their barley and rye in the ſuburbs, and to incloſe their gardens with walls. However, there are plenty of citrons, lemons, oranges, dates, grapes, and other fruits. There are alſo olive-trees, roſes, and odoriferous plants. In the woods and mountains there are lions, wild beeves, oſtriches, monkeys, cameleons, roebucks, hares, pheaſants, partridges, and other ſorts of birds and beaſts. The moſt remarkable rivers are the Guadilcarbar, Magrida, Magerada, and Caps. The form of government is ariſtocratic; that is, by a council, whoſe preſident is the dey, not unlike the doge of Venice. The members of the divan or council are choſen by the dey, and he in his turn is elected by the divan; which is compoſed of ſoldiers, who have more than once taken off the dey's head. The baſhaw is a Turk, reſiding at Tunis; whoſe buſineſs is to receive the tribute, and protect the republic: the common revenues are only 400,000 crowns a-year, becauſe the people are very poor; nor can they ſend above 40,000 men into the field; nor more than 12 men of war of the line to ſea, even upon the moſt extraordinary occaſions. There are generally about 12,000 Chriſtian ſlaves in this country; and the inhabitants carry on a great trade in linen and woollen cloth. In the city of Tunis alone there are above 3000 clothiers and weavers. They alſo have a trade in horſes, olives, oil, ſoap, oſtriches eggs and feathers. The Mahometans of this city have nine colleges for ſtudents, and 86 petty ſchools. The principal religion is Mahometaniſm; but the inhabitants conſiſt of Moors, Turks, Arabs, Jews and Chriſtian ſlaves. However, the Turks, though feweſt in number, domineer over the Moors, and treat them little better than ſlaves.

TUNKERS, a religious ſect of baptiſts in Pennſylvania, ſo called from the word *tunker*, to put a morſel in ſauce. They are alſo called *tumblers*, becauſe in performing baptiſm they plunge the perſon into the water with the head firſt. As the Germans ſound the letters *t* and *b* like *d* and *p*, the words *tunkers* and *tumblers*, have been ſometimes written *dunkers* and *dumplers*. Their church government and diſcipline are the ſame with thoſe of the Engliſh baptiſts, except that every brother is allowed to ſpeak in the congregation, and the beſt ſpeaker is uſually ordained to be their miniſter. They are a harmleſs, well meaning people.

TUNNAGE. See Tonnage.

TUNNY, in ichthyology. See Scomber.

TUNNY-Fishing. See Fishery.

TURBAN, the head-dreſs of moſt of the eaſtern nations. It conſiſts of two parts, a cap and ſaſh of fine linen or taffety, artfully wound in divers plaits about the cap. The cap has no brim, is pretty flat, though roundiſh at top, and quilted with cotton; but does not cover the ears. There is a good deal of art in giving the turban a fine air; and the making of them is a particular trade. The ſaſh of the Turks turban is white linen; that of the Perſians red woollen. Theſe are the diſtinguiſhing marks of their different religions. Sophi king of Perſia, being of the ſect of Ali, was the firſt who aſſumed the red colour, to diſtinguiſh himſelf from the Turks, who are of the ſect of Omar, and whom the Perſians eſteem heretics.

TURBINATED, is a term applied by naturaliſts to ſhells which are ſpiral or wreathed conically, from a larger baſis to a kind of apex.

TURBITH-mineral. See Chemistry, n° 705, and Pharmacy, n° 303.

TURBO, the wreath, in zoology, a genus of inſects belonging to the order of *vermes teſtaceæ*. The animal is of the ſnail kind; the ſhell conſiſts of one ſpiral ſolid valve, and the aperture is orbicular. There are 116 ſpecies; of which the moſt remarkable are, 1. The *littoreus*, or periwinkle. This is abundant on moſt rocks far above low-water mark. The Swediſh peaſants believe, that when theſe ſhells creep high up the rocks, they indicate a ſtorm from the ſouth. They are eaten by the poor people in moſt parts of this kingdom. Young lobſters are ſaid to take up their lodging in the empty ſhells of theſe animals, which has given occaſion to a notion that periwinkles are changed into lobſters. 2. The *clathrus*, or barbed wreath, has a taper ſhell of eight ſpires, diſtinguiſhed by elevated diviſions running from the aperture to the apex. There is a variety pellucid, with very thin edges. It is analogous to that curious and expenſive ſhell, the *wentle-trap*.

TURBOT, in ichthyology. See Pleuronectes.

TURCÆ, or Turci, (Mela); ſuppoſed to be the *Tuſci* of Ptolemy; whom he places between Caucaſus and the Montes Ceraunii. The name is ſaid to denote, "to deſolate, or lay waſte." Herodotus places them among the wild or barbarous nations of the north. There is a very rapid river called *Turk*, running into the Caſpian Sea, from which ſome ſuppoſe the Turks to take their name. They made no figure in the world till towards the 7th century; about the beginning of which they ſallied forth from the

Portæ Caſpiæ, laid waſte Perſia, and joined the Romans againſt Choſroes king of Perſia. In 1042 they ſubdued the Perſians, in whoſe pay they ſerved, and from whom they derived the Mahometan religion: and afterwards pouring forth, over-ran Syria, Cappadocia, and the other countries of the Hither Aſia, under diſtinct heads or princes, whom Ottoman ſubduing, united the whole power in himſelf, which to this day continues in his family, and who fixed his ſeat of empire at Pruſa in Bithynia. His ſucceſſors ſubdued all Greece, and at length took Conſtantinople in 1453; which put a period to the Roman empire in the Eaſt, under Conſtantine the laſt emperor. It is a ſtanding tradition or prophecy among the Turks, that their empire will at length be overturned by the Franks or Chriſtians; which ſeems now to be drawing on apace towards accompliſhment.

TURCOISE. See TURQUOISE.

TURCOMANIA, a province of Aſiatic Turkey, anſwering to the ancient kingdom of Armenia.

TURDUS, the thruſh; a genus of birds belonging to the order of *paſſeres*. The bill is ſtraightiſh, bending towards the point, and ſlightly notched near the end of the upper mandible. The noſtrils are oval, naked or half covered with a membrane; the corners of the mouth are furniſhed with a few ſlender hairs, and the tongue is ſlightly jagged at the end. There are 136 ſpecies; of which 7 are Britiſh, the viſcivorus, pilaris, iliacus, muſicus, roſeus, merula, and torquatus.

1. The *viſcivorus*, or miſſel, is the largeſt of the genus. Its length is 11 inches; its breadth 16½. The bill is ſhorter and thicker than that of other thruſhes; duſky, except the baſe of the lower mandible, which is yellow. The irides are hazel. Head, back, and leſſer coverts of the wings, are of a deep olive brown. The lower part of the back is tinged with yellow. The loweſt order of leſſer coverts, and the great coverts, are brown; the firſt tipped with white, the laſt both tipped and edged with the ſame colour. The inner coverts of the wings white. The tail is brown; the three outermoſt feathers tipped with white. The cheeks and throat are mottled with brown and white; the breaſt and belly are whitiſh yellow, marked with large ſpots of black; the legs are yellow.

Theſe birds build their neſts in buſhes, or on the ſide of ſome tree, generally an aſh, and lay four or five eggs: their note of anger or fear is very harſh, between a chatter and ſhriek; from whence ſome of its Engliſh names. Its ſong, however, is very fine; which it begins ſitting on the ſummit of a high tree, very early in the ſpring, often with the new-year, in blowing ſhowery weather, which makes the inhabitants of Hampſhire to call it the *ſtorm-cock*. It feeds on inſects, holly and miſſeltoe berries, which are the food of all the thruſh kind: in ſevere ſnowy weather, when there is a failure of their uſual diet, they are obſerved to ſcratch out of the banks of hedges the root of arum, or the cuckoo pint; this is remarkably warm and pungent, and a proviſion ſuitable to the ſeaſon.

2. The *pilaris*, or fieldfare, is in length 10 inches, in breadth 17. The head is aſh-coloured inclining to olive, and ſpotted with black; the back and greater coverts of the wings of a fine deep cheſnut; the tail is black; the lower parts of the two middlemoſt feathers, and the interior upper ſides of the outmoſt feathers excepted: the firſt being aſh coloured, the latter white. The legs are black; the talons very ſtrong.

This bird paſſes the ſummer in the northern parts of Europe; alſo in Lower Auſtria. It breeds in the largeſt trees; feeds on berries of all kinds, and is very fond of thoſe of the juniper. Fieldfares viſit Britain in great flocks about Michaelmas, and leave us the latter end of February or the beginning of March.

Theſe birds, and the redwings were the *turdi* of the Romans, which they fattened with crumbs of figs and bread mixed together. Varro informs us that they were birds of paſſage, coming in autumn, and departing in the ſpring. They muſt have been taken in great numbers; for, according to Varro (lib. 3. c. 5.) they were kept by thouſands together in their fattening aviaries. They do not arrive in France till the beginning of December.

3. The *muſicus*, or throſtle, is in length 9 inches, in breadth 13½. In colour, it ſo nearly reſembles the miſſel-thruſh, that no other remark need to be added, but that it is leſs, and that the inner coverts of the wings are yellow.

The throſtle is the fineſt of our ſinging birds, not only for the ſweetneſs and variety of its notes, but for the long continuance of its harmony; for it obliges us with its ſong for near three parts of the year. Like the miſſel-bird, it delivers its muſic from the top of ſome high tree; but to form its neſt deſcends to ſome low buſh or thicket: the neſt is made of earth, moſs, and ſtraw, and the inſide is curiouſly plaſtered with clay. It lays five or ſix eggs, of a pale bluiſh green, marked with duſky ſpots.

4. The *iliacus*, or redwing, has a very near reſemblance to the throſtle; but is leſs: their colours are much the ſame; only the ſides under the wings and the inner coverts in this are of a reddiſh orange, in the throſtle yellow; above each eye is a line of yellowiſh white, beginning at the bill and paſſing towards the hind part of the head.

Theſe birds appear in Great Britain a few days before the fieldfare; they come in vaſt flocks, and from the ſame countries as the latter. With us they have only a diſagreeable piping note; but in Sweden, during the ſpring, they ſing very finely, perching on the top of ſome tree among the foreſts of maples. They build their neſts in hedges, and lay ſix bluiſh-green eggs ſpotted with black.

5. The *merula*, or black-bird, when it has attained its full age, is of a fine deep black, and the bill of a bright yellow; the edges of the eyelids yellow. When young, the bill is duſky, and the plumage of a ruſty black, ſo that they are not to be diſtinguiſhed from the females; but at the age of one year they attain their proper colour.

This bird is of a very retired and ſolitary nature; frequents hedges and thickets, in which it builds earlier than any other bird: the neſt is formed of moſs, dead graſs, fibres, &c. lined and plaſtered with clay, and that again covered with hay or ſmall ſtraw. It lays four or five eggs of a bluiſh-green colour, marked with irregular duſky ſpots. The note of the male is extremely fine, but too loud for any place except the woods: it begins to ſing early in the ſpring, continues its muſic part of the ſummer, deſiſts in the moulting ſeaſon, but reſumes it for ſome time in September and the firſt winter-months.

6. The *torquatus*, or ring-ouzel, is ſuperior in ſize to the black-bird: the length is 11 inches, breadth 17. The bill in ſome is wholly black, in others the upper half is yellow; on each ſide the mouth are a very few briſtles; the head and whole upper part of the body are duſky, edged with pale brown; the quill-feathers and the tail are black. The coverts of the wings, the upper part of the breaſt, and the belly, are duſky, ſlightly edged with aſh-colour. The middle of the breaſt is adorned with a white creſcent, the horns of which point to the hind part of the neck. In ſome birds this is of a pure white, in others of a dirty hue. In the females and in young birds this mark is wanting, which gave occaſion to ſome naturaliſts to form two ſpecies of them.

The ring-ouzel inhabits the Highland hills, the north of England, and the mountains of Wales. They are alſo found to breed in Dartmoor, in Devonſhire, and in banks on the ſides of ſtreams. The places of their retreat are not known. In Scotland and Wales they breed in the hills, but deſcend to the lower parts to feed on the berries of the mountain-aſh. They migrate in France at the latter ſeaſon; and appear in ſmall flocks about Monthard in Burgundy, in the beginning of October, but ſeldom ſtay above two or three weeks.

To theſe we ſhall add the deſcription of the *polyglottus*, or mocking thruſh, which is a native of America. It is about the ſize of a thruſh, of a white and grey colour, and a reddiſh bill. It is poſſeſſed not only of its own natural notes, which are muſical and ſolemn, but it can aſſume the tone of every other animal in the wood, from the wolf to the raven. It ſeems even to ſport itſelf in leading them aſtray. It will at one time allure the leſſer birds with the call of their mates, and then terrify them when they have come near with the ſcreams of the eagle. There is no bird in the foreſt but it can mimick; and there is none that it has not at times deceived by its call. But, unlike ſuch as we uſually ſee famed for mimicking with us, and who have no particular merit of their own, the mock-bird is ever ſureſt to pleaſe when it is moſt itſelf. At thoſe times it uſually frequents the houſes of the American planters; and ſitting all night on the chimney-top, pours forth the ſweeteſt and the moſt various notes of any bird whatever. It would ſeem, if accounts be true, that the deficiency of moſt other ſong-birds in that country is made up by this bird alone. They often build their neſts in the fruit-trees about houſes, feed upon berries and other fruits, and are eaſily rendered domeſtic.

TURENNE (Viſcount). See Tour.

TURF, *peat*, a blackiſh earth uſed in ſeveral parts of England, Holland, and Flanders, as fuel. Turf, as diſtinguiſhed from peat, conſiſts of mould interwoven with the roots of vegetables; when thoſe roots are of the bulbous kind, or in a large proportion, they form the looſer and worſe kind of turf; but when mixed with a conſiderable proportion of peat, they form what is called *ſtone-turf*; it at firſt hardens, but at laſt crumbles by long expoſure to the air.

TURGESCENCE, among phyſicians, denotes a ſwelling or growing bloated.

TURGOT (Anne Robert James), the famous financier, was born at Paris May 10, 1727, of a very ancient Norman family. His father was for a long time provoſt of the corporation of merchants. During this period he was the object of general admiration; and the regularity and economy of his adminiſtration procured him the particular reſpect of the citizens. M. Turgot was the youngeſt of three brothers. The eldeſt was intended for the rank of magiſtracy, which had been the ſtation of his family for ſeveral generations; the ſecond was deſtined for the army; and Robert for the church. He had ſcarcely attained the age at which reflection commences, when he reſolved to ſacrifice all temporal advantages to liberty and conſcience, and to purſue his eccleſiaſtical ſtudies without declaring his repugnance to their propoſed object. At the age of 23 years he took his degree, and was elected prior of the Sorbonne.

The time when it was neceſſary for him to declare that he would not be an eccleſiaſtic was now arrived. He announced this reſolution to his father by letter, ſhowing the motives which induced him to decline the clerical order. His father conſented, and he was appointed maſter of requeſts. M. Turgot prepared himſelf for this office by particular application to thoſe parts of ſcience which are moſt connected with its functions and duties, viz. the ſtudy of natural philoſophy, as far as it relates to agriculture and manufactures, to the ſubjects of merchandiſe, and the execution of public works, together with ſuch parts of mathematical knowledge as lead to a practical application of natural philoſophy, and facilitate the calculations that are frequently neceſſary in politics, commerce, and law.

About this period he wrote ſome articles for the *Encyclopédie*, of which the moſt capital were, *Etymology*, *Exiſtence*, *Expanſibility*, *Fair*, and *Foundation*. He had prepared ſeveral others, but theſe five only were inſerted; the perſecution ſet on foot againſt the *Encyclopédie* hindered him from continuing to write in it, being unwilling that his opinions ſhould be publiſhed in a work which was received with diſapprobation by ſome of the moſt diſtinguiſhed people of that time.

In 1761 M. Turgot was appointed intendant of Limoges. In this office he did much good. He gave activity to the ſociety of agriculture eſtabliſhed at Limoges, by directing their efforts to important objects: he opened a mode of public inſtruction for female profeſſors of midwifery: he procured for the people the attendance of able phyſicians during the raging of epidemic diſeaſes: he eſtabliſhed houſes of induſtry, ſupported by charity (the only ſpecies of almſgiving which does not encourage idleneſs): he introduced the cultivation of potatoes into his province, &c. &c. While M. Turgot proceeded with unremitting activity and zeal, in promoting the good of the people over whom he was placed, he meditated projects of a more extenſive nature, ſuch as an equal diſtribution of the taxes, the conſtruction of the roads, the regulation of the militia, the prevention of a ſcarcity of proviſion, and the protection of commerce.

At the death of Louis XV. the public voice called M. Turgot to the firſt offices of government, as a man who united the experience reſulting from habits of buſineſs to all the improvement which ſtudy can procure. After being at the head of the marine department only a ſhort time, he was, Auguſt 24, 1774, appointed comptroller general of the finances. During his diſcharge of this important office, the operations he carried on are aſtoniſhing. He ſuppreſſed 23 kinds of duties on neceſſary occupations, uſeful contracts, or merited compenſations. He aboliſhed the corvée (A) for the highways, ſaving the nation thirty millions of livres annually.—He ſet aſide another kind of corvée, which reſpected the carriage of military ſtores and baggage.—He abated the rigour in the adminiſtration of indirect impoſitions, to the great profit of the contributors, the king, and the financiers.—He ſoftened the mode of collecting the territorial impoſts.—He ſtopped the progreſs of a plague among cattle.—He ſuppreſſed a ſedition conducted with art.—He provided for the equal diſtribution of ſubſiſtence.—He gave the utmoſt encouragement to the cultivation of the three chief productions of France, viz. wheat, cattle, and wine, and to the commerce thence reſulting.—He reformed a number of abuſes, ſome of which yielded a profit

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(A) The word *corvée* ſeems to be derived from *cura viæ*, i. e. "the care of the roads." It ſignifies the call made on individuals to furniſh labour and materials in kind for the conſtruction and repair of roads. The ſame exiſts to this day in England under the name of *ſtatute duty*. It is indeed with us under proper reſtrictions; but in France, where there are no turnpikes, all the roads, which are very good, were made and repaired by the *corvée* alone; whence it became an intolerable burden to the labourers.

to the place he filled. He aboliſhed as much as he could the ſale of offices.—He formed many uſeful eſtabliſhments. —He paid the penſions of the poorer ſervants of the ſtate, who were four years in arrear.—He ſupplied the expences of a coronation, the marriage of a princeſs, and the birth of a prince.—He facilitated payments as far as India.—He ſettled a part of the colony debts, and put the reſt in order.—He found the public borrowing at five and a half *per cent.* and reduced the rate to four.—He leſſened the public engagements 84 millions. He found the revenue 19 millions deficient, and left a ſurplus of three millions and a half.—All theſe he accompliſhed within the ſpace of 20 months, during ſeven of which ſevere fits of the gout totally incapacitated him for buſineſs.

At length, however, by the artifices of the courtiers, his office was taken from him; but when removed to a private ſtation, M. Turgot did not experience that frightful void which is the juſt but dreadful puniſhment of ambitious men when deſerted by fortune. The ſciences and the belles lettres, which he had cultivated in his youth, afforded him conſolation, while an active ſphere of life was denied him. Natural philoſophy and chemiſtry were his favourite purſuits; yet he frequently entertained himſelf with poetry, eſpecially with tranſlating Virgil into French verſe. "We know (ſays the Marquis de Condorcet) but of one Latin verſe compoſed by M. Turgot, and which was intended for a picture of Dr Franklin.

"*Eripuit cœlo fulmen, mox ſceptra tyrannis.*"

The attacks of the gout, under which he had long laboured, becoming more frequent and exceſſive, forewarned him of the approaching moment, when, in conformity to the laws of nature, he was going to fill in a higher order of beings, the rank which theſe laws deſtined for him. He died March 20, 1781.

For a more ample account of this illuſtrious ſtateſman, we refer the reader to the Hiſtory of his Life, written by the Marquis de Condorcet.

TURIN, an ancient, populous, ſtrong, handſome, flouriſhing city of Italy, and capital of Piedmont, where the ſovereign reſides, with an archbiſhop's ſee, a ſtrong citadel, and an univerſity. It is ſeated on a vaſt plain, at the confluence of the rivers Doria and Po. It is one of the handſomeſt places in Italy; but the air is unhealthy in the autumn and winter on account of the thick fogs. One half of this place is lately built; and the ſtreets are ſtraight and clean, being waſhed by an aqueduct. The two largeſt ſtreets are the New-ſtreet and that of the Po, which are lighted in the winter time. The houſes are handſome, and all built of the ſame height. The ducal palace conſiſts of two magnificent ſtructures, joined together by a gallery, in which are ſeveral ſtatues, all ſorts of arms, the genealogy of the dukes of Savoy, a repreſentation of the celeſtial ſigns, a royal library, and many other curioſities. Beſides theſe two ſtructures, there is the palace of the prince of Carignan, the hoſpital of St John, the ſeminary of the Jeſuits, the royal hoſpital, and the metropolitan church of St John, wherein they pretend to keep the cloth in which is the print of the face of Jeſus Chriſt. Theſe are all ſuperb ſtructures. When the plague reigned at Marſeilles in 1720, a great number of artificers withdrew to Turin; inſomuch that there are now above 87,000 inhabitants, and 48 churches and convents. Turin is very well fortified, and extremely ſtrong; as the French found by experience in 1706, who then beſieged it a long while to no purpoſe. The citadel, which is flanked with five baſtions, is without doubt a maſterpiece of architecture. There are very fine walks on the ramparts, which require two hours to paſs round them. There are alſo very fine gardens on the ſide of the river Po; and the houſe commonly called *La Charité* is remarkable, as there is room for 3000 poor people. The college of the academy is very large and well built, and has a great number of ancient inſcriptions. In the royal library are 19,000 manuſcripts, beſides 30,000 printed books. It is charmingly ſeated at the foot of a mountain, 62 miles north eaſt of Genoa, 72 ſouth-weſt of Milan, and 280 north-weſt of Rome. E. Long. 7. 45. N. Lat. 44. 50.

TURKEY, in ornithology. See **Meleagris**.

Turkey, a very extenſive empire, comprehending ſome of the richeſt countries in Europe, Aſia, and Africa. See **Turcæ**.

1
Conſtantinople becomes the capital of the Turkiſh dominions.

Under the article **Constantinople**, n° 111, *et ſeq.* we have given an account of the origin and progreſs of the Turks, as far as ſeemed neceſſary for underſtanding the ſubſequent and more important part of their hiſtory. In 1453 they made themſelves maſters of the city of Conſtantinople, which from that time became the capital of their empire. Mohammed II. at that time the ſultan, after having treated the inhabitants with the greateſt cruelty, began to think of adding Servia to his dominions. Accordingly, in 1454, he entered that country at the head of 20,000 men, and obliged the inhabitants to pay him an annual tribute of 40,000 ducats. On his return to Adrianople, Mohammed repeopled the towns and villages about Conſtantinople with 4000 men and women who fell to his ſhare; and going to that city, built a palace eight ſtadia in compaſs, which he lined with lead taken from the monaſteries. Next year a fleet was ſent againſt the iſlands of Rhodes and Chios; but the attempt on both proved unſucceſsful: however the iſland Cos was reduced, and ſome other places; after which the ſultan turning his arms towards Hungary, laid ſiege to Belgrade. At firſt he met with ſucceſs; beat down part of the wall, and ſtopped the navigation of the river with 60 veſſels: but the celebrated John Hunniades, happening to arrive at that critical juncture, made a furious ſally, entirely routed the Turkiſh army, wounded Mohammed himſelf in the thigh, and burnt all his ſhips. Hunniades himſelf did not long ſurvive this engagement, dying ſoon after of a wound he had received therein according to ſome, or of the plague according to others.

2
Unſucceſsful attempt on Rhodes and Chios.

3
Mohammed repulſed at Belgrade.

4
Expedition againſt the Morea.

Mohammed being thus repulſed from Belgrade, ſet about the entire conqueſt of the Morea, the ancient Peloponneſus. The Grecian princes, among whom were two of the emperor's brothers, Thomas and Demetrius, were ſo terrified by the taking of Conſtantinople, and the great progreſs of the Turks, that they prepared to retire into Italy; upon which the Albanians ſeized on the country, chooſing one Manuel Cantacuzenus, a Greek, for their prince. Then falling on the Greeks who remained, they made an offer to the ſultan of the cities and fortreſſes, provided he would allow them to keep the open country; for the Albanians were ſhepherds, who had no fixed habitation. At this time, however, the ſultan choſe rather to ſupport the Greeks than to let the country fall into the hands of ſuch barbarians; and having defeated the Albanians, was content to accept of a tribute from the Greeks. But the danger was no ſooner over, than the Grecian princes revolted anew; upon which Mohammed entering the country with a powerful army, prince Thomas, with his family, fled to Italy; while Demetrius thought it moſt eligible to ſubmit to the ſultan, by whom he was carried away, with many of the moſt conſiderable perſons of Lacedæmon, Achaia, &c. where Turkiſh governors were appointed. Two thouſand families were alſo carried away from the Morea, in order to be ſettled at Conſtantinople, and 2000 young men to be enrolled among the ſultan's troops. Many cities at this time fell into the hands of

5
One of the Greek princes ſubmits.

6 The whole country ſubdued.

of the Turks, among which the principal were Corinth and Athens. The Greeks, however, ſtill made ſome faint ſtruggles; but all in vain: for by the year 1459 the whole country was ſubdued, excepting ſome maritime places held by the Venetians; and prince Thomas was obliged finally to take up his abode at Rome, where he was lodged in the pope's palace, and had a penſion of 3000 livres a-year allowed him for his expences.

7 War with Scanderbeg

8 His ſucceſs againſt the Turks.

Mohammed now purſued his good fortune; and having made war on the emperor of Trebizond, he ſubdued his dominions, and put him to death. His career, however, was for ſome time ſtopped by Scanderbeg the Epirote. This prince had already defeated an army of 12,000 Turkiſh horſe, of whom only 5000 eſcaped the ſlaughter; and diſperſed another, with the loſs of their general, and 4120 of his men killed on the ſpot. Encouraged by this ſucceſs, he laid ſiege to Belgrade, which it ſeems was now in the hands of the Turks: but, through the treachery of his ſcouts, his army was defeated, and 5000 of his men killed; upon which, one of his generals, by name *Moſes*, went over to the Turks.

Scanderbeg, not at all diſpirited by this misfortune, proſecuted the war with the utmoſt vigor. His firſt enterprize was againſt his perfidious general Moſes, who had been immediately put at the head of an army by the ſultan. This army was by Scanderbeg totally deſtroyed, excepting about 4000 men; upon which Moſes fell into ſuch diſgrace with the Turks, that he returned to his old maſter, who forgave his treachery, and reſtored him to all his former poſts.

The bad ſucceſs of Moſes did not prevent Ameſa, the nephew of Scanderbeg, from following his example. Mohammed received him kindly, and ſent him with Iſhak baſhaw of Conſtantinople; whom he intruſted with an army of 50,000 men againſt his uncle. Scanderbeg, with only 6000 men, retired towards Lyſſa, a maritime city of the Venetians. The Turks purſued, contrary to the advice of Ameſa; and being ſurpriſed by Scanderbeg, were utterly defeated, with the loſs of their camp, 20,000, or, according to others, 30,000 men killed on the ſpot, and the treacherous Ameſa taken priſoner. With the like good fortune Scanderbeg defeated three other Turkiſh armies, one of 20,000, another of 30,000, and the third of 18,000 men. On this Mohammed ſent againſt him an old experienced commander, at the head of 40,000 choſen troops; but as he likewiſe was able to atchieve nothing, the ſultan thought proper to conclude a peace with Scanderbeg in 1461.

9 Peace concluded.

10 Other conqueſts of Mohammed.

11 A formidable combination againſt the Turkiſh powers.

12 The war carried on with various ſucceſs.

Mohammed being thus freed from ſuch a troubleſome enemy, completed the conqueſt of the Greek iſlands; ſubdued Wallachia, Boſnia, and Illyria, extending his empire nearly to the confines of Italy. But as it was eaſy to ſee that no conqueſts would ſatisfy the Turkiſh ambition, the Venetians, who found themſelves ill-treated by their warlike neighbours, entered into an alliance with the Hungarians, to repreſs the overgrown power of the Turks, and prevent the weſtern parts of the world from being totally over-run by them; and into this alliance Scanderbeg was ſoon drawn, notwithſtanding his treaty with Mohammed already mentioned. The Hungarians invaded the Turkiſh dominions on the weſt ſide, defeated ſome troops, and carried off 20,000 ſlaves: the Venetians invaded the Morea, where they made ſome conqueſts, but were ſoon obliged to abandon them: however, they recovered the iſland of Lemnos; but being defeated in two engagements at land, they were obliged to ſolicit aſſiſtance from France, Germany, and Spain. Having obtained conſiderable ſupplies from thoſe parts, they again entered the Morea; but meeting with ſtill worſe ſucceſs than before, they applied for aſſiſtance to Matthias the ſon of John Hunniades king of Hungary. Matthias willingly made another incurſion into the Turkiſh dominions, ravaged Servia, and carried off a vaſt number of priſoners with a great booty.

In the mean time, Mohammed, fearing leſt Scanderbeg ſhould be declared generaliſſimo of the Chriſtian forces, ſent to him, deſiring a renewal of the league between them. But this being refuſed, the war was renewed with the utmoſt vigour. Many Turkiſh armies were ſent againſt this hero; but they were utterly defeated and diſperſed, till the year 1466, when by his death the ſultan was freed from the moſt formidable enemy he had ever encountered.

13 Scanderbeg dies.

14 Epirus and Albania reduced.

The death of Scanderbeg was followed by the entire reduction of Epirus and Albania. The Venetians in 1469 defeated the Turks in a pitched battle; but were driven out of Negropont, at that time the ſtrongeſt city in Europe: after which they entered into an alliance with Ferdinand king of Naples, Lewis king of Cyprus, and the grand maſter of Rhodes, at the ſame time that they ſent ambaſſadors to Uzun Haſſan king of Perſia, in order to perſuade him to attack the Turkiſh dominions on the eaſt ſide. Mohammed did not loſe his courage at the number of his enemies; but having defeated the Perſians, reduced the Venetians to ſuch diſtreſs, that they were obliged to conclude a treaty in 1479.

15 The Venetians obliged to ſue for peace.

16 Death of Sultan Mohammed.

17 Further conqueſts of the Turks.

18 Peace concluded.

In 1481 the war was renewed, and the city of Rhodes beſieged, but without ſucceſs; however, the city of Cephalonia was taken from the Venetians, Italy invaded, and the city of Otranto taken. This was the laſt of the exploits of Mohammed II. who died this year of the gout, and was ſucceeded by his ſon Bayezid, or Bajazet II. Under this prince a war commenced with the Mamalukes of Egypt, which, under his ſucceſſor Selim I. ended in the total ſubjection of that country. Bajazet, however, greatly facilitated Selim's conqueſt by the reduction of Circaſſia, whence the Mamalukes drew their principal reſources. Caramania and Croatia were totally reduced; the cities of Lepanto, Modon, and Durazz, taken by the Turks, though the Venetians recovered Cephalonia; Syria on the eaſt, and Moldavia on the weſt, were invaded and ravaged by the victorious armies of the ſultan; till at laſt a peace was concluded with the European powers in 1503.

19 Earthquakes and plague at Conſtantinople.

20 Sultan Bajazet deſirous of reſigning in favour of his eldeſt ſon.

21 Is depoſed, and put to death by his ſecond ſon Selim.

The year 1509 is remarkable for a dreadful earthquake at Conſtantinople, which overturned a great number of houſes, and deſtroyed 13,000 people; being alſo followed by an epidemic diſtemper, which carried off great numbers. About this time alſo the ſultan, finding the infirmities of old age drawing on, and being deſirous of paſſing the remainder of his days in quiet, reſolved to reſign the throne to his eldeſt ſon Achmed. But having engaged in this affair with too great precipitation, and before he had gained over the grandees, his ſecond ſon Selim, whom he had made governor of Trabezond, haſtily croſſing the Euxine ſea, dethroned and put to death his father, in the year 1512.

22 Selim defeats the Perſians, and reduces Egypt.

23 His death.

The new emperor, who had not ſcrupled to ſacrifice his father to his ambition, did not heſitate at eſtabliſhing himſelf on the throne by the death of his brother alſo. Accordingly, as Achmed, knowing he could be nowhere ſafe, reſolved to ſtand on his defence, Selim with a powerful army marched againſt him; and having defeated the few forces of his brother, took him priſoner, and put him to death. Having thus ſecured himſelf, he marched againſt the Perſians, whom he overthrew in a great battle: after which he took the city of Taurus; made ſome other conqueſts; and having ſecured tranquillity on the eaſtern ſide of his dominions, turned his arms againſt Sultan Gauri of Egypt. Him he reduced in the manner related under the article EGYPT, nº 101. His farther deſigns of conqueſt were fruſtrated by his death, which happened in the year 1519.

24 Is ſucceeded by Solyman a warlike prince.

52 The city of Rhodes reduced.

26 The king of Hungary defeated and killed.

27 Vienna beſieged without ſucceſs.

Selim was ſucceeded by his ſon Solyman I. ſurnamed *Kanuni*, or *The Lawgiver*, who proved no leſs ambitious and warlike than his father. Having defeated and killed the governor of Damaſcus, who had rebelled againſt him, he attacked the European princes with a deſign to extend his dominions as far to the weſtward as he poſſeſſed to the eaſtward of his capital. In 1520 he ſet out with a great army to conquer Hungary. The city of Belgrade was immediately inveſted, and in a ſhort time taken. Rhodes alſo being attacked by a great force by ſea and land, was obliged to ſubmit, after a moſt deſperate reſiſtance, as is related under that article, nº 33, *et ſeq.*; and Solyman entered the city in triumph on Chriſtmas day 1522. His conqueſts for ſome time were ſtopped by a rebellion in Egypt; but this being ſoon quaſhed, the war with Hungary was renewed in 1525. King Lewis having raſhly engaged the Turkiſh army of 200,000 men with only 25,000, was utterly defeated, himſelf drowned in a ditch, and his whole army, excepting a few horſe, cut in pieces.—This defeat was followed by the ſurrender of Buda, which, however, the Hungarians retook in 1528; but next year it was again taken by the Turks, and ſoon after both the Moldavias ſubmitted to their juriſdiction. The city of Vienna was then inveſted: but after being reduced to the greateſt ſtraits, the ſultan was obliged to abandon the ſiege by the coming on of the autumnal rains; which, however, he did not without barbarouſly maſſacring all his priſoners.

28 Georgia, Bagdad, &c. reduced.

29 Tunis reduced by Charles V.

The raiſing the ſiege of Vienna was followed by an entire repulſe of the Turks from the German territories: on which Solyman, reſolving to extend his dominions on the eaſt, ſubdued the country of Georgia, and made himſelf maſter of the city of Bagdad; at the ſame time that his admiral, the celebrated Barbaroſſa, ravaged the coaſts of Italy, and took the cities of Biſerta and Tunis in Africa. But, in 1536, he was obliged to retire before Charles V. of Spain, who retook the city of Tunis. Solyman, to revenge this diſgrace, ſuſpended for a time the war in Perſia, in order to turn all his forces againſt Italy: but while this country was in danger of being totally overwhelmed, a Venetian captain having raſhly taken and ſunk ſome Turkiſh veſſels, Solyman changed his deſign of attacking Italy into that of chaſtiſing the Venetians. However, after ſome trifling encounters, a peace was concluded in 1540.

30 Hungary reduced to a Turkiſh province.

31 Malta beſieged unſucceſsfully.

This year the war was renewed in Hungary: the tranſactions were very unfortunate for the Chriſtians, and ended in the entire reduction of the kingdom to a Turkiſh province. The kingdom of France, being oppreſſed by its enemies, entered into an alliance with Solyman, who was now grown ſo powerful, that the whole European powers ſeemed ſcarce able to reſiſt him. However, in 1565, he was baffled by the knights of Malta, as is related under that article; and in 1566 an end was put to his ambition and his conqueſts by death.

32 Account of the battle of Lepanto.

Solyman was ſucceeded by his ſon Selim II. ſurnamed *Meſt*, or "The Drunken." Under him the empire at firſt loſt nothing of its luſtre; but in 1571 the maritime power of the Turks was almoſt entirely deſtroyed at Lepanto, where one of the moſt remarkable ſea-engagements mentioned in hiſtory took place. The Chriſtian fleet was commanded by Doria the Venetian admiral; and conſiſted of 78 Spaniſh and 3 Malteſe galleys, under Don John of Auſtria, natural ſon to the emperor Charles V. Beſides theſe, under Venieri, a Venetian officer, were 108 galleys, 6 galleaſſes, 2 tall ſhips, and a great many ſmall galliots. Colonna, a kinſman of the pope, had alſo 12 of his galleys under his command. On board this fleet were 20,000 good ſoldiers, many of them perſons of great quality, who went volunteers in the expedition. Though the Turkiſh fleet conſiſted of 335 ſail, the moſt experienced officers were againſt fighting at that time, conſidering the great ſtrength of the confederates, and that there was no neceſſity for an engagement. But the opinion of Ali Paſha, the chief admiral, who was for a battle, prevailing, Parteu Paſha, the next in command, took on board 12,000 janiſaries and ſpahis, drawn out of the neighbouring garriſons; beſides 4000 other ſoldiers. Then putting out of the gulph, the fleet ſteered their courſe for the iſle of Corzalates, of old Echinates, half-way between Lepanto and Patras; and the Chriſtians moving towards them, both fleets came in ſight, October 7, afternoon. Hereupon Don John, having ordered the great enſigns of the confederates, which was the ſignal for engaging, to be hoiſted, clad in armour, went in his long boat to encourage the ſeveral ſquadrons of the centre under his command; while Doria did the like in the right wing, and Barbadico, the Venetian proveditor-general, in the left.

The ſignal was no ſooner given, than the Turks, with a hideous cry, fell on ſix galleaſſes which lay at anchor near a mile a-head of the confederate fleet; but thoſe ſhips fired ſo briſkly on them, firſt from their forecaſtles and then as they paſſed by, ſo galled their galleys with whole broadſides, that ſeveral of them were ſunk, which made the reſt bear farther off. The wind likewiſe chopped about to the weſt, and incommoded the Turks with the ſmoke. However, they ſoon rallied their diſordered ſquadrons, and came on with ſurpriſing reſolution. The action was continued for ſeveral hours with equal bravery on both ſides; but victory at laſt declared for the confederates.

33 The Turks defeated with great ſlaughter.

The number of Turks ſlain in this famous naval fight could not with certainty be known. An author who wrote an account of this war, makes their number 32,000 beſides priſoners, who were about 3500. The galleys taken from them amounted to 161. Forty more were ſunk or burnt; and of galliots, with other ſmall veſſels, about 60 were taken.

34 Little advantage reaped by the Chriſtians from the victory.

Notwithſtanding the prodigious loſs ſuſtained by the Turks on this occaſion, the confederates reaped but little advantage from this victory; and next year Kilij Ali Paſha, who had ſucceeded to the poſt of high admiral, fitted out a fleet of 250 galleys, with which he ravaged the coaſts of Chriſtendom wherever he came, and maintained his ground ſo well, that the confederates could never gain the leaſt advantage over him.

35 Decline of the Turkiſh power.

The Turkiſh power from this time, however, began to decline. The progreſs of civilization being much more quick among the weſtern nations, and their improvements in the art of war very conſiderable, the Turks found it not only impoſſible to extend their dominion over Germany, but even a matter of ſome difficulty to withſtand the power of the weſtern princes. During the remainder of the reign of Selim, the war was carried on in Hungary with little advantage on either ſide; but under his ſucceſſor, ſultan Morad III. the Turks met with ſeveral ſevere checks from the Germans.

36 Confederacy againſt them.

37 Misfortunes of the Turks.

In 1594, Mohammed III. having ſucceeded his father Morad, deſtroyed his 19 brethren, in order to ſecure himſelf on the throne; and for the ſame reaſon cauſed 10 of his father's wives and concubines to be thrown into the ſea, leſt any of them ſhould prove with child. The emperor Rodolph II. having entered into a confederacy againſt him with the princes of Tranſylvania, Walachia, and Moldavia, defeated the Turks and their Tartar auxiliaries in ſeveral engagements, and took many cities; while ſo grievous a famine and plague raged in Hungary, that of 85,000 Tartars who had entered the country the year before, ſcarce 8000 remained alive. This was followed by new misfortunes; ſo that in the following year the Turks were entirely driven out of Tranſylvania, Moldavia, and Walachia.

38 War with Poland.

In 1621, under Othman or Ozman II. we find the Turks firſt engaged in a war with Poland; but a peace was concluded the ſame year; the chief article of which was, that the Poles ſhould have a free trade in the Turkiſh dominions, and that for this their merchants ſhould pay 10,000 ſequins.

39 The Poles firſt allowed to trade to Turkey.

The Turkiſh affairs continued pretty much in the ſame way till the year 1673, when a dreadful war broke out with Germany, Ruſſia, and Poland, whoſe army was at that time commanded by the celebrated John Sobieſki.

40 War with Ruſſia, Germany, and Poland.

The year before, hoſtilities had commenced on account of the Poles having endeavoured to detach the Coſſacks from their allegiance to the ſultan. At this time the Turks were ſucceſsful through the diſſenſions which reigned among the Poles; and the latter were obliged to pay an annual tribute of 20,000 rix-dollars, and to deliver up 48 towns and villages in the territory of Kaminieck.

41 The Poles defeated, and become tributary.

However, the articles of this treaty were never executed; for, in 1673, the ſtates of Poland ſent a letter to Kyoprili Ahmed Paſha, the vizir at that time, informing him that they conſidered as null the conditions of the treaty, being concluded without their conſent, and that they would rather ſuffer death, than ſubmit to the infamy of paying one ſingle farthing by way of tribute.

42 The ſtate refuſed to ratify the treaty.

On this the ſultan, Mohammed IV. determined to take a ſevere revenge on their perfidy, ſet out with a great army; but was entirely defeated, with the loſs of 20,000 men killed on the ſpot, all the baggage, 25,000 waggon loads of proviſion and ammunition, and 2000 purſes of money for paying the army.

43 The Turks defeated, and peace concluded.

Soon after this victory, John was proclaimed king of Poland: but his ſubjects, jealous of his glory, refuſed to ſupport him properly in proſecuting his advantage; ſo that four years after, a treaty was concluded, by which the Poles for ever reſigned their pretenſions to Kaminieck and to the dominion of the Coſſacks in Podolia.

44 The Turks and Tartars defeated by the Ruſſians.

But though peace was thus made with Poland, the war was carried on very unſucceſsfully with Ruſſia. In 1678, an army of the Tartars was entirely cut in pieces or taken near the city of Cherin; which ſo intimidated another army of 40,000 Turks, who had waited for the arrival of theſe auxiliaries, that they threw away their arms, and fled without ſtopping till they had croſſed the river Bog. This defeat inclined the ſultan to peace; but the negotiations proving ineffectual, he, in 1679, again ſent a powerful army of 80,000 Turks, 30,000 Tartars, and 4000 Coſſacks, under the command of the vizir, to retrieve his loſt honour.

43 Another army defeated, and reduced to great diſtreſs.

This army, however, ſucceeded little better than the former: for the vizir was defeated in ſeveral engagements; and at laſt, according to cuſtom, put to death on account of the bad ſucceſs of the war.

46 War with the Venetians.

In 1684 the Venetians again declared war, while the Poles and Germans continued their hoſtilities with the utmoſt violence. The Turks were forced to yield to the ſuperior fortune and valour of their adverſaries; they were defeated in a great number of engagements, and loſt many places of importance.

47 The Turkiſh affairs retrieved by Kyoprili.

In ſhort, their affairs ſeemed to be totally going to wreck, when, in 1688, they were retrieved by the new vizir Ahmed Kyoprili, a man of great ſkill and experience in war, as well as of the moſt upright and blameleſs character. Having prevailed in the divan to have the war carried on, he applied his whole care to the raiſing of an army, and providing warlike ſtores.

48 He rouſes the enthuſiaſm of the people.

But finding the people every where intimidated and unwilling to oppoſe the enemy, the treaſury exhauſted, and an univerſal langour prevailing, he made a new kind of proclamation, in which he told the people, that "as he found it neceſſary to truſt the command of the army againſt the haughty Germans to none but himſelf, ſo he would not employ in this expedition any ſoldier forced into the ſervice; knowing that the will was of more value with God than the deed: that he would only put the Muſſulmen in mind, that, by the precepts of God and his prophet, every one is commanded neither to avoid martyrdom, nor to deſpair of ſucceſs againſt infidels, &c." Having thus once rouſed the enthuſiaſm of the common people, they flocked in great numbers to his ſtandard; after which, having reformed many abuſes both in the civil and military departments, he led them againſt the enemy. The good effects of his reformations were evident.

49 Is at laſt defeated and killed.

Great numbers of the enemy were cut off, and almoſt all the important places taken which had been loſt before, when, in 1691, he was defeated and killed by the Germans at Iſlankamen. After his death, the Turkiſh affairs again fell into diſorder; and, though the utmoſt efforts were uſed by ſucceeding vizirs, no progreſs could be made: and in 1697, a prodigious overthrow was given them by prince Eugene at Zenta.

50 Peace concluded.

At laſt, in 1698, all parties being weary of ſuch an expenſive and ruinous war, a pacification took place at Carlowitz, but on different terms with the different nations who had been at war with the Turks.

51 Terms made with the emperor.

The emperor made a truce for 25 years, upon condition that all Tranſylvania ſhould be reſigned to him: the city of Temeſwaer was to be reſtored to the Turks, and the navigation of the Teiſſe and Maros rivers be free to both nations; that the country between the Danube and the Teiſſe, called *Bachbak*, remain in the emperor's hands: that the boundary of the eaſtern part of Hungary, belonging to the emperor, ſhould be a right line drawn from the mouth of the Maros towards the banks of the river Teiſſe to the mouth of the Boſſut, where it falls into the Saave: that towards the ſouth the Saave ſhould part the Turkiſh from the Imperial limits, till it receives the Unna: and that no new caſtles beſides Belgrade and Peterwaradin ſhould be erected, or old ones fortified, any where within theſe boundaries.

52 With the Ruſſians.

The Ruſſian ambaſſador made a truce only for two years, upon the footing of each party poſſeſſing what he had taken. The Poles made a truce on the like terms with the ſultan; namely that they ſhould have Kaminieck, Podolia, and Ukrania, reſtored to them, in the ſame extent as poſſeſſed by them before ſultan Mohammed's firſt expedition into Poland; and, on the other hand, reſign Soczava, Nemos, and Soraka, in Moldavia, to the Turks.

53 With the Venetians.

The Venetians obtained theſe conditions: that all the Morea, as far as Hexamilos, ſhould belong to them; and that the firm land with Naupaktum (or Lepanto), Preveſa, and the caſtle of Romania, which had been demoliſhed, ſhould be reſtored to the Turks; that the bay of Corinth ſhould be common to both, and the Venetians poſſeſs Lenkade with the adjacent iſlands. The yearly tribute paid by the iſlands in the Archipelago to the Venetians was to be aboliſhed; and Zakinth to be declared free from the like burden by the Turks. In Dalmatia, Knin, Cing, Kiklut, Verlika, Duare, and Vergoraz, were to be left to the republic, and fixed as the boundaries of their dominions on that ſide. The Raguſians were to continue free, and the Venetians to retain the caſtles of Caſtlenuovo and Riſano, with what they poſſeſſed in the neighbourhood. Both parties were allowed to fortify their borders with new fortreſſes; or to repair thoſe which were decayed, excepting Naupaktum, Preveſa, and the caſtle of Romania before mentioned.

54 Turkiſh affairs to the year 1769.

From the concluſion of the peace of Carlowitz to the year 1769, nothing very remarkable occurs in the Turkiſh hiſtory, excepting their recovery of the Morea from the Venetians by the treaty of Paſſarowitz. (See the article VENICE). Their war with the Ruſſians under Peter the Great has been taken notice of under the article RUSSIA; thoſe afterwards with PERSIA, under that article. None of theſe, indeed, 55 War with Ruſſia.

56 Aſoph taken by the Ruſſians.

57 The Turks defeated.

indeed, were of any great conſequence; but in 1769, a war commenced with Ruſſia, which threatened the Ottoman empire with deſtruction, and which has given it ſuch a ſevere check as it can ſcarcely recover. The origin of this war is given under the article POLAND, nº 101; and during the courſe of it, an almoſt uninterrupted train of ſucceſs attended the Ruſſian arms. About the end of March 1769, a body of Ruſſian troops made themſelves maſters of the important fortreſs of Aſoph, at the mouth of the river Don. In the end of April, prince Gallitzin, commander in chief of the Ruſſian army on the frontiers of Poland, paſſed the river Nieſter, hoping to take the fortreſs of Choczim by ſurpriſe; but being diſappointed; he was obliged to return. Near the beginning of July, however, he again paſſed that river, and on the 13th attacked and defeated the van of the grand vizir's army, conſiſting of about 50,000 or 60,000 men. Thirteen thouſand of the fugitives entered Choczim; which was next day inveſted by the Ruſſians: but they were at laſt obliged to raiſe the ſiege and repaſs the Nieſter; which they could not effect without conſiderable loſs.

58 The Turkiſh vizir beheaded.

59 Choczim taken by the Ruſſians.

In the mean time, both the Ottoman and Ruſſian courts were diſpleaſed with the conduct of their generals. The Turkiſh grand vizir was deprived of his command, and afterwards beheaded; and was ſucceeded by Moldovani Aga Pacha, a man of a bold and enterprizing ſpirit. On his firſt taking the command of the army, finding it impoſſible to ſubſiſt where he was, he attempted to force a paſſage over the Nieſter, but being three times repulſed with great loſs, he made a precipitate retreat towards Bender, at the ſame time drawing the troops out of Choczim, which the Ruſſians immediately took poſſeſſion of.

60 They reduce the province of Yaſſy.

Prince Gallitzin was now ſuperſeded by General Romanzow, who took the command of the army on the 29th of September. Soon after his arrival, he received news of the ſucceſs of general Elmpt, who, with a body of 10,000 men, had reduced the province of Yaſſy. He inveſted Bender; but finding the ſeaſon of the year too far advanced, he ſoon withdrew his troops, and put them into winter quarters.

61 Unſucceſsful negotiations for peace.

62 Bender inveſted.

This firſt campaign had proved ſo unpropitious to the Turkiſh affairs, that the court would gladly have concluded a peace, if they could have obtained it upon honourable terms; but the Ruſſians inſiſting upon the entire ceſſion of Moldavia and Walachia as a preliminary article, the negotiations came to nothing. A new campaign was therefore reſolved on; and this proved ſtill more unſucceſsful than before. The grand Ruſſian army under general Romanzow paſſed the Nieſter in the month of May 1770; and, having aſſembled at Choczim on the 3d of June, marched towards Pruth: at the ſame time, their ſecond army, commanded by general Panin, arrived before Bender. The plan of operation was, that the latter ſhould form the ſiege of Bender, and Romanzow ſhould cover it.

63 The Turks and Tartars defeated by General Romanzow.

64 The grand vizir defeated with prodigious ſlaughter.

65 Bender taken and the inhabitants maſſacred.

66 Vaſt number of cannon taken by the Ruſſians.

On the 18th of July, general Romanzow attacked an army of 80,000 Turks and Tartars, commanded by the Kahn of Crimea, and ſtrongly intrenched on an almoſt inacceſſible mountain, forced their intrenchments, and obliged them to flee in the utmoſt confuſion, leaving an immenſe quantity of ammunition and proviſions, &c. in their camp; which they totally abandoned to the victors.—After this victory, the Ruſſian general puſhed on towards the Danube; and on the 2d of Auguſt attacked another Turkiſh army, commanded by the grand vizir in perſon, and totally defeated it, making himſelf maſter of their camp, ammunition, 143 pieces of cannon, and above 7000 carriages loaded with proviſions. The loſs of the Turks on this occaſion was not reckoned leſs than 40,000 men, and ſome accounts raiſed it to 60,000.—During the courſe of this ſummer alſo, the fortreſs of Kilia Nova, at the moſt northerly mouth of the Danube, ſurrendered by capitulation; and likewiſe that of Ackerman, or Bialogorod, near the mouth of the Nieſter. Bender was taken by ſtorm on the 27th of November; and the Ruſſians, enraged at the obſtinate reſiſtance they had met with, made a terrible ſlaughter of their enemies. It was computed that 30,000 Turks periſhed on this occaſion. The fortreſs of Brailow, ſituated on the northern ſide of the Danube, was inveſted on the 26th of September; and the garriſon were ſo much intimidated by the taking of Bender, that they abandoned the place, and moſt of them were drowned in croſſing the river.—During this campaign, it was reckoned that the Ruſſians took 1000 pieces of cannon from their enemies.

67 A Ruſſian fleet lands ſome troops on the Morea.

68 They deſtroy the Turkiſh fleet.

This year alſo a Ruſſian fleet of 16 or 18 ſhips entered the Mediterranean, and landed a body of troops on the Morea. Theſe being joined by the Greeks, committed great cruelties on the Turks and made themſelves maſters of almoſt the whole country. At laſt, however, the Porte, notwithſtanding their bad ſucceſs in other parts, found means to ſend a force into the Morea ſufficient to overpower the Ruſſians. The Greeks now ſuffered in their turn; and the Ruſſians, hearing that a Turkiſh fleet had paſſed the Dardanelles, abandoned the Morea, and ſailed to meet their antagoniſts. A battle enſued, in which the Turks were defeated; and having imprudently retired into a neighbouring harbour, they were next day entirely deſtroyed by the Ruſſian fire-ſhips, except one ſhip of 64 guns which was taken. This fleet conſiſted of 15 ſhips of the line, from 96 to 60 guns, three large frigates, and ſeven large armed veſſels, beſides galleys. After this victory the Ruſſian fleet blocked up the mouth of the Dardanelles, interrupted the Turkiſh trade, prevented the carrying of proviſions to Conſtantinople by ſea, and raiſed contributions from moſt of the iſlands in the Archipelago.

69 The Turks gain ſome advantages.

70 They take Giurgewo and defeat General Eſſen.

In 1771, matters did not at firſt go on ſo ſucceſsfully on the part of the Ruſſians. On the ſide of the Danube, they were obliged to keep on the defenſive. Another army, under prince Dolgorucki, had better ſucceſs; they reduced the whole peninſula of Crim Tartary in leſs than a month, though defended by an army of 50,000 men.—During theſe tranſactions the Turks made themſelves maſters of the fortreſs of Guirgewo; which enabled them to become ſo formidable on the ſide of Walachia, that prince Repnin durſt not attack them. Upon his refuſal to do ſo, he was deprived of his command; which was given to general Eſſen. On the 17th of Auguſt, he attacked the Turkiſh intrenchments; but, after a deſperate engagement of four hours, was defeated, with the loſs of upwards of 3000 men.

71 Are outwitted by General Romanzow.

72 Two Turkiſh armies totally defeated.

This was the only engagement of any conſequence in which the Turks had proved victorious ſince the beginning of the war; and, after it their uſual bad fortune attended them. In conſequence of their victory, they determined to winter on the northern ſide of the Danube, which would have been of the utmoſt ſervice to them; and with which view they conſiderably reinforced their army in Walachia. But general Romanzow, by a train of maſterly diſpoſitions, not only thwarted all their ſchemes, but ſurpriſed them on their own ſide of the river. They had divided their army into two great bodies, which were ſtationed in the neareſt and moſt important poſts on the Turkiſh ſide of the Danube. On the 20th of October, one of theſe bodies was ſurpriſed at Tuliza by general Wieſman, and another at Maczin by general Milarodowits. The event was the ſame in both places. The intrenchments were forced, the Turks totally routed, and their artillery, ſtores, and magazines taken, together with the two towns and their caſtles. Next day general Weiſman attacked the grand vizir himſelf, with the like

73
The grand vizir defeated, and driven beyond mount Hemus.

like ſucceſs. The intrenchments were forced, a vaſt quantity of artillery taken, and likewiſe the town and caſtle of Babadagh; while the vizir, with the remains of his army, fled 30 miles to ſeek refuge at Mount Hemus. A few days afterwards general Eſſen defeated another body of Turks, and retook the fortreſs of Giurgewo, driving the enemy totally out of Walachia. The Ruſſian fleet this year ſpread ruin and deſolation through the defenceleſs iſlands of the Archipelago and the coaſts of Aſia, ſtriking terror into the city of Conſtantinople itſelf. A dreadful peſtilence raged this year in the Turkiſh army; and in the autumn broke out at Moſcow, where it deſtroyed vaſt numbers.

74
The Turks driven out of Walachia, &c.

75
They ſue for peace.

The affairs of the Turks were now in ſuch a deſperate condition, that they very eagerly ſued for peace. The only conditions on which this could be obtained, however, were, that the Crimea, Budziac Tartary, and all that vaſt tract of country on the coaſt of the Black Sea, as far as the north ſhore of the Danube, ſhould continue for ever under the dominion of Ruſſia; that the Ruſſians ſhould enjoy an unlimited freedom of navigation on the Black Sea, together with the poſſeſſion of the city of Aſoph, on the mouth of the Don; and that a ſum of money ſhould be paid them by way of indemnification for the expences of the war.

76
Negotiations broken off.

Theſe terms, however, were rejected; and the negotiations, which continued through the whole year 1772, at laſt came to nothing. The commiſſioners on both ſides retired from Buchareſt, the place where the congreſs was held, on the 22d of March 1773. For ſome time a deſultory kind of war was carried on between detachments from the two armies.

77
Romanzow paſſes the Danube.

But as this was very prejudicial to the Ruſſians, who could not be ſo eaſily recruited as the Turks, about the middle of June, Romanzow made preparations for paſſing the Danube with the grand Ruſſian army, conſiſting of 87,000 men: which, however, he did not accompliſh till the 24th; and then marched with his army, in large diviſions, towards the city of Siliſtria. He was terribly haraſſed on his march by large bodies of the Turkiſh cavalry, of whom the grand vizir had detached 27,000 for this purpoſe. At laſt, however, they arrived before the city, which was ſtrongly fortified, and defended by a body of troops conſiſting of about 24,000 men.

78
A Turkiſh army defeated by General Weiſman,

On the 29th of June, this body was defeated by general Weiſman, who commanded the van of the Ruſſian army, and forced to retire into Siliſtria. The grand vizir then detached 50,000 men to the relief of the place: upon this the Ruſſians found it neceſſary to retreat; which was not accompliſhed without very great difficulty and loſs.

79
Who is killed.

In this retreat general Weiſman was killed, and the army left all their magazines behind them.

Many other ſevere conflicts happened this campaign, which proved leſs glorious to the Ruſſians than any of the former ones. In 1774, however, their arms were attended with better ſucceſs. Romanzow's army was reinforced by 40,000 men; and, on the night between the 16th and 17th of June, paſſed the Danube in ſpite of all oppoſition.

80
The Turks every where defeated.

A continued ſeries of engagements then happened between the Ruſſian generals and different bodies of the Turks. In theſe the latter were always defeated; and at laſt became ſo much diſpirited, that a body of 40,000, or, according to ſome accounts, of 70,000 Turks, fled at the firſt ſight of a body of their enemies greatly inferior in number, leaving behind them all their tents and baggage, with a fine train of braſs artillery. From this time, diſorder, mutiny, and diſmay, ſeized all the Turkiſh armies, and they abſolutely refuſed to face their enemies. They plundered the baggage, robbed and murdered their officers, deſerted by thouſands, taking the road to Conſtantinople, and committing every kind of outrage by the way. The miniſters of ſtate, after having tried all methods to induce this lawleſs crew to return to their duty, were obliged to furniſh them with veſſels for their tranſportation into Aſia.

81
Almoſt the whole army deſerts.

According to ſome accounts, no fewer than 140,000 of the turkiſh troops deſerted in this manner. Even in the grand vizir's camp at Schunla, matters went on in the ſame manner. He was abandoned by his whole cavalry; his European and Aſiatic troops quarrelled, and cut one another to pieces before his face; and, in ſhort, the vaſt army he commanded was reduced almoſt to nothing. The Ruſſian general did not fail to take advantage of theſe misfortunes. He placed the different diviſions of his army in ſuch advantageous ſituations, that he totally cut off all communication between the Turkiſh camp and every mean of ſubſiſtence.

82
Romanzow dictates terms of peace.

The unfortunate vizir, therefore, was obliged at laſt to ſubmit to the terms which Romanzow dictated to him. The principal articles were, the independency of the Crimea; the abſolute ceſſion of Kilburn, Kerche, and Jenickala, and all the country between the Bog and the Nieper; a free navigation in all the Turkiſh ſeas, in which was included the paſſage through the Dardanelles, with all the privileges and immunities which were granted to the moſt favoured nations. Ruſſia gave up all her conqueſts, except Aſoph and Taganrok. There were, beſides, ſeveral ſtipulations in favour of the inhabitants of Moldavia and Walachia, and the Greek iſlands which were reſtored by Ruſſia.

83
Appearance of a prophet in Upper Aſia.

Soon after this period an extraordinary alarm was excited at the Porte by the ſudden appearance of a new prophet in Upper Aſia. This man, whoſe name was *Sheik Manſour*, pretended that he was predoomed by the eternal and immutable decrees of Heaven to fill up the meaſure of Divine revelation to mankind; and that as he was to be the laſt, ſo he was the greateſt of the prophets. The ſcene of his miniſtry was in the wide and deſolate regions on the borders of the Caſpian Sea; and though the firſt rumour of his proceedings repreſented him as at the head of a multitude of armed enthuſiaſts ready to overturn the eſtabliſhed government and the religion of Mahomet, it was ſoon diſcovered that all the military fury of his zeal was directed againſt the Chriſtians. He had even influence enough to form a combination of all the nations of Caucaſean Tartars againſt the Ruſſians, which was certainly of ſome ſervice to the Turks in that war, which the empreſs Catherine was now meditating againſt them.

84
A rebellion in Egypt.

In the mean time, while this war was impending, the moſt formidable rebellion broke out in Egypt, the granary of the Turkiſh empire (ſee EGYPT, n° 125); but it was, after a long, bloody, and dangerous war, almoſt ſuppreſſed by the wiſe conduct and intrepid bravery of Haſſan Bey, the Captain Pacha or Grand Admiral, who, at the age of 70, fought with all the ardour of youth, and all the ſkill of the moſt conſummate general. That veteran, however, was recalled before he was able to carry all his patriotic deſigns into execution, that he might aid the divan with his counſel, in the critical ſituation into which the empire was brought by the arrogant claims of the court of Ruſſia.

85
A new war with Ruſſia,

The reſult of the deliberations was a precipitate declaration of war againſt that court, contrary to the better judgment of the old Pacha. The war commenced in autumn 1787, and the hordes of Tartars which were firſt brought into the field, headed by the new prophet, were every where defeated by the ſuperior diſcipline of the Ruſſian troops commanded by prince Potemkin.

86
And Auſtria.

Some enterprizes which were undertaken by the Turks againſt the iſland of Tamen and the Crimea were attended with as little ſucceſs as the attempts of the Tartars: while the emperor Joſeph declared to the Porte that he would aſſiſt his ally the empreſs of Ruſſia with an army of 80,000 men. Four Auſtrian armies were accordingly aſſembled; one at Carlſtadt in Croatia, under the command of general de Vins; another at Peterwaradin in Hungary, commanded by general Langlois; a third on the borders of Lithuania, under general Febris; and the fourth in the Buccowine, under the orders of the prince of Saxe-Cobourg. Two other generals, ten lieutenant-generals, and thirty major-generals, were all ordered to prepare for active ſervice in the frontier armies. If any thing had been yet wanting to ſhow the fixed determination of the court of Vienna, the meaſure of ſending general Alvinzi to act in and obſerve the conduct of the Ruſſian armies during the war, and the receiving a Ruſſian officer of equal rank to act the ſame part in the Auſtrian, would have been alone a ſufficient explanation.

87 The Turks at firſt ſucceſsful.

The war between the Turks and Auſtrians was carried on with various ſucceſs. At firſt the advantage was evidently on the ſide of the Ottomans, and the imperial Joſeph acquired no warlike renown. His declared purpoſe was to get poſſeſſion of Belgrade; from which however his enemies repulſed him with diſgrace. The prince of Saxe-Cobourg in his department of the war diſplayed indeed prodigies of valour; but being oppoſed to a ſuperior force, he was long obliged to act only on the defenſive. At length, being joined by a body of Ruſſian forces under general Soltikow, preparations were made for commencing in form the ſiege of Choczim, which was ſurrendered to the allied armies on Michaelmas day 1788, after a defence which would have done honour to the ableſt general in Europe. Still, however, ſucceſs ſeemed to lean to the Turks. The grand vizir made a ſudden incurſion into the Bannat, and ſpread conſternation and diſmay to the very gates of Vienna. The Auſtrian affairs ſeemed approaching to a very alarming criſis; not only the ſplendid views of conqueſt which were beheld in the imagined partition of a tottering empire had totally diſappeared, but had left in their place the ſad and gloomy reverſe of a diſcontented and impoveriſhed people, an exhauſted treaſury, and an army thinned by peſtilence and deſertion. The firſt campaign of an invaſive war had already produced an impreſſion on the territory of the invader.

88 General Laudohn takes the command of the Auſtrian army.

In this ſituation of affairs Marſhal Laudohn was with ſome difficulty drawn from his retirement to take the command of the army in Croatia; and under his auſpices fortune began to ſmile on the Auſtrian arms. He quickly reduced Dubicza and Nevi, though they were both defended with the moſt obſtinate bravery. He then ſat down before Turkiſh Gradiſca; but the autumnal rains coming on with ſuch violence that the Saave overflowed its banks, he was compelled to raiſe the ſiege. During this period the war in the Bannat raged with the utmoſt violence; torrents of blood were ſhed on both ſides; much deſperate valour diſplayed on the one ſide, and many brave actions performed on the other; while a very great part of that fine but unfortunate country ſuffered all the deſolation and ruin that fire and ſword, under the dominion of vengeance and animoſity, could inflict. The inhabitants were objects of commiſeration; but the injuſtice with which the emperor had commenced the war made his perſonal loſſes be conſidered as nothing more than the due reward of his conduct.

Hitherto the Ruſſians had hardly entered into the war; but at laſt they began to act with vigour both by ſea and land. They experienced however a very general coldneſs with reſpect to their claims, pretenſions, and deſigns, in almoſt all the courts of Europe. The court of London prohibited Britiſh ſeamen from entering into foreign ſervice, and declared its reſolution to obſerve the ſtricteſt neutrality. The united provinces of Holland purſued the ſame line of conduct; and ſome of the ambitious views of Ruſſia were thus blaſted. It the mean time a vaſt Ruſſian army, eſtimated at 150,000 men, appeared on the banks of the river Bog, adjoining to the confines of Poland, Turkey, and Tartary, and on the way to the Black Sea, under the orders of prince Potemkin and general Romanzow; theſe being aſſiſted by prince Repnin, general Soltikow, and other commanders of note. This great force was ſupported by a field train of 137 pieces of artillery, beſides a vaſt park of heavy battering cannon and mortars, deſtined for the ſiege of Oczakow; and furniſhed with that exuberance of powder, ball, ſhells, and all manner of military machines, which are the uſual concomitants of a Ruſſian army. After the moſt obſtinate defence, Oczakow was taken on the 17th of December 1788, and the governor baſha graced the triumphant return of prince Potemkin to Peterſburgh. In the mean time Ruſſia found herſelf attacked by a new and formidable enemy in the Swediſh monarch, of whoſe exploits we have given an account elſewhere (ſee SWEDEN, n° 246.); and by his interference her conqueſts were certainly retarded.

89 Ruſſians take Oczakow.

90 Gradiſca and Belgrade taken by Laudohn.

Marſhal Laudohn renewed his attempts upon Gradiſca as ſoon as the ſeaſon would permit, and after a brave defence it fell into his hands. This with ſome other ſucceſſes rouſed the emperor from his inactivity, and made him ſeriouſly determine upon the attack which he had long meditated upon Belgrade. The enterprize was entruſted to Laudohn, who, with that good fortune which ſeemed conſtantly to attend him, made himſelf maſter of the place in leſs than a month. The reſt of the campaign was little elſe than a ſucceſſion of the moſt important ſucceſſes; and a circumſtance that did not a little contribute to this, was the ſyſtem adopted by the Auſtrians and Ruſſians, of ſuffering the Turkiſh troops to march out of the ſeveral places they garriſoned without moleſtation. Accordingly, while one detachment of general Laudohn's forces took poſſeſſion of Czernitz in Walachia, another made itſelf maſter of Cladova in Servia. Buchareſt, the capital of the former of theſe provinces, fell without oppoſition into the hands of prince Cobourg: while Akerman on the Black Sea was reduced by the Ruſſians; and Bender ſurrendered to prince Potemkin, not without ſuſpicion of ſiniſter practices, on the 15th of November.

91 The emperor dies, and his ſucceſſor concludes a peace.

Soon after this, the emperor Joſeph died, and his ſucceſſor Leopold ſhowed a deſire for peace. After the reduction of Orſova, therefore, which happened on the 16th of April 1790, the war was carried on with languor on the part of Auſtria; and in the month of June a conference was agreed upon at Reichenbach, at which the miniſters of Pruſſia, Auſtria, England, and the United Provinces, aſſiſted, and at which alſo an envoy from Poland was occaſionally preſent. After a negotiation, which continued till the 17th of Auguſt, it was agreed that a peace ſhould be concluded between the king of Hungary and the Ottoman Porte; that the baſis of this treaty ſhould be a general ſurrender of all the conqueſts made by the former, retaining only Choczim as a ſecurity till the Porte ſhould accede to the terms of the agreement, when it was alſo to be reſtored. Catherine was thus deprived of an ally, but ſtill ſhe continued the war. On the 22d of December 1790, the fortreſs of Iſmail was taken by ſtorm by general Suwarrow; and it is ſaid that the ſiege and the capture did not coſt the Ruſſians leſs than 10,000 men. The moſt ſhocking part of the tranſaction is, that the garriſon (whoſe bravery merited, and would have received from a generous foe, the higheſt honours) were maſſacred in cold blood by the mercileſs Ruſſians, to the amount of, by their own account, upwards of 30,000 men; and the place was given up to the unreſtrained fury of the brutal ſoldiery. After this bloody ſcene, the Ruſſians went into winter quarters; the vizir retired towards Conſtantinople, and on his return fell a ſacrifice to the ſanguinary policy which has long diſgraced the Ottoman counſels.

92 Succeſs of the Ruſſians.

The campaign of 1791 opened on the part of Ruſſia with the taking of Maczin, on the 4th of April, by prince Gallitzin; and in a ſubſequent victory on the 12th by the ſame general, in the neighbourhood of Brailow, the Turks loſt not leſs than 4000 men and upwards of 100 officers, beſides many pieces of cannon. On the 14th the Ruſſian arms experienced a check, by which they loſt about 700 men, and were obliged to relinquiſh the intention of beſieging Brailow. After reinforcing this place, the vizir proceeded to the banks of the Danube near Siliſtria; and, by means of a bridge which he threw acroſs the river, his advanced poſts were enabled to make incurſions on the oppoſite ſide. The ability of the vizir and the valour of the Turks were however exerted in vain againſt the diſcipline and experience of European armies. In the month of June, 15,000 Turks were defeated by a party of cavalry under general Kutuſow. On the 3d of July the fortreſs of Anape was taken by general Gudowitſch, and the garriſon, to the amount of 6000 men, made priſoners. This event was followed, on the 9th of the ſame month, by a ſignal victory which prince Repnin obtained near Maczin over a body of 70,000, the flower of the Turkiſh army. The Ottomans left upwards of 4000 dead upon the field of battle, and loſt their entire camp equipage, colours, and 30 pieces of cannon. The Ruſſians are ſaid to have loſt only 150 men killed, and between 200 and 300 wounded.

93
Peace is at laſt concluded.

At laſt peace was reſtored between the Porte and Ruſſia, principally through the mediation of Great Britain and the northern powers. Catherine, who talked high at firſt, confined her views at length to the poſſeſſion of Oczakow, with the diſtrict extending from the Bog to the Nieſter, and even then providing for the free navigation of the latter river. Theſe terms, conſidering the ill ſucceſs of the war, cannot be accounted very diſadvantageous to the Porte, who has loſt a fortreſs more uſeful for the purpoſe of annoying Ruſſia than for defending their own territories; but certainly of conſiderable importance to Ruſſia, which, by this ceſſion, has ſecured the peaceable enjoyment of the Crimea.

94
Account of the Turkiſh dominions.

The Turkiſh empire comprehends ſeveral countries in Europe, Aſia, and Africa. In Europe it is bounded on the ſouth by the Mediterranean; on the north by Croatia, Sclavonia, and Tranſylvania; on the eaſt by Poland, Ruſſia, and Aſia; and on the weſt by the Adriatic and Dalmatia. The principal countries of Turkey in Europe are Romania, Bulgaria, Servia, Walachia, Moldavia, Beſſarabia, Greece, Macedonia, Albania, Theſſaly, Levadia, Morea, and the Archipelago iſlands. Turkey in Aſia is divided into Eaſtern and Weſtern. The eaſtern comprehends Georgia, Turcomania, and Diarbekr: and the Weſtern, Anatolia, or Aſia Minor, Syria, and Paleſtine.—In Africa the Turkiſh dominions are Egypt, and ſome diſtricts of Barbary. But for an account of theſe different countries, ſee the articles as they occur in the order of the alphabet.

95
Of the government, &c. in Turkey.

The grand ſignior, or emperor of the Turks, is reſtrained by no laws or compacts, the government being purely monarchical: but if he indulges not the humours of the people, and eſpecially of the mutinous janiſaries, he is in danger not only of being depoſed, but alſo of being put to death. Thoſe who have offices under the government he ſqueezes, diſgraces, and puts to death, upon the leaſt ſuggeſtion of their diſaffection or miſconduct, without giving them an opportunity of anſwering for themſelves, they being looked upon as more immediately his ſlaves: but others ſeem to enjoy almoſt as great a degree of ſecurity, both in their perſons and properties, as the ſubjects of other abſolute monarchies. Indeed, in all ſuch there is a gradation of governors and officers, of which the higher fleece and oppreſs thoſe below them, and the loweſt make repriſals upon the common people. In the ſucceſſion to the empire, no regard is paid to age or birthright, the Turks thinking it ſufficient if, in their elections, they keep to the family. Women are excluded from the throne. The emperor's council is either ordinary or extraordinary. The firſt, meeting every Sunday and Thurſday, conſiſts of the great officers of ſtate, and is called the *galibe divani*. To the other, which is called *ajack divani*, are ſummoned all the great perſons and officers of the empire, and even the oldeſt and moſt experienced ſoldiers. The ſultan hears what paſſes from an adjoining chamber. At the head of the miniſtry is the grand vizir, who is as it were his lieutenant-general, with whom he divides, or rather to whom he leaves, the care of the whole empire; he being entruſted not only with the finances, with foreign affairs, and the adminiſtration of juſtice in civil and criminal matters, but alſo with the conduct of the war, and the command of the army. Great and dangerous as this charge is, there have been men who have executed it with ſafety and ſucceſs both in peace and war, and have died quietly in their beds; but that is not the caſe with the moſt of them, it being the uſual policy of the emperors to ſhelter themſelves from the clamours of the people by throwing the whole blame of any mal-adminiſtration upon him, and giving him up to the public reſentment. His income, without any breach of probity, may amount to 600,000 dollars, excluſive of preſents and other perquiſites. Notwithſtanding his high dignity, his palace is open to every one, and he gives audience to the meaneſt of the poor. When the ſultan names a grand vizir, he puts into his hand the ſeal of the empire; and when he honours him with the command of an army, he takes out one of the plumes of his own turban at the head of the troops, and delivers it to him to place it in his own. The other great officers of ſtate are the kaimakan, or vizir's deputy, not to be confounded with the governor of Conſtantinople, who is alſo called *kaimakan*; the vizirs of the bench, or baſhas of three horſe-tails, becauſe three horſe-tails are carried before them when they march, and who ſit in the divan or courts of juſtice with him; the kadinlaſquiers, or chief juſtices of provinces; the beiglerbegs or viceroys, of which the chief are thoſe of Romelia, Natolia, and Damaſcus; the ordinary baſhas or governors of towns and diſtricts under the beiglerbegs; the reis effendi, or lord chancellor and ſecretary of ſtate; the teſterder or high treaſurer; the aga of the janiſaries; the aga of the ſpahis; the aga of the ſiluds, &c. The chief officers of the ſeraglio are the kiſlaragaſi, who is ſuperintendant of the women, and has the command of all the black eunuchs; the capi aga, who has the command of all the white eunuchs, and to whom all petitions to be preſented to the prince are delivered. Both theſe are alſo eunuchs, and of the ſame complexion as thoſe of whom they have the command. Beſides the women and eunuchs, there are in the ſeraglio the ichoglans and azamoglans, mutes, dwarfs, and buffoons, The ichoglans are young men bred up in the ſeraglio, not only to ſerve about the prince, but to fill in time the firſt poſts of the empire. The azamoglans are trained up there for inferior employments.

No children are admitted into the ſeraglios of Conſtantinople, Pera, or Adrianople, till they are firſt reviewed and approved of by the grand ſignior. They are generally the moſt beautiful, well-made, and ſprightly, that can be met with. They are firſt taught, after being circumciſed, ſilence and a modeſt humble behaviour. Then they are inſtructed in the Mohammedan religion, to ſpeak and write the Turkiſh language, and afterwards the Perſian and Arabic. As they grow up, they are taught manly exerciſes, and whatever is thought requiſite to qualify them for ſtate-employments: but they are ſeldom preferred out of the ſeraglio until the age of 40.

The ladies of the haram are a collection of young beautiful virgins, either the preſents of governors, purchaſed, or captives taken in war; moſt of them being the children of Chriſtian parents. They are taught muſic, dancing, and other accompliſhments, and furniſhed with the richeſt clothes and ornaments. Some of them frequently play and dance before the grand ſignior, while others divert him with their converſation. They have a great many female ſlaves to wait on them; but are ſcarce ever ſuffered to go abroad, except when the grand ſignior changes his place of reſidence; when a troop of black eunuchs convey them to the boats, which are encloſed with lattices: and when they go by land, they are put into cloſe chariots, and ſignals made at certain diſtances, to give notice that none may approach the road through which they are to paſs.

96 Dreſs, manners, &c. of the Turks.

The Turks are generally robuſt and well-ſhaped, of a good mien, and patient of hardſhips, which render them fit for war. They ſhave their heads; but wear their beards long, except the military and thoſe in the ſeraglio, who wear only whiſkers. They cover their heads with a white linen turban of an enormous ſize, and never pull it off but when they ſleep. None but Turks muſt preſume to wear a white turban. Their breeches or drawers are of a piece with their ſtockings; and they have ſlippers inſtead of ſhoes, which they pull off when they enter a temple or houſe. They wear ſhirts, with wide ſleeves, not gathered at the wriſts, and over them a veſt tied with a ſaſh; their upper garment being a looſe gown, ſomething ſhorter than the veſt.

The women's dreſs pretty much reſembles that of the men; only they have a ſtiffened cap with horns, ſomething like a mitre, on their heads inſtead of a turban, and wear their hair flowing down. When they go abroad, they are ſo wrapped up, that their faces cannot be ſeen.

The Turks ſit, eat, and ſleep, according to the cuſtom of the eaſt, on ſophas or cuſhions, mattreſſes, and carpets. Rice is their moſt general food, and coffee their common drink. Their moſt uſual ſalutation is to bow the head a little, laying the right-hand on their breaſts; but to perſons of rank they ſtoop ſo low as to touch the border of their veſt. The women are kept under a rigorous confinement. They have generally delicate ſkins, regular features, black hair and eyes, with an admirable cheſt. Many of them are complete beauties. Their cleanlineſs is extraordinary; for they bathe twice a-week, and ſuffer not the ſmalleſt hair or the leaſt ſoil to be upon their bodies. As to the qualities of their minds, they are ſaid to want neither wit, vivacity, nor tenderneſs; and to be exceeding amorous. It is no doubt for this reaſon that the men never ſuffer their wives faces to be ſeen, not even by the deareſt friend they have in the world.

There is no need of much wit to behave one's ſelf well here; for a good mien and gravity ſupply the place of merit in the eaſt, and much gaiety would ſpoil all. Not that the Turks want wit; but they ſpeak little, and pride themſelves in ſincerity and modeſty more than eloquence. The Turks uſe no unneceſſary words, whereas the Greeks talk inceſſantly. Though theſe two nations are born under one climate, their tempers are more different than if they lived in the moſt diſtant countries. The Turks make profeſſion of candour and faithfulneſs, and are a charitable good-natured people, jealouſy excepted, and very ſober. On the other-hand, they are extremely proud, inſolent, indolent, ſuperſtitious, and covetous. They are alſo much addicted to unnatural luſt; and deſpiſe all other nations in general, eſpecially thoſe which are not of their religion. The common appellation that they give the Chriſtians is that of dogs. An uniformity runs through all the actions of the Turks, and they never change their manner of living. They ſeem to have no kind of genius for the improvement of the arts and ſciences, though they live under the influence of the ſame heaven, and poſſeſs the ſame countries, as the ancient Grecians did. They generally loiter away their time, either among the women in the haram, or in ſmoking or taking opium; and though they herd together, you will obſerve as little converſation among them as amongſt ſo many horſes in a ſtable. They ſeldom travel, or uſe any exerciſe or rural ſports; and diſcover little or no curioſity to be informed of the ſtate of their own or any other country: but Turkey, after all, is not without men of parts, probity, and honour; nor without benevolent, liberal, converſible, and ingenious people. They behave very commendably to their ſlaves and ſervants, and frequently better than the Chriſtians do to theirs. There are no hereditary governments or titles of nobility in Turkey; and indeed the commonalty there enjoys the greateſt liberty.

97 Languages and learning.

The languages ſpoken in Turkey in Europe are the Turkiſh and Tartarian, which have a great affinity to one another; the modern Greek, which differs widely from the ancient; the Sclavonian, and Walachian. The Arabic is the language of the learned. Learning is at a very low ebb among the Turks: however, they have ſome ſchools, colleges, and academies; but they are on a very different footing from thoſe among us. Not many years ſince a printing-houſe was ſet up at Conſtantinople, where books of all kinds were allowed to be printed, except on matters of religion. The moſt ingenious Muſſelmen employ themſelves in reading the Alcoran and the commentators upon it, to which almoſt all their learning is confined. Some of them amuſe themſelves with poetry, in which they are ſaid to ſucceed very well. Other Turks delight in muſic, and ſpend the whole day in playing upon an inſtrument, without being tired, though they only repeat the ſame tune. It is ſaid there are a great many manuſcripts in the Turkiſh, Arabian, and Perſian languages, among the Turks; but it is not to be ſuppoſed that they contain any very deep, ſolid, ingenious, or uſeful learning.

98 Forces.

The Turkiſh regular troops are the ſpahis and timarſpahis, who are light-horſe. The latter, who have eſtates in land aſſigned them inſtead of pay, are obliged to bring a certain number of ſlaves into the field with them. The tributary princes of Moldavia and Walachia, and the Crim Tartars, are alſo obliged to ſend auxiliaries. But the flower of the Turkiſh army conſiſts of the janiſaries, who amount to about 40,000, and are all infantry. They have particular privileges, being ſubject to no juriſdiction but that of their aga or commander. Their pay is three aſpers a-day, beſides victuals, and a ſuit of clothes every year. They are all lodged at Conſtantinople together in a ſort of barracks, having been educated in the ſeraglio, and trained up to the exerciſe of arms from their infancy. Beſides the janiſaries, there is another body of foot called *capis*. The whole Turkiſh army, regulars and irregulars, amounts to above 300,000 men. Beſides the true janiſaries, or janiſaries of the porte, and in actual pay, there are great numbers all over the empire, who procure themſelves to be regiſtered in this body, in order to be entitled to their privileges. The bachelors only are capable of bearing offices in the barracks or chambers at Conſtantinople. When any of the janiſaries are diſabled in the ſervice, they have an allowance for life. To diſtinguiſh them, they wear a cap of a particular make. The emperor's guards are compoſed of them, and they are feared and reſpected every where, though they carry only a cane in their hand; for arms are not delivered to them but when they take the field. The chief commanders of the army are diſtinguiſhed by two or three horſe-tails carried before them. The Turkiſh navy is not ſo conſiderable as might be expected in ſuch extenſive dominions, ſituated on ſeveral ſeas, and abounding in commodious harbours. By their neglecting navigation and foreign commerce, they can never find ſailors to man a great fleet; and thoſe they have are unſkilful, as well as their pilots and officers. If they would apply themſelves to navigation, and make the moſt of their ſituation and advantages, they could not fail to become a very formidable maritime power. Their navy generally conſiſts of about 40 large ſhips, excluſive of galleys. In time of war they hire or buy merchant-ſhips, and others are ſent them from Algiers, Tunis, and Tripoli. The captain-baſha, or admiral, is the ſecond officer in the empire, the grand vizir being the only officer above him. His power is abſolute when he is out of the Dardanelles; and not only the ſea-officers, but all the governors of the maritime provinces, receive orders from him. The pilots are moſtly Greeks, and the captains renegadoes. The captain-baſha ſails round the Archipelago, in ſummer, to collect the capitation-tax, and learn the ſtate of affairs in thoſe parts.

The revenues of the empire are paid either into the public treaſury, or into the ſultan's private treaſury. The former, called by the Turks *deitalmali muſlimim*, i. e. *the public money of the Muſſulmen*, is not to be touched but on the moſt preſſing exigency of the ſtate. The other the ſultan may diſpoſe of at pleaſure. Prince Cantimir ſays, in his time, 27,000 purſes, amounting to 13,000,000 and a half of crowns, were annually returned to both treaſuries; ariſing from the produce of the cuſtoms, demeſne lands, the capitation or tax paid by every ſubject of the empire who is not of the Mahometan religion; the annual tributes paid by the cham of the Crim Tartars, the princes of Moldavia, Walachia, the little republic of Raguſa, and part of Mingrelia; together with half a million of money out of a million and a half levied annually in Egypt. Theſe are the fixed revenues: but vaſt ſums are alſo raiſed by the confiſcations of the eſtates and effects of the baſhas and other officers, and from the eſtates of Turks dying without male iſſue.

The manufactures and commodities of Turkey are, ſilks, carpets, goat's hair, wool, camel's hair, cotton-yarn, dimity, burdets, waxed linen, ſhagreen-ſkins, blue, red, and yellow Morocco leather; coffee, rhubarb, turpentine, ſtorax, gums, opium, galls, maſtic, emery, lemnian bole, pomegranate-ſhells, ſponges, dates, almonds, wine, oil, figs, raiſins, mother-of-pearl, boxwood, ſaffron, &c. Theſe are exported in large quantities by the ſeveral European trading nations, who import their own goods and purchaſe thoſe of the country. The inland trade is carried on chiefly by the Jews and Armenians; and even the Turks ſend merchandiſe, both by land and water, from one part of the empire to another, but not to foreign Chriſtian countries. No nation is more advantageouſly ſituated for traffic than the Turkiſh; having the navigation of the Black Sea, the Levant, and the Red Sea; and conſequently greater opportunities of importing the rich merchandiſes of the Eaſt, and diſtributing them all over Europe, than any maritime power: but they never attempt diſtant voyages, and have but few merchant-ſhips, both their imports and exports being chiefly made in foreign bottoms. Tyre, Sidon, and Alexandria, which once commanded the navigation and trade of the world, are in their poſſeſſion, but make no figure in commerce at this day: and well it is for the Chriſtians that the Turks are ſuch an indolent generation; for their ſituation and vaſt extent of empire would enable them to monopolize the trade of the world, if they attended to it. Several European Chriſtian nations have envoys and reſidents at Conſtantinople, and conſuls in other ports. In this empire there is a great traffic in the human ſpecies: not only male ſlaves, but beautiful young girls, being publicly bought and ſold.

The empire is ſtyled the Ottoman kingdom or empire, the Ottoman Porte, the Sublime Porte, the Sublime Sultanian Porte, &c. The appellation of *Porte* is ſaid to be derived from the large gate built by Mohammed II. at the entrance of the ſeraglio at Conſtantinople; though the Orientals in general call a royal palace the *king's porte* or *gate*.

TURMERIC, in botany. See Curcuma.

TURNEBUS (Adrian), an eminent French critic, was born in 1512. His true name was Turnbull. He was the ſon of a Scotchman, an officer in the Scotch troop of guards, who married a Norman lady. The ſon, who is the ſubject of this article, changed his name into Tourneboeuf; but this name giving occaſion for puns, he varied it to Turnebe, in Latin Turnebus. He acquired ſo extenſive a reputation by his learning, that he had great offers made him from Italy, Germany, and England; but we are told he preferred poverty in his own country to riches in any other. He taught polite literature firſt at Toulouſe; but in 1547 went to be Greek profeſſor at Paris, whither his name drew ſcholars to him from all parts of Europe: in 1552, he took upon him the care of the royal Greek preſs for three years, when he quitted it on being admitted into the number of royal profeſſors. He died in 1565; and his works, which are all in Latin, were printed at Straſburg, in one vol. folio, 1600. His *Adverſaria*, 3 vols. folio, had been printed at Paris before.

TURNEP, in botany, a ſpecies of Brassica. For the culture of them, ſee Agriculture, n° 151.

Turnep-Bread. See Bread.

Turnep-Fly. See Chrysomala.

TURNING, the art of forming hard bodies, as wood, ivory, iron, into a round or oval ſhape by means of a machine called a *lathe*.

This art was well known to the ancients, and ſeems to have been carried by them to a very great degree of perfection; at leaſt, if we believe the teſtimony of Pliny and ſeveral other authors, who tell us, that that thoſe precious vaſes enriched with figures in *half-relief*, which ſtill adorn our cabinets, were turned on the lathe.

The art of turning is of conſiderable importance, as it contributes eſſentially to the perfection of many other arts. The architect uſes it for many ornaments, both within and without highly finiſhed houſes. The mathematician, the aſtronomer, and the natural philoſopher, have recourſe to it, not only to embelliſh their inſtruments, but alſo to give them the neceſſary dimenſion and preciſion. In ſhort, it is an art abſolutely neceſſary to the goldſmith, the watchmaker, the joiner, the ſmith.

Turning is performed by the lathe, of which there are various kinds, and ſeveral inſtruments, as gouges, chiſels, drills, formers, ſcrew-tales, uſed for cutting what is to be turned into its proper form as the lathe turns round. One of the moſt ſimple kinds of lathe is repreſented in Plate DXI. fig. 1. in which *a* is the footſtool, *b* the cord, *c* the frame of the lathe, *d d* the puppets, *e e* the points, *f* the ſpanging-tree.

The lathe ſhould be fixed in a place very well lighted; it ſhould be immoveable, and neither too high nor too low. The puppets ſhould neither be ſo low as to oblige the workman to ſtoop in order to ſee his work properly, nor ſo high that the little chips, which he is continually driving off, ſhould come into his eyes.

The piece to be turned ſhould be rounded (if it be wood) before it be put on the lathe, either with a ſmall hatchet made for the purpoſe, or with a plane, or with a file, fixing it in a viſe, and ſhaving it down till it is everywhere almoſt of an equal thickneſs, and leaving it a little bigger than it is intended to be when finiſhed off. Before putting it on the lathe, it is alſo neceſſary to find the centres of its two end ſurfaces, and that they ſhould be exactly oppoſite to each other, that when the *points* of the puppets are applied to them, and the piece is turned round, no ſide may belly out more than another. To find theſe two centres, lay the piece of wood to be turned upon a plank; open a pair of compaſſes to almoſt half the thickneſs of the piece; fix one of the legs in the plank, and let the point of the other touch one of the ends of the piece, brought into the ſame plane with the plank on which the compaſſes are fixed and very near the fixed leg. Deſcribe four arches on that end at equal diſtances from each other at the circumference of the end, but interſecting one another within; the point of interſection is the centre of the end. In the ſame manner muſt the centre of the other end be found. After finding the two centres, make a ſmall hole at each of them, into which inſert the points of the puppets, and fix the piece ſo firmly as not to be ſhaken out, and yet looſe enough to turn round without difficulty.

The piece being thus fixed, it is neceſſary in the next place to adjuſt the cord, by making it paſs twice round the piece, and in ſuch a manner that the two ends of the cord, both that which is fixed to the *ſpang* and to the *foot-board*, come off on the ſide on which the turner ſtands, that the piece may move againſt the edge of the cutting-tool and be turned. If the lathe be moved by a wheel, the manner of adjuſting the cord needs no directions.

If the workman does not chooſe to be at trouble to find the two centres of the piece in the manner deſcribed above, let him lay, as nearly as he can, the centre of one end upon the *point* of the left hand *puppet*, and then let him puſh forward the right hand puppet, ſtriking it with a mallet till its point is as near as he can in the centre of the other end of the piece; and then fixing the right hand puppet by a gentle blow of the mallet on the key, let him turn round the piece to ſee by the eye if the centres have been properly found. If any part of it bellies out, let him ſtrike that part gently with the mallet till it goes properly; then let him ſtrike one of the puppets pretty ſmartly to drive the points into the piece, and afterwards fix the puppet by ſtriking the key. If the workman cannot judge by the eye whether the piece be turning properly round its centres or not, he ſhould apply gently the point of an inſtrument called a *triangular graver*, leaning it on the *reſt*, and it will mark by a line the place where the piece is out of its centre; and by ſtriking upon this line with a mallet, the piece can eaſily be placed properly. The *reſt*, of which we have juſt ſpoken, ought to be placed upon the two arms of the lathe, and fixed with ſcrews as near the piece as the workman pleaſes.

The piece being fixed between the two points of the puppets (or, as they are called in Scotland, the *heads*), the cord adjuſted, and the *reſt* fixed as near the work as poſſible without touching it; the workman is now to take a *gouge* (fig. 2. in which *a* is the mouth and *b* the handle) of a proper ſize in his left hand, and hold it by the handle a little inclined, keeping the back of the hand lowermoſt. With his right hand, the back of which is to be turned upwards, he is to graſp it as near the end as poſſible on this ſide of the *reſt*; then leaning the gouge on the *reſt*, he is to preſent the edge of it a little higher than the horizontal diameter of the piece, ſo as to form a kind of tangent to its circumference; then putting the right foot on the foot-board, and turning round the wheel, and holding the gouge firmly on the *reſt*, the piece will be cut neatly. In the ſame manner are the chiſels, formers, and other inſtruments to be uſed, taking care that the wood be cut equally, and that the inſtrument be not puſhed improperly, ſometimes ſtronger than at others; and taking care alſo that the inſtrument uſed do not follow the work, but that it be kept firmly in the hand without yielding.

The young turner ought to endeavour to acquire the management of the gouge and the chiſel, which are the inſtruments by far the moſt frequently uſed, and the moſt neceſſary in this art: by them, almoſt entirely, are the ſoft woods *turned*; for as for hard woods and other things, as box, ebony, horn, ivory, and the metals, they are hardly ever turned except by *ſhaving off*. In that caſe gravers are to be uſed with ſquare, round, or triangular mouths (fig. 3, 4, 5.). They ſhould be held horizontally while applied to the wood, and not obliquely as directed for the gouge and the chiſel.

After the work is completely turned, it is next to be poliſhed; and this cannot be done with the inſtruments hitherto mentioned. Soft woods, as pear-tree, hazle, maple, ought to be poliſhed with ſhark-ſkin or Dutch ruſhes. There are different ſpecies of ſharks; ſome of which have a greyiſh, others a reddiſh ſkin. Shark-ſkin is always the better to be a good deal uſed; at firſt it is too rough for poliſhing. The *Dutch-ruſh* is the *equiſetum hyemale* of Linnæus, which grows in moiſt places among mountains, and is a native of Scotland; it has a naked, ſimple, round ſtem, about the thickneſs of a writing pen. The oldeſt plants are the beſt. Before uſing them they ſhould be moiſtened a little, otherwiſe they break in pieces almoſt immediately, and render it exceedingly difficult to poliſh with them. They are particularly proper for ſmoothing the hard woods, as box, lignum vitæ, ebony, &c. After having cleaned up the piece well, it ſhould be rubbed gently either with wax or olive-oil, then wiped clean and rubbed with its own raſpings or with a cloth a little worn. Ivory, horn, ſilver, and braſs, are poliſhed with pumice-ſtone finely pounded and put upon leather or a linen cloth a little moiſtened: with this the piece is rubbed as it turns round in the lathe; and to prevent any dirt from adhering to any part of it, every now and then it is rubbed gently with a ſmall bruſh dipt in water. To poliſh very finely, the workmen make uſe of tripoli, a particular kind of earth, and afterwards of putty or calx of tin. Iron and ſteel are poliſhed with very fine powder of emery; this is mixed with oil, and put between two pieces of very tender wood, and then the iron is rubbed with it. Tin and ſilver are poliſhed with a burniſher and that kind of red ſtone called in France *ſanguine dune*. They may be poliſhed alſo with putty, putting it dry into ſhammy-ſkin, or with the palm of the hand.

To ſucceed in turning iron, it is neceſſary to have a *lathe* exceedingly ſtrong in all its parts, and exceedingly well fixed. The puppets ſhould be ſhort, and the *reſt* well fixed very near the work: the back of the reſt ſhould be two or three lines lower than the iron to be turned.

The lathe and other inſtruments being prepared, it is neceſſary to determine the length and thickneſs of the iron to be turned according to the deſign which is to be executed, and to make a model of it in wood a little thicker than it ought to be: Then one exactly like this is to be forged of the beſt iron that can be procured; that is to ſay, it muſt not be new, but well prepared and well beaten with hammers; it muſt have no flaws, nor cracks, nor pimples. New iron, which has not been well beaten, often contains round drops of caſt iron, called by the workmen *grains*, which blunt the edges of the gouges, chiſels, and other inſtruments uſed for cutting; break them, or make them ſlide. The iron being forged according to the model, it ſhould be annealed, that is, heated red hot and allowed to cool ſlowly on the coals till the fire go out of itſelf. Some people, to ſoften the iron, cover it over with clay and allow it to cool. The iron cylinder being thus made, it is next to be put upon the lathe, finding the centres as formerly directed, and boring a ſmall hole in them that the iron may not eſcape from the points.

The points ſhould be oiled from time to time to prevent their being exceſſively heated and ſpoiled while the iron is turning. A *crotchet* is then to be applied to the iron to be turned, a little above its centre, pretty gently, and by this means the inequalities of the cylinder will be taken off. Other inſtruments are then to be applied to mould the iron according to the model; and whenever any of them grow hot, they are to be plunged into a baſon of water lying beſide the workman. If the iron, after being properly turned, is to be bored like a gun-barrel, one of the puppets is to be removed and another ſubſtituted in its place, having a ſquare hole through it, into which the collar of the iron is to be fixed firmly, ſo as not to ſhake; then borers are to be applied, like thoſe which lockſmiths uſe to bore keys; and beginning with a ſmall one, and afterwards taking larger ones, the hole is to be made as wide and deep as neceſſary; great care muſt be taken to hold the borers firm on the *reſt*, otherwiſe there is danger of not boring the hole ſtraight. The borer muſt be withdrawn from time to time to oil it and to clean the hole. Since it is difficult to make a hole quite round with borers alone, it is neceſſary to have alſo an inſtrument a good deal ſmaller than the hole, one of the ſides of which is ſharp, very well tempered, and a little hollow in the middle. This inſtrument being fixed in a pretty long handle, is to be applied with ſteadineſs to the inner ſurface of the hole, and it will entirely remove every inequality that may have been there before its application.

We ſhall now deſcribe the manner of cutting a ſcrew upon our cylinder. Some perſons make uſe of an inſtrument, conſiſting principally of a female ſcrew, for this purpoſe: but this is rather an improper inſtrument; for if one preſſes too violently, or inclines it ever ſo little to the right or left, he runs the greateſt riſk of ſpoiling the ſcrew. To avoid this danger, ſome perſons uſe it only to trace out the lines of the ſcrew, and afterwards finiſh it with a file. But there is a much better way of cutting a ſcrew; and it is this. Take a tap for making a female ſcrew, the threads of which have been cut very accurately, and exactly of the ſize of the ſcrew which you want; and having put it in the opening which you have traced in the collar of the axis on which the ſcrew is to be cut, ſolder it with tin, ſal-ammoniac, and roſin, as exactly correſponding to the axis as poſſible. Take then a puppet with a hole cut into a correſponding female ſcrew, into which the male ſcrew is to be put. The axis on which the ſcrew is to be cut muſt be placed exactly horizontally between the two puppets. The *reſt* is then to be brought as near as poſſible to the place where the ſcrew is to be cut, and a ſmall hollow ſhould be cut in that part of it which is exactly oppoſite to the place where the ſcrew is to be cut, to hold your inſtrument firmly and prevent it from ſhaking. The inſtrument with which the ſcrew is to be cut ſhould be very ſharp, and its point ſhould make an angle of 60° with the ſcrew to be cut; and if you wiſh the ſcrew to be cut very deep, it ſhould make an angle a little larger. The lathe being now put in motion, the tap fixed at the end of the axis will move gradually through the female ſcrew in the puppet; and your inſtrument in the mean time will trace a ſimilar male ſcrew on the axis fixed in the lathe. Many perſons, after having in this manner drawn the outlines of the ſcrew, finiſh it with a ſcrew-tale of three teeth correſponding exactly to the ſize of the ſcrew, or with a triangular file; but this laſt method is rather improper.

This is the exacteſt method of cutting ſcrews. There is another method deſcribed by F. Plumier, which may ſometimes be of uſe. "Cut (ſays he) a ſmall fillet of paper large enough to cover that part of the axis which you mean to cut into a ſcrew: then mark upon the two borders of it, which join when it is rolled on the axis, the largeneſs of the teeth of the ſcrew with a compaſs. Having thus marked the whole border at equal diſtances, draw a ſtraight line from the firſt point of the border to the ſecond, from the ſecond to the third, and ſo on. You will have ſeveral oblique parallel lines equally diſtant from one another. Wrap the fillet of paper thus marked upon the part of the axis on which the ſcrew is to be traced, ſo that the borders of it touch without overlapping each other: then all the extremities of theſe lines meeting mutually, will trace out a very exact ſcrew; and this you will mark upon the axis by means of a knife formed into a kind of fine ſaw by the edge of another knife. This firſt trace you are carefully to enlarge with a ſmall file till it becomes large enough to admit the edge of a three-cornered file; with which you cut a little; then, taking a proper ſcrew-tale, you introduce it into the hollows already made; and turning the lathe, you are to follow the hollow of the ſcrew with this inſtrument till the ſcrew is finiſhed."

For turning ovals, a lathe of ſomewhat a different conſtruction is uſed. The axis or ſpindle, having on it the pulley over which the band-cord paſſes for turning the lathe, is fixed between the two puppets ſo as to turn round eaſily; one end of it paſſes through one of the puppets, and to it is firmly fixed a circular plate of braſs, ſo that it turns round along with the ſpindle. Upon this plate two brazen ſegments of circles are faſtened, the circumferences of which correſpond to the circumference of the plate: their chords are parallel, and equally diſtant from the centre of the plate, ſo that they leave a diſtance between them. They have a groove in each of them: in theſe grooves another plate is placed which exactly fills up the ſpace between the two grooves, but is ſhorter than the diameter of the larger circular plate on which it is laid. This plate is made to ſlide in the grooves. To its centre is fixed a ſhort ſpindle, on which the piece of wood to be turned is fixed. When the lathe is ſet a-going, the circular plate moves round, and carries the piece along with it; the plate of braſs on which the piece is fixed being fixed looſely in the grooves already deſcribed, ſlides down a little every time that the grooves become perpendicular to the floor (and there are particular contrivances to prevent it from ſliding down too far); and by theſe two motions combined, the circular one of the large plate, and the ſtraight one of the ſmall, the circumference of the piece of wood to be turned neceſſarily deſcribes an oval; and gouges or other tools being applied in the uſual manner ſupported on the *reſt*, it is cut into an oval accordingly. The ſmall plate may be made to ſlide either more or leſs in the grooves; and by this contrivance the tranſverſe diameter of the oval, or rather ellipſe, may be made longer or ſhorter at pleaſure. Another, and ſtill ſimpler method, if poſſible, of turning ovals, is this: Take two ovals of metal, exactly of the ſize of the oval which you intend to make; fix them firmly on the ſpindle of the lathe ſo as to turn round with it: fix between them the wood to be turned; and then it is eaſy, by the help of chiſels and other tools, to cut it, as the lathe goes into exactly the figure of the external ovals. Or an oval may be formed by placing the wood, or whatever is to receive that ſhape, obliquely on the lathe. There are ſeveral other ingenious methods of turning; but our bounds do not permit us to enter upon them. We ſhall therefore conclude this article with a number of receipts which every turner ought to know.

1. *The method of moulding boxes both of ſhell and horn.*—In the firſt place, form a proper mould, which muſt conſiſt of two pieces, *viz.* of a circle about half an inch thick, which ſhould ſlope a little in order to draw out the moulded ſhell the more eaſily; and a ring fitted to the outſide

of the circle, ſo that both together make the ſhape of a box. Theſe two pieces being adjuſted, it is neceſſary to round the ſhell to be moulded of ſuch a ſize that, when moulded, it will be a little higher than the ring of the mould, that there may be no deficiency. The mould is then to be put into a preſs on a plate of iron, exactly under the ſcrew of the preſs; put then the ſhell upon the circle of the mould, ſo that its centre alſo is exactly oppoſite to the ſcrew of the preſs: then take a piece of wood formed into a truncated cone, and not ſo thick as the diameter of the circle of the mould, nor ſo deep as the ring: then put a plate of iron above the cone, and ſcrew down the preſs gently and cautiouſly till the whole is well fixed: then plunge the whole into a cauldron of boiling water placed above a fire. In 8 or 10 minutes the ſhell or horn will begin to ſoften; ſcrew the preſs a little firmer that the wooden cone may ſink into the ſoftened ſhell: repeat this from time to time till the cone is quite ſunk in the mould; then take out the preſs and plunge it into cold water. When it is cold, take the box now formed out of the mould, and put into the inſide of it a new mould of tin exactly of the form you wiſh the inſide of the box to be; do the ſame with the outſide, put it again into the preſs and plunge it into boiling water; ſcrew the preſs gradually till the box be faſhioned as you deſire.

2. *Method of preparing green wood ſo that it will not ſplit in the turning.*—Having cut your wood into pieces of a proper ſize, put it into a veſſel full of a ley made with wood aſhes. Boil it there about an hour; then, taking the cauldron off the fire, allow the ley to cool; then take out the wood and dry it in the ſhade.

3. *Method of giving an ebony-black to hard and fine woods.*—After forming the wood into the deſtined figure, rub it with aquafortis a little diluted. Small threads of wood will riſe in the drying, which you will rub off with pumice-ſtone. Repeat this proceſs again, and then rub the wood with the following compoſition: Put into a glazed earthen veſſel a pint of ſtrong vinegar, two ounces of fine iron-filings, and half a pound of pounded galls, and allow them to infuſe for three or four hours on hot cinders. At the end of this time augment the fire, and pour into the veſſel four ounces of copperas (ſulphat of iron), and a quart of water having half an ounce of borax and as much indigo diſſolved in it; and make the whole boil till a froth riſes. Rub ſeveral layers of this upon your wood; and when it is dry, poliſh it with leather, on which you have put a little tripoli.

4. *Method of giving to plum-tree the colour of brazil wood.*—Slack lime with urine, and bedaub the wood over with it while it is hot: allow it to dry; then take off the coat of lime and rub it with ſhamoy ſkin well oiled. Or, ſteep your wood in water, having a quantity of alum diſſolved in it: then, having allowed brazil wood to diſſolve in water five or ſix hours, ſteep your wood in it, kept lukewarm during a night; and when it is dry, rub it, as before directed, with ſhamoy ſkin well oiled.

5. *Method of giving a fine black colour to wood.*—Steep your wood for two or three days in lukewarm water in which a little alum has been diſſolved; then put a handful of logwood, cut ſmall into a pint of water, and boil it down to leſs than half a pint. If you then add a little indigo, the colour will be more beautiful. Spread a layer of this liquor quite hot on your wood with a pencil, which will give it a violet colour. When it is dry, ſpread on another layer; dry it again and give it a third: then boil verdegriſe at diſcretion in its own vinegar, and ſpread a layer of it on your wood: when it is dry, rub it with a bruſh, and then with oiled ſhamoy ſkin. This gives a fine black, and imitates perfectly the colour of ebony.

6. *Method of cleaning and whitening bones before uſing them.*—Having taken off with a ſaw the uſeleſs ends of the bones, make a ſtrong ley of aſhes and quick lime, and into a pailful of this ley put four ounces of alum, and boil the bones in it for an hour; then take the veſſel containing the ley off the fire and let it cool; then take out the bones and dry them in the ſhade.

7. *Method of ſoldering ſhells.*—Clean the two ſides of the ſhells which you wiſh to join together; then, having joined them, wrap them up in linen folded double and well moiſtened; then heat two plates of iron pretty hot that they may keep their heat for ſome time; and putting your ſhells rolled up between them under a preſs, which you muſt ſcrew very tight, leave them there till the whole is cold, and they will be ſoldered. If you do not ſucceed the firſt time, repeat the proceſs.

8. *Method of moulding ſhells.*—Put ſix pints of water into a kettle; add to it an ounce of olive or other oil; make the water boil; then put in your ſhell, and it will grow ſoft. Take it out and put it into a mould under a preſs, and it will take the figure you want. This muſt be done quickly: for if the ſhell cool ever ſo little, the proceſs will fail. It will not require much preſſure.

9. *Method of tinging bones and ivory red.*—Boil ſhavings of ſcarlet in water. When it begins to boil, throw in a quarter of a pound of aſhes made from the dregs of wine, which will extract the colour: then throw in a little rock alum to clear it, and paſs the water through a linen cloth. Steep your ivory or bone in aquafortis, and put it into the water. If you wiſh to leave white ſpots, cover the places deſtined for them with wax.

10. *To tinge ivory black.*—Steep the ivory during five or ſix days in water of galls with aſhes made with dried dregs of wine and arſenic; then give it two or three layers of the ſame black with which plum-tree is blackened, in order to imitate ebony. Or, diſſolve ſilver in aquafortis, and put into it a little roſe water. Rub the ivory with this, and allow it to dry in the ſun.

11. *Method of hardening wood to make pulleys.*—After finiſhing the pulley, boil it ſeven or eight minutes in olive oil, and it will become as hard as copper.

12. *To make Chineſe varniſh.*—Take of gum lac in grains four ounces; put it into a ſtrong bottle with a pound of good ſpirit of wine, and add about the bulk of a hazel nut of camphor. Allow them to mix in ſummer in the ſun, or in winter on hot embers for 24 hours, ſhaking the bottle from time to time. Paſs the whole through a fine cloth, and throw away what remains upon it. Then let it ſettle for 24 hours, and you will find a clear part in the upper part of the bottle, which you muſt ſeparate gently and put into another vial, and the remains will ſerve for the firſt layers.

TURNSTONE, in ornithology. See TRINGA.

TURPENTINE, a tranſparent viſcous ſubſtance, flowing either naturally or by inciſion from ſeveral unctuous or reſinous trees; as the terebinthus, pine, larch, fir, &c. See PINUS, p. 765; CHEMISTRY *Index*; MATERIA MEDICA, *the Table*.

Oil of TURPENTINE. See CHEMISTRY-*Index*, and PHARMACY, n° 174.

TURPETH, the cortical part of the root of a ſpecies of convolvulus, brought from the Eaſt Indies. It is accounted a pretty ſtrong cathartic; but it is very uncertain in its ſtrength, for ſometimes a doſe from a ſcruple to a dram purges violently, while at other times a much greater doſe produces very little effect.

TURQUOISE, is the tooth of an animal penetrated with the blue calx of copper: it loſes its colour when heated;

it is opaque, and of a lamellar texture, and ſuſceptible of a fine poliſh; its ſpecific gravity is from 2,5 to 2,908; ſome are of a deep blue, ſome of a whitiſh blue, but become of a deeper when heated. This ſubſtance is found in Perſia and Languedoc. The copper may be extracted from it by diſtilled vinegar. According to Reaumur (*Mem. Par.* 1715) nitrous acid will not diſſolve that of Perſia, though it will that of France, which ſhows a difference between them.

TURRETIN (Francis), miniſter and profeſſor of divinity at Geneva, his native place, was born in 1623. Having ſtudied at Geneva, Leyden, Saumur, Montauban, and Niſmes, with great ſucceſs, he was admitted into the miniſtry in 1648, and ſerved at the ſame time the French and Italian churches at Geneva. Two years after, he was offered the profeſſorſhip of philoſophy, which he refuſed; but accepted the invitation of the church of Lyons. He was recalled to Geneva at a year's expiration, becauſe he was wanted to give lectures in divinity; which he began in 1653. He was ſent to Holland in 1661, to procure money which the city of Geneva had occaſion for. He had in that journey all the ſucceſs he could promiſe himſelf; and gained ſuch a character there, that he was ſtrongly importuned by the Walloon churches at the Hague and at Leyden to enter into their ſervice. On his return he reſumed the functions of his place, and continued there till his death with remarkable application. He died in 1687, with the character of a man of great merit; eloquent, judicious, laborious, learned, and zealous for orthodoxy. His works were publiſhed by his ſon John Alphonſus, in 3 and in 4 vols 4to.

TURRITIS, TOWER-MUSTARD, in botany: A genus of plants belonging to the claſs of *tetradynamia*, and to the order of *ſiliquoſa*; and in the natural ſyſtem ranging under the 39th order, *Siliquoſæ*. The ſiliqua is very long and angulated; the calyx connivent and erect; the corolla is alſo erect. There are three ſpecies; two of which are natives of Great Britain, the glabra and hirſuta.

TURTLE, in ichthyology. See TESTUDO.

Turtle-Dove, in ornithology. See COLUMBA.

TUSCAN ORDER, in architecture. See ARCHITECTURE, n° 42.

Tuscan Earth, a yellowiſh kind of bole dug in many parts of Italy, particularly about Florence, where there is a ſtratum of it eight or ten feet thick, at the depth of five or ſix feet from the ſurface. It is ſuppoſed to have an aſtringent property.

TUSCANY, a duchy of Italy, which makes part of the ancient Hetruria, excepting ſome ſmall detached parts, is encompaſſed by a part of the Mediterranean, called here the *Tuſcan Sea*; the eccleſiaſtical ſtate; the duchy of Modena; and the republic of Lucca; its extent from north to ſouth being about 116 Engliſh miles, and from eaſt to weſt about 80.

Though ſome parts of it are mountainous, yet both the hills and dales are covered with vines, olives, citron, lemon, and orange trees, &c. The mountains yield alſo copper, iron, alum, &c. and ſome quarries of the fineſt marble and porphyry. Here is alſo plenty of corn, rice, ſaffron, honey, wax, wool, flax, hemp, with mineral waters, rich paſture, ſalt-pits, ſulphur, alabaſter, chalcedony, lapis lazuli, borax, amethyſts, cornelians, jaſpers, quickſilver, cryſtals, and black ſlate. In ſome places the elms and aſhes yield manna.

The principal river in Tuſcany is the Arno, which has its ſource in the Appennine mountains, and falls into the ſea below Piſa. There are ſome other ſmaller rivers.

This duchy fell under the dominion of the Romans about 455 years before Chriſt. The Oſtrogoths poſſeſſed themſelves of it in the fifth century, and after them the Lombards, who were expelled by Charlemagne anno 800; in conſequence of which it became ſubject to the German emperors, who appointed governors over it. At laſt the cities of Florence, Piſa, Sienna, and ſome others, during the contentions between the pope and the emperor, and their reſpective adherents, the Guelphs and Gibbelines, withdrew themſelves from the dominion of both, and erected themſelves into ſeparate commonwealths. In that of Florence, John de Medicis, a popular nobleman, ſo inſinuated himſelf into the favour of his countrymen, that they inveſted him with ſovereign power. Pope Pius V. conferred the title of *grand duke* on Coſmo de Medicis anno 1570, in whoſe family the duchy continued until the death of Gaſton de Medicis, who died anno 1737. The duchy was then transferred to the duke of Lorrain, afterwards the emperor Francis I. in lieu of the duchy of Lorrain, which, by the peace of 1736, was given to king Staniſlaus during his life, and then was to be annexed to France. Leopold, the ſecond ſon of Francis I. and afterwards emperor of Germany, ſucceeded to this duchy. It is now enjoyed by Leopold's ſecond ſon, brother to the preſent emperor of Germany, Francis II. The grand duke's annual revenues are computed at about 500,000 l. ſterling, ariſing chiefly from the tenths of all eſtates that are ſold or alienated, and the ground-rents of the houſes in Leghorn, and the duties on almoſt all manner of proviſions.

The great duke is abſolute in his dominions. His ſtanding forces conſiſt only of three regiments of foot and two of dragoons, and his marine of a few galleys and galeaſſes; but, in caſe of neceſſity, it is ſaid he can bring 30,000 men into the field, and increaſe his marine with 20 men of war; but it does not appear how he can man them.

The principal places are Florence, Piſa, Leghorn, Sienna, Orbitello, Piombino, and Arezzo.

TUSK, or TORSK, in ichthyology. See GADUS.

TUSSILAGO, COLT'S FOOT, in botany: A genus of plants belonging to the claſs of *ſyngeneſia*, and order of *polygamia ſuperflua*; and in the natural ſyſtem ranging under the 49th order, *Compoſitæ*. The receptacle is naked; the pappus ſimple; the ſcales of the calyx equal, of the ſame height as the diſk, and ſomewhat membranaceous. There are 12 ſpecies; three of which are indigenous to Britain, the farfara, hybrida, and petaſites.

The *farfara*, or common colt's foot, grows plentifully on the banks of rivulets, or in moiſt and clayey ſoils, in England and Scotland.—The leaves are ſmoked in the manner of tobacco, or a ſyrup or decoction of them and the flowers ſtand recommended in coughs and other diſorders of the breaſt and lungs. It ſeems now to be almoſt entirely rejected. The downy ſubſtance under the leaves, boiled in a lixivium with a little ſaltpetre, makes excellent tinder. The *petaſites*, or common butter-burr, is frequent in wet meadows and by the ſides of rivers. Its leaves are the largeſt of any plant in Great Britain, and in heavy rains afford a ſeaſonable ſhelter to poultry and other ſmall animals. The root dug up in the ſpring is reſinous and aromatic. A drachm of it in a doſe has been ſometimes given as a ſudorific and alexipharmic; but as it poſſeſſes thoſe virtues but in a ſmall degree, it has loſt its reputation in the ſhops.

TUTENAGO, an ore of zinc, containing commonly from 60 to 90 *per cent.* of zinc, the remainder iron, and a ſmall proportion of clay.

TUTOR, in the civil law, is one choſen to look to the perſons and eſtate of children left by their fathers and mothers in their minority. The different kinds of *tutory* eſtabliſhed among the Romans, and the powers and duties of tutors, are deſcribed in *Inſt. Leg.* 1. T. XIII. ſect. 1. and 2. to which the reader is referred. See alſo the article GUARDIAN.

dian.—For the nature and effects of tutory in the Scotch law, which is founded on that of the Romans, ſee *Scotch Law*, Part III. Sect. 7.

Tutor is alſo uſed in the Engliſh univerſities for a member of ſome college or hall, who takes on him the inſtructing of young ſtudents in the arts and faculties.

TUTTY, an argillaceous ore of zinc, found in Perſia, formed on cylindrical moulds into tubulous pieces, like the bark of a tree, and baked to a moderate hardneſs; generally of a browniſh colour, and full of ſmall protuberances on the outſide, ſmooth and yellowiſh within, ſometimes whitiſh, and ſometimes with a bluiſh caſt. Like other argillaceous bodies, it becomes harder in a ſtrong fire; and after the zinc has been revived and diſſipated by inflammable additions, or extracted by acids, the remaining earthy matter affords, with oil of vitriol, an aluminous ſalt.

Tutty is celebrated as an ophthalmic, and frequently employed as ſuch in unguents and collyria. See Pharmacy, n° 654.

TWEED, a river of Scotland, which riſes on the confines of the ſhire of Clydeſdale, and running eaſtward thro' Tweedale, and dividing the ſhire of Merſe from Teviotdale and Northumberland, falls into the German Sea at Berwick. It abounds with ſalmon.

TWEEDALE, or Peebles, a county in the ſouth of Scotland. It has already been deſcribed under the word Peebles; but in that article ſeveral inaccuracies were committed, which a gentleman of that county has been kind enough to point out, and which therefore we take this opportunity of correcting.

Tweedale is chiefly a grazing county, producing excellent mutton from healthy black-faced ſheep. It is remarkable, that among this particular breed the rot or dropſical diſeaſe, and the trembling illneſs, are exceedingly rare, unleſs when they happen to be imported by ſtranger ſheep.—The account which we formerly gave of the vaſt number of eels ſwarming in Weſt-water Loch, and tumbling into the river Yarrow at particular ſeaſons, is a miſtake. At preſent no greater number of eels is ſeen there than in other rivers and lochs. This loch and Yarrow water are more than 20 miles aſunder, and running different ways, ſo that the account at any rate was impoſſible. The lake on the borders of Annandale is at preſent called *Loch Skeen*, and not *Loch Gennet*; the cataract which it forms is called the *Grey Mare's Tail*: the fall is into Moffat water. Douglas of Cavers ought not to have been reckoned among the families of Tweedale, as that branch of the Douglaſes belongs to a different county. Our miſtake proceeded from this circumſtance—In very ancient times all the country waſhed by the Tweed went by the name of *Tweedale*, and the Douglaſes were wardens of that diſtrict. Peebles lies in N. Lat. 55. 38. W. Long. 3.

TWELFTH-day, the feſtival of the Epiphany, or the manifeſtation of Chriſt to the Gentiles; ſo called, as being the twelfth day, excluſive, from the nativity or Chriſtmas-day.

TWILIGHT, that light, whether in the morning before ſun-riſe, or in the evening after ſun-ſet, ſuppoſed to begin and end when the leaſt ſtars that can be ſeen by the naked eye ceaſe or begin to appear.

TWINKLING *of the Stars*. See Optics, n° 21.

TWINS, two young ones delivered at a birth, by an animal which ordinarily brings forth but one.

TWITE, in ornithology. See Fringilla.

TYGER, or Tiger, in zoology. See Felis.

TYLE, or Tile, in building, a ſort of thin laminated brick uſed on the roofs of houſes: or, more properly, a kind of fat clayey earth kneaded and moulded of a juſt thickneſs, dried and burnt in a kiln like brick, and uſed in the covering and paving of houſes.

TYMPAN, among printers, a double frame belonging to the preſs, covered with parchment, on which the blank ſheets are laid in order to be printed off. See *Printing-Preſs*.

TYMPANUM, in mechanics, a kind of wheel placed round an axis or cylindrical beam, on the top of which are two levers or fixed ſtaves for the more eaſily turning the axis in order to raiſe a weight required. The tympanum is much the ſame with the peritrochium; but that the cylinder of the axis of the peritrochium is much ſhorter and leſs than the cylinder of the tympanum.

Tympanum, in anatomy. See Anatomy, n° 141.

TYMPANY, in medicine. See Medicine, n° 337, and Surgery, n° 265.

TYNDALE (William), a zealous Engliſh reformer, and memorable for having made the firſt Engliſh verſion of the Bible, was born on the borders of Wales ſome time before 1500. He was of Magdalene-hall in Oxford, where he diſtinguiſhed himſelf by ſucking in early the doctrines of Luther, and by as zealouſly propagating thoſe doctrines among others. Afterwards he removed to Cambridge, and from thence went to live with a gentleman in Glouceſterſhire in the capacity of tutor to his children.—While he continued there, he ſhowed himſelf ſo furious for Luther, and ſo inveterate to the pope, that he was forced, merely for the ſecurity of his perſon, to leave the place. He next endeavoured to get into the ſervice of Tonſtall biſhop of Durham, but did not ſucceed. His zeal for Lutheraniſm made him deſirous to tranſlate the New Teſtament into Engliſh; and as this could not ſafely be done in England, he went into Germany, where, ſetting about the work, he finiſhed it in 1527. He then began with the Old Teſtament, and finiſhed the five books of Moſes, prefixing diſcourſes to each book, as he had done to thoſe of the New Teſtament (a). At his firſt going over into Germany, he went into Saxony, and had much conference with Luther; and then returning to the Netherlands, made his abode chiefly at Antwerp.

Jortin's Life of Eraſmus.

(a) An anecdote is told of Biſhop Tonſtal, which is amuſing in itſelf, and does much honour to the Biſhop's moderation. Tonſtal being at Antwerp in 1529, he ſent for one Packington an Engliſh merchant there, and deſired him to ſee how many New Teſtaments of Tyndale's Tranſlation he might have for money. Packington, who was a ſecret favourer of Tyndale, told him what the Biſhop propoſed. Tyndale was very glad of it; for, being convinced of ſome faults in his works, he was deſigning a new and more correct edition: but he was poor, and the former impreſſion not being ſold off, he could not go about it: ſo he gave Packington all the copies that lay in his hands; for which the Biſhop paid the price, and brought them over, and burnt them publicly in Cheapſide.—Next year, when the ſecond edition was finiſhed, many more were brought over; and one Conſtantine being taken in England, the lord chancellor, in a private examination, promiſed him that no hurt ſhould be done him if he would reveal who encouraged and ſupported them at Antwerp; which he accepted of, and told them that the greateſt encouragement they had was from the Biſhop of London, who had bought up half the impreſſion. This made all that heard of it laugh heartily, though more judicious perſons diſcerned the great temper of that learned Biſhop in it.

werp. During his peregrinations from one country to another, he ſuffered ſhipwreck upon the coaſt of Holland, and loſt all his books and papers. His tranſlations of the Scriptures being in the mean time ſent to England, made a great noiſe there; and, in the opinion of the clergy, did ſo much miſchief, that a royal proclamation was iſſued out, prohibiting the buying or reading ſuch tranſlation or tranſlations. But the clergy were not ſatisfied with this, they knew Tyndale capable of doing infinite harm, and therefore thought of nothing leſs than removing him out of the way. For this purpoſe one Philips was ſent over to Antwerp, who inſinuated himſelf into his company, and under the pretext of friendſhip betrayed him into cuſtody. He was ſent to the caſtle of Filford, about 18 miles from Antwerp: and though the Engliſh merchants at Antwerp did what they could to procure his releaſe, and letters were alſo ſent from lord Cromwell and others out of England; yet Philips beſtirred himſelf ſo heartily, that he was tried and condemned to die. He was firſt ſtrangled by the hands of the common hangman, and then burned near Filford caſtle, in 1536. While he was tying to the ſtake, he cried with a fervent and loud voice, "Lord, open the king of England's eyes."

TYPE (τυπος), an impreſſion, image, or repreſentation of ſome model, which is termed the *antitype*. In this ſenſe the word occurs often in the writings of divines, who employ it to denote that prefiguration of the great events of man's redemption which they have found or fancied in the principal tranſactions recorded in the Old Teſtament.

That the death of Chriſt for the ſins of men, and his reſurrection from the dead for their juſtification, were prefigured in the ritual worſhip inſtituted by Moſes, is indeed incontrovertible *; but when divines conſider as a type every thing mentioned in the Hebrew Scriptures, in which an active imagination can diſcover the ſlighteſt reſemblance or analogy to any circumſtance in the life, or death, or reſurrection of Chriſt, they expoſe the whole doctrine of *types* to the ridicule of unbelievers, and do a real injury to that cauſe which it is their profeſſed intention to ſerve. To contend, as ſome of them have done, that the extraction of Eve from the ſide of Adam, while he was in a deep ſleep, was intended as a type of the Roman ſoldier's piercing our Saviour's ſide while he ſlept the ſleep of death; or that the envy of the ſons of Jacob to their brother Joſeph, was typical of the envy of the Scribes and Phariſees to Jeſus the Meſſiah, is to burleſque the Scriptures, and inſult reaſon.

The nature of types ſeems indeed to be very little underſtood even by thoſe who pretend to have ſtudied them with care. They are generally compared to prophecies having a double ſenſe, and are thought to have been ſo contrived as to give information of the future events to which they pointed; but the information which they gave of Chriſtianity muſt have been exceedingly obſcure to thoſe who lived before the coming of Chriſt, however plain it may appear to us who can now compare the type with the antitype. A different opinion has indeed been maintained, not only by myſtical cabbaliſts, who will maintain any thing from which common ſenſe revolts, but alſo by writers who, when treating of other ſubjects, have ſhown that they poſſeſſed very ſound underſtandings. One of the ableſt defenders of revelation, ſpeaking of the purpoſe for which the paſſover was inſtituted, aſks "What is the price and worth of a lamb, whoſe blood infallibly gives life to thoſe who are tinged with it, and the non-aſperſion or neglect of which is ſufficient to condemn Jew and Gentile to death without diſtinction?" Taking it for granted that this queſtion is capable of no anſwer but one favourable to the concluſion which he wiſhes to draw from it, he then proceeds in the following words: "Though the Meſſiah was not already come, who could doubt but that ſuch a myſtery *typified him*, ſince he was to be the Saviour and Deliverer of his people? and who would not be prepared to believe that he will deliver his people, and ſave them by the *effuſion of his blood*, when it is obvious that it is to the immolation of a lamb, and the aſperſion of its blood, that all Iſrael owe their lives and liberties?"

Lally's Principles of the Chriſtian Religion.

That the ſacrifice of the paſchal lamb for the ſafety of the Iſraelites was typical of the ſacrifice of the Lamb of God for the ſins of the world, and that the reſemblance or analogy of the type to the antitype was in many reſpects exceedingly ſtriking, are facts known to every Chriſtian; but they could not poſſibly be known to the ancient Hebrews before it was revealed to them that Chriſt was to ſuffer. At the inſtitution of the paſſover, nothing was ſaid from which the great body of the people could infer that they were to be redeemed from death and ſin by the blood of the Meſſiah, as their fathers had in Egypt been delivered from the deſtroying angel by the blood of the immolated lamb. We readily agree with the ingenious writer, that in the blood of a lamb there is no worth to propitiate the eternal God, and from him to purchaſe life for the man who is ſprinkled with it; but the Iſraelites, at the era of their departure from Egypt, held opinions very different from his and ours. They thought groſsly of the Deity, and believed, with their ſuperſtitious maſters, that he put the higheſt value on animal ſacrifices. In the New Teſtament Chriſt is called our *Paſſover*, and is ſaid to have been ſacrificed for us. Chriſtians therefore cannot doubt but that the Jewiſh ſacrifice of the paſchal lamb was emblematical of the great ſacrifice ſlain on the croſs; but as the majority of the ancient Hebrews were ignorant of all the circumſtances of reſemblance between the type and antitype, we cannot conceive how they ſhould have dreamed of a future paſſover of which their own was but an empty figure.

Some learned men indeed ſeem to imagine, that when the rites of the law were inſtituted, the people were taught to conſider them as of no value in themſelves, but merely as ſhadows of good things to come, and that by means of theſe ſhadows a diſtinct and even ſteady view was given to them of the ſubſtance; but this is a ſuppoſition which receives no ſupport from Scripture. That Abraham, who rejoiced to ſee Chriſt's day, and ſeeing it was glad; that Moſes, who was directed to make all things relating to the tabernacle according to the pattern ſhowed to him in the mount; and that ſuch other individuals as, like him, could look up to a God inviſible, and perform at once a worſhip purely ſpiritual; that theſe men were admoniſhed that the ritual law was only the ſhadow of a future and more perfect diſpenſation—cannot, we think, be queſtioned. Nay, that Abraham, Moſes, and a few others, may have had as accurate notions of Chriſtianity as we have at preſent, is a poſition which we feel not ourſelves inclined to controvert; but that the great body of the Hebrew nation was taught from the beginning to conſider their law as imperfect, or as deriving any little value which it had from its being emblematical of a purer worſhip to be revealed in the fulneſs of time, is a ſuppoſition which cannot be admitted without confounding all the divine diſpenſations.

The law was a ſchoolmaſter given to the poſterity of Jacob, to guard them from idolatry, and to train them by degrees for the coming of Chriſt. That it might anſwer this purpoſe the more effectually, prophets were raiſed up from time to time to point out its ſecret and ſpiritual meaning, as the people became able to receive it; and no reaſon can be aſſigned for the introduction of ſo burdenſome and carnal a ritual between the fall and the clear revelation of redemption, but becauſe mankind at large were not at that

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* See Epiſt. to the Heb. paſſim.

period capable of a more ſpiritual and refined worſhip. See Theology, Part II. Sect. iv.

If this be ſo, how abſurd is it to ſuppoſe that the ancient Iſraelites ſaw through their ſacrifices the future ſacrifice of Chriſt, and the ſimple, though ſublime, worſhip of the Chriſtian church; that when their law promiſed temporal rewards to the obedient, they looked for heavenly ones through the Meſſiah; and that when they were offering a ſin-offering for their tranſgreſſions, they had their eyes fixed on the croſs of Chriſt, being aware that the blood of bulls and of goats could never take away ſin? Had the Iſraelites, at their deliverance from Egyptian bondage, been capable of all this faith, it is not to be ſuppoſed that the Father of Mercies would have laid upon them ſuch a yoke of ordinances; for that would have been in effect to ſay, though you are capable of worſhipping me in ſpirit and in truth, according to the diſpenſation which ſhall be revealed to your poſterity, yet I command you to obſerve a multifarious ritual, which you *know* to be preparatory to that diſpenſation, and of *no real value in itſelf!*

The law therefore had only the *ſhadow* of good things to come, and not ſuch an image of them, as that merely from beholding the type mankind could acquire an accurate notion of the antitype. It was indeed ſo contrived as naturally to lead the thinking part of the nation to the hopes of future redemption; but without the illuſtrations of the prophets it could not of itſelf have made them comprehend the means by which that redemption was to be effected. Between the types and the antitypes, the ſhadow and the ſubſtance, the reſemblance, or, to ſpeak more properly, the analogy, is ſo ſtriking, that no unprejudiced perſon can now entertain a doubt but that the law and the goſpel are parts of one great ſcheme of providence, which, commencing with the fall, was completed by the effuſion of the Holy Spirit on the day of pentecoſt. But it would be as equitable to condemn a Bacon or a Newton to ſpend his time in the amuſements of children, as it would have been to place the Jews under the ritual law, had they been capable of acquiring from the ſhadows of that law adequate notions of the ſubſtance of Chriſtianity.

Type, among letter-founders and printers, the ſame with letter. See Letter.

Type is alſo uſed to denote the order obſerved in the intenſion and remiſſion of fevers, pulſes, &c.

TYPHA, Cat's tail, in botany: A genus of plants belonging to the claſs of *monœcia*, and order of *triandria;* and in the natural ſyſtem ranging under the 3d order, *Calamariæ*. The amentum of the male flower is cylindrical; the calyx is tripetalous, but ſcarcely diſtinguiſhable; there is no corolla. The female has a cylindrical amentum below the male; the calyx is compoſed of villous hair; there is no corolla, and only one ſeed fixed in a capillary pappus. There are two ſpecies, both natives of Britain; the latifolia and anguſtifolia.

1. *Latifolia*, great cat's tail, or reed mace, is frequent in ponds and lakes. The ſtalk is ſix feet high; the leaves a yard long, hardly an inch wide, convex on one ſide: the amentum, or cylindrical club which terminates the ſtalk, is about ſix inches long, of a dark brown or fiſcous colour. Cattle will ſometimes eat the leaves, but Schreber thinks them noxious: the roots have ſometimes been eaten in ſalads, and the down of the amentum uſed to ſtuff cuſhions and matreſſes. Linnæus informs us, that the leaves are uſed by the coopers in Sweden to bind the hoops of their caſks.

2. *Anguſtifolia*, narrow-leaved cat's tail, is found in pools and ditches. The leaves are ſemi-cylindrical, and the male and female ſpike are remote and ſlender.

TYPHON. See Whirlwind.

Typhon, the devil of the ancient Egyptians. See Polytheism, nº 29.

TYPOGRAPHY, the art of printing. See Printing.

TYRANNION, a celebrated grammarian in Pompey's time, was of Amiſus in the kingdom of Pontus. He was the ſcholar of Dionyſius of Thrace at Rhodes. He fell into the hands of Lucullus, when that general of the Roman army defeated Mithridates, and ſeized his dominions. This captivity of Tyrannion was no diſadvantage to him, ſince it procured him an opportunity of being illuſtrious at Rome, and raiſing a fortune. He ſpent it, among other things, in making a library of above 30,000 volumes. He died very old, being worn out with the gout. His care in collecting books contributed very much to the preſervation of Ariſtotle's works.

TYRANT, among the ancients, denoted ſimply a king or monarch; but the ill uſe which ſeveral perſons inveſted with that ſacred character made of it, has altered the import of the word; and tyrant now carries with it the idea of an unjuſt or cruel prince, who invades the people's liberty, and rules in a more deſpotic manner than the laws of nature or of the country allow.

TYRE, formerly a celebrated city of Aſia, on the coaſt of Syria, ſituated under the 54th degree of eaſt longitude, and 32d of north latitude. It was built, according to ſome writers, 2760 years before the Chriſtian era. There were two cities of that name; the one called *Palætyrus*, ſituated on the continent; and the other the city of *Tyre*, built on an iſland about half a mile from the ſhore. It was about 19 miles in circumference, including Palætyrus; the town on the iſland was about four miles round. The buildings of Tyre were very magnificent; the walls were 150 feet high, and broad in proportion. This city was at one period the moſt famous commercial city in the world. Of its commercial tranſactions, the moſt particular account that is to be found in any ancient writer has been given by the prophet Ezekiel, which at the ſame time conveys a magnificent idea of the extenſive power of that ſtate. It reſiſted Nebuchadnezzar king of Babylon for 13 years: at the end of which, wearied with endleſs efforts, the inhabitants reſolved to place the ſea between them and their enemy, and paſſed accordingly into the iſland. The new city ſtood out againſt Alexander the Great for ſeven months; and before he could take it, he was obliged to fill up the ſtrait which ſeparated the iſland from the continent. It was repaired afterwards by Adrian, and became the metropolis of the province. It afterwards fell into the hands of the Arabs; and after being taken by Baldwin II. king of Jeruſalem, it was deſtroyed by the ſultan of Egypt in 1289, and abandoned, never more to riſe from its ruins. An excellent account of its ſituation and modern ſtate may be found in Volney's Travels, vol. ii. It now conſiſts of a ſmall village, compoſed of wretched huts, containing about 50 or 60 poor families. The words of Ezekiel are literally fulfilled, "And they ſhall make a ſpoil of thy riches." (Ezek. xxvi. 12, 13, 14). Mr Bruce ſaw this queen of the nations converted into a place for fiſhers to dry their nets in. Its harbour, formerly ſo famous for its ſhipping, is now almoſt choaked up. It is called *Sour* or *Tſour* by the Orientals.

TYRIAN Dye. See Murex and Purpura.

TYRONE, a county of Ireland, in the province of Ulſter, 46 miles in length, and 37 in breadth; bounded on the north by Londonderry, on the eaſt by Armagh and Lough-Neagh, on the ſouth by Fermanagh, and on the weſt by Donnegal. It is a rough and rugged country, but tolerably fruitful; contains 12,683 houſes, 30 pariſhes, 4 baronies, 4 boroughs, and ſends 10 members to parliament. The principal town is Dungannon.

U, V.

U or u, the 20th letter and 5th vowel of our alphabet, is formed in the voice by a round configuration of the lips, and a greater extruſion of the under one than in forming the letter o, and the tongue is alſo more cannulated. The ſound is ſhort in *curſt*, *muſt*, *tun*, *tub*; but is lengthened by a final *e*, as in *tune*, *tube*, &c. In ſome words it is rather acute than long; as in *brute*, *flute*, *lute*, &c. It is moſtly long in polyſyllables; as in *union*, *curious*, &c. but in ſome words it is obſcure, as in *nature*, *venture*, &c. This letter in the form of V or v, is properly a conſonant, and as ſuch is placed before all the vowels; as in *vacant*, *venal*, *vibrate*, &c. Though the letters v and u had always two ſounds, they had only the form v till the beginning of the fourth century, when the other form was introduced, the inconvenience of expreſſing two different ſounds by the ſame letter having been obſerved long before. In numerals V ſtands for five; and with a daſh added at top, thus $\bar{V}$, it ſignifies 5000.

In abbreviations amongſt the Romans, V. A. ſtood for *veterani aſſignati*; V. B. *viro bono*; V. B. A. *viri boni arbitratu*; V. B. F. *vir bonæ fidei*; V. C. *vir conſularis*; V. C. C. F. *vale, conjux chariſſime, feliciter*; V. D. D. *voto dedicatur*; V. G. *verbi gratia*: Vir. Ve. *virgo veſtalis*; V. L. *videlicet*; V. N. *quinto nonarum*.

VACCINIUM, the WHORTLE-BERRY, or *Bilberry*, in botany: A genus of plants of the claſs of *octandria*, and order of *monogyna*; and arranged in the natural ſyſtem under the 18th order, *Bicornes*. The calyx is ſuperior; the corolla monopetalous; the filaments inſerted into the receptacle; the berry quadrilocular and polyſpermous. There are 15 ſpecies; the moſt remarkable of which are,

1. The *myrtillus*, black whorts, whortle-berries, or bilberries, growing in woods and on heaths abundantly. The flowers frequently vary, with five ſegments at the rim, and with ten ſtamina. The berries when ripe are of a bluiſh black colour; but a ſingular variety, with white berries, was diſcovered by the duke of Athol, growing in the woods, about mid-way between his two ſeats of Dunkeld and Blair. The berries have an aſtringent quality. In Arran and the Weſtern Iſles they are given in diarrhœas and dyſenteries with good effect. The Highlanders frequently eat them in milk, which is a cooling agreeable food; and ſometimes they make them into tarts and jellies, which laſt they mix with whiſky, to give it a reliſh to ſtrangers.—They die a violet colour; but it requires to be fixed with alum. The grous feed upon them in the autumn.

2. The *uliginoſum*, or great bilberry-buſh, is found in low moiſt grounds, and almoſt at the ſummits of the Highland mountains. The leaves are full of veins, ſmooth and glaucous, eſpecially on the under ſide; the berries are eatable, but not ſo much eſteemed as the preceding; as they are apt, if eaten in any quantity to give the headach.

3. The *vitis idæa*, or red whortle-berries, frequent in dry places, in heaths, woods, and on mountains. The berries have an acid cooling quality, uſeful to quench the thirſt in fevers. The Swedes are very fond of them made into the form of a rob or jelly, which they eat with their meat as an agreeable acid, proper to correct the animal alkali.

4. The *oxycoccus*, cran-berries, moſs-berries, or moor-berries, frequent on peat-bogs in the Lowlands, but not ſo common in the Highlands of Scotland. The ſtalks are long, ſlender, woody, weak, and trailing: the leaves are ſtiff, acutely oval, glaucous underneath, their edges turned back, and grow alternate; two or three flowers grow ſingly on long red footſtalks out of the extremity of the branches; the flowers are red, divided deeply into four acute ſegments, which are reflected quite backwards; the filaments are downy; the antheræ ferruginous and longer than the filaments: the berries red, and about the ſize of the hawthorn berries. At Longtown, on the borders of Cumberland, they are made ſo conſiderable an article of commerce, that, at the ſeaſon when they are ripe, not leſs than 20l. or 30l's worth are ſold by the poor people each market-day for five or ſix weeks together, which are afterwards diſperſed over different parts of the kingdom for making the well-known cranberry-tarts.

VACUUM, in philoſophy, denotes a ſpace empty or devoid of all matter or body.

It has been a matter of much diſpute among philoſophers whether there be in nature a perfect vacuum, or ſpace void of all matter: but if bodies conſiſt of material ſolid atoms, it is evident that there muſt be vacuities, or motion would be impoſſible (See METAPHYSICS, nº 193). We can even produce ſomething very near a vacuum in the receiver of an air pump and in the Torricellian tube (See PNEUMATICS, *paſſim*); and it is very doubtful whether the particles of the denſeſt bodies known be in perfect contact. See OPTICS, nº 63—68.

VADIUM, a pledge in law, is either *vivum* or *mortuum*.

VADIUM Vivum, or *Living Pledge*, is when a man borrows a ſum (ſuppoſe 200l.) of another; and grants him an eſtate, as of 20l. *per annum*, to hold till the rents and profits ſhall repay the ſum ſo borrowed. This is an eſtate conditioned to be void as ſoon as ſuch ſum is raiſed. And in this caſe the land or pledge is ſaid to be living: it ſubſiſts, and ſurvives the debts; and, immediately on the diſcharge of that, reſults back to the borrower.

VADIUM Mortuum, or *Dead Pledge*. See MORTGAGE.

VAGABOND, or VAGRANT, one who wanders illegally, without a ſettled habitation. Such perſons are cognizable by the laws. See IDLENESS.

VAGINA, properly ſignifies a ſheath or ſcabbard; and the term *vagina* is uſed in architecture for the part of a terminus, becauſe reſembling a ſheath out of which the ſtatue ſeems to iſſue.

VAGINA, in anatomy, a canal reaching from the external orifice, or os pudendi, of women, to the uterus.

VAILLANT (John Foy), a phyſician and great medaliſt, to whom, according to Voltair, France was indebted for the ſcience of medals, and Louis XIV. for one half of his cabinet, was born at Beauvais in 1632. Through the means of the miniſter Colbert he travelled into Italy, Greece, Egypt, and Perſia, to collect medals for the royal cabinet; and returned with ſo many as made the king's cabinet ſuperior to any in Europe. In one of his voyages the ſhip he ſailed in was fallen upon and taken by an Algerine corſair. After a captivity of near five months he was permitted to return to France, and received at the ſame time 20 gold medals which had been taken from him. He embarked in a veſſel bound for Marſeilles, and was carried on with a favourable wind for two days, when another corſair appeared, which, in ſpite of all the ſail they could make, bore down upon them within the reach of cannon-ſhot. Mr

Vaillant, dreading the miſeries of a freſh ſlavery, reſolved, however, to ſecure the medals which he had received at Algiers, and in order thereto ſwallowed them. But a ſudden turn of the wind freed them from this adverſary, and caſt them upon the coaſts of Catalonia; where, after expecting to run aground every moment, they at length fell among the ſands at the mouth of the Rhone. Mr Vaillant got to ſhore in a ſkiff, but felt himſelf extremely incommoded with the medals he had ſwallowed, which might weigh altogether five or ſix ounces, and therefore did not paſs like Scarborough waters. He had recourſe to a couple of phyſicians; who were a little puzzled with the ſingularity of his caſe; however, nature relieved him from time to time, and he found himſelf in poſſeſſion of the greateſt part of his treaſure when he got to Lyons. Here he explained, with much pleaſure to his friends, thoſe medals which were already come to hand, as well as thoſe which were daily expected; among which laſt was an Otho, valuable for its rarity.—He was much careſſed on his return; and when Louis XIV. gave a new form to the academy of inſcriptions in 1701, Mr Vaillant was firſt made aſſociate, and then penſionary. He wrote ſeveral works relating to ancient coins, and died in 1706.

VAIR, or VAIRE, a kind of fur, formerly uſed for lining the garments of great men and knights of renown. It is repreſented in engraving by the figures of little bells reverſed, ranged in a line. See HERALDRY, Chap. II. Sect. 2.

VAIRY, in heraldry, expreſſes a coat, or the bearings of a coat, when charged or chequered with vairs.

VALAIS, a valley in Swiſſerland, which extends from the ſource of the river Rhone to the lake of Geneva. It is near 100 miles in length, but the breadth is very unequal. It is bounded on the north by the Alps, which ſeparate it from the cantons of Bern and Uri, on the eaſt by the mountains of Forche, on the ſouth by the dutchy of Milan and the Val d'Aoſte, and on the weſt by Savoy and the republic of Geneva. The inhabitants profeſs the Roman Catholic religion. They are ſubject to the ſwelling of the throat called *bronchocele;* and idiots are ſaid to abound among them more than in any other place of the globe. They are naturally hardy, enterpriſing, and good natured. It is ſurrounded on all ſides by very high mountains, moſt of which are covered with ſnow and ice that never thaw. However, the ſoil is fertile in corn, wine, and good fruit. The muſcat-wine, which is produced here, is excellent, and well known all over Europe. There are mineral waters, plenty of game, and ſome mines. This country comprehends 55 large pariſhes, to which one biſhop only belongs, whoſe ſee is at Sion the capital. The mountains afford good paſture for their cattle in ſummer, and their harveſt continues from May to October; it being ſooner or later according to the ſituation of the place.

VALANTIA, in botany: A genus of plants in the order *monœcia*, of the claſs *polygamia*, and in the natural ſyſtem arranged under the 41ſt order, the *aſperifoliæ*. There is ſcarcely any calyx; the corolla is monopetalous, flat, fourparted; the ſtamina four, with ſmall antheræ: the hermaphrodite flowers have a piſtillum with a large germen, a bifid ſtyle, the length of the calyx, and one ſeed; the piſtilla of the male flowers are hardly diſcernible. There are eight ſpecies, only one of which is a native of Britain, the *cruciata;* the ſtalks of which are ſquare, the whole plant hairy, the leaves oval and verticillate, four in the whirl; the flowers are yellow, and grow on ſhort peduncles out of the alæ of the leaves. The roots, like thoſe of the galiums, to which it is nearly related, will dye red. It is aſtringent, and was once uſed as a vulnerary.

VALENCIA, a province of Spain, which has the title of a kingdom; and is bounded on the eaſt and ſouth by the Mediterranean ſea, on the north by Catalonia and Arragon, and on the weſt by New Caſtile and the kingdom of Murcia. It is about 165 miles in length and 63 in breadth. It is one of the moſt populous and agreeable parts of Spain, and where they enjoy almoſt a perpetual ſpring. The great number of rivers wherewith it is watered renders it extremely fertile, particularly in fruits and wine. There are very rugged mountains in it, which contain mines of allum and other minerals.

VALENCIA, a city of Spain, and capital of the kingdom of the ſame name. It contains about 12,000 houſes, beſides thoſe of the ſuburbs and the ſummer-houſes round it. It has an univerſity, and an archbiſhop's ſee; and was taken from the Moors by the Chriſtians in the 13th century. The town is handſome, and adorned with very fine ſtructures. It is not very ſtrong, though there are ſome baſtions along the ſides of the walls. They have manufactures in wool and ſilk, which bring in great ſums to the inhabitants. It is ſeated on the river Guadalaviar, over which there are five handſome bridges; and it is about three miles from the ſea, where there is a harbour, 110 miles north of Murcia, and 165 eaſt by ſouth of Madrid. This city ſurrendered to the earl of Peterborough in the year 1705; but it was loſt again in 1707. W. Long. 0. 10. N. Lat. 39. 23.

VALENCIENNES, an ancient, ſtrong, and conſiderable city of France, in the department of the North and late province of Hainault. It contains about 20,000 ſouls. The Scheld divides it into two parts. It is a very important place; the citadel and fortifications, the work of Vauban, were conſtructed by order of Louis XIV. who took this town from the Spaniards. It was confirmed to him by the treaty of Nimeguen, in 1678. In 1793, it ſurrendered to the allies after a ſevere ſiege, but was afterwards abandoned; and is now in the poſſeſſion of the French republicans. Beſides lace, this city is noted for manufactories of woollen ſtuffs and very fine linens. It is 20 miles weſt ſouth weſt of Mons, 17 north-eaſt of Cambray, and 120 north-eaſt by north of Paris. E. Long. 3. 37. N. Lat. 50. 21.

VALENS (Flavius), emperor of the Eaſt, a great patron of the Arians. Killed by the Goths in the year 379. See CONSTANTINOPLE, n° 76.

VALENTINIAN I. emperor of the Weſt, a renowned warrior, but a tyrant over his ſubjects. See ROME, n° 523.

VALENTINIAN II. emperor of the Weſt, a prince celebrated for his virtues, and above all for his moderation; yet a conſpiracy was formed againſt him by Arbogaſtes, the commander in chief of his armies; and he was ſtrangled in the year 392. See ROME, n° 536.

VALENTINIANS, in church hiſtory, a ſect of Chriſtian heretics, who ſprung up in the ſecond century, and were ſo called from their leader Valentinus.

The Valentinians were only a branch of the Gnoſtics, who realized or perſonified the Platonic ideas concerning the Deity, whom they called *Pleroma* or *Plenitude*. Their ſyſtem was this: the firſt principle is Bythos, *i. e.* Depth, which remained many ages unknown, having with it Ennoe or Thought, and Sige or Silence; from theſe ſprung the Nous or Intelligence, which is the only ſon, equal to and alone capable of comprehending the Bythos; the ſiſter of Nous they called *Aletheia* or *Truth;* and theſe conſtituted the firſt quaternity of æons, which were the ſource and original of all the reſt: for Nous and Aletheia produced the World and Life; and from theſe two proceeded Man and the Church. But beſides theſe 8 principal æons, there were 22 more; the laſt of which, called *Sophia*, being deſirous to arrive at the knowledge of Bythos, gave herſelf a great deal of uneaſineſs, which created in her Anger and Fear, of which was born Matter. But the Horos or Bounder ſtopped her, preſerved her in the Pleroma, and reſtored her to Perfection. Sophia then produced the Chriſt and the Holy Spirit, which brought the æons to their laſt perfection, and made every one of them contribute their utmoſt to form the Saviour. Her Enthymeſe, or Thought, dwelling near the Pleroma, perfected by the Chriſt, produced every thing that is in the world by its divers paſſions. The Chriſt ſent into it the Saviour, accompanied with angels, who delivered it from its paſſions, without annihilating it: from thence was formed corporeal matter. And in this manner did they romance concerning God, nature, and the myſteries of the Chriſtian religion.

VALERIAN, or Valerianus, (Publius Licinius), emperor of Rome, remarkable for his captivity and cruel treatment by Sapor I. king of Perſia. See Rome, n° 491.

VALERIANA, in botany: A genus of plants belonging to the claſs *triandria* and order *monogynia*, and in the natural ſyſtem arranged under the 48th order, *aggregatæ*. There is hardly any calyx; the corolla is monopetalous, gibbous at the baſe, ſituated above the germen; there is only one ſeed. There are 21 ſpecies, only four of which are natives of Britain, the *officinalis*, the *locuſta*, the *rubra*, the *dioica*; of theſe only the officinalis is uſeful. The root of this plant is perennial: the ſtalk is upright, ſmooth, channelled, round, branched, and riſes from two to four feet in height: the leaves on the ſtem are placed in pairs upon ſhort broad ſheathes; they are compoſed of ſeveral lance-ſhaped, partially dentated, veined, ſmooth pinnæ, with an odd one at the end, which is the largeſt: the floral leaves are ſpear-ſhaped and pointed; the flowers are ſmall, of a white or purpliſh colour, and terminate the ſtem and branches in large bunches. It flowers in June, and commonly grows about hedges and woods.

Woodville's Medical Botany.

It is ſuppoſed to be the φȣ of Dioſcorides and Galen, by whom it is mentioned as an aromatic and diuretic: it was firſt brought into eſtimation in convulſive affections by Fabius Columna, who relates that he cured himſelf of an epilepſy by the root of this plant: we are told, however, that Columna ſuffered a relapſe of the diſorder; and no further accounts of the efficacy of valerian in epilepſy followed till thoſe publiſhed by Dominicus Panarolus fifty years afterwards, in which three caſes of its ſucceſs are given. To theſe may be added many other inſtances of the good effects of valerian root in this diſeaſe, ſince publiſhed by Cruger, Schuchmann, Riverius, Sylvius, Marchant, Chomel, Sauvages, Tiſſot, and others.

The advantages ſaid to be derived from this root in epilepſy cauſed it to be tried in ſeveral other complaints termed *nervous*, particularly thoſe produced by increaſed mobility and irritability of the nervous ſyſtem, in which it has been found highly ſerviceable. Bergius ſtates its virtues to be antiſpaſmodic, diaphoretic, emmenagogue, diuretic, anthelmintic. The root in ſubſtance is moſt effectual, and is uſually given in powder from a ſcruple to a dram: its unpleaſant flavour may be concealed by a ſmall addition of mace. A tincture of valerian in proof ſpirit and in volatile ſpirit are ordered in the London Pharmacopœia.—Cats are very fond of the ſmell of this root, and ſeem to be intoxicated by it.

VALERIUS Maximus, a Latin hiſtorian, ſprung from the families of the Valerii and Fabii, which made him take the name of *Valerius Maximus*. He ſtudied polite literature, and afterwards followed Sextus Pompey to the wars. At his return he compoſed an account of the actions and remarkable ſayings of the Romans and other great men; and dedicated that work to the emperor Tiberius. Many of the learned think that this is the ſame that is now extant, and bears the name of Valerius Maximus; but others maintain, that what we have now is only an abridgment of the work written by this celebrated hiſtorian, and that this abridgment was made by one Nepotian of Africa. However, this work is well written, and contains a great number of memorable actions performed by the Greeks and Romans that are worthy of being read.

VALET, a French term, uſed as a common name for all domeſtic men-ſervants employed in the more ſervile offices, as grooms, footmen, coachmen, &c. But with us it is only uſed in the phraſe *valet de chambre*, which is a ſervant whoſe office is to dreſs and undreſs his maſter, &c.

VALETTA, a city of Malta, and capital of the iſland (ſee Malta, n° 26). It is ſituated in E. Long. 14. 34. N. Lat. 35. 54.

VALETUDINARY, among medical writers, denotes a perſon of a weak and ſickly conſtitution, and frequently out of order.

VALID, in law, an appellation given to acts, deeds, tranſactions, &c. which are clothed with all the formalities requiſite to their being put into execution, and to their being admitted in a court of juſtice.

VALLADOLID, an ancient, large, and handſome city of Spain, in Old Caſtile, and capital of a principality of the ſame name, with a biſhop's ſee and an univerſity. It is ſurrounded with ſtrong walls, embelliſhed with handſome buildings, large public ſquares, piazzas, and fountains. It is large and populous, containing 11,000 houſes, with fine long and broad ſtreets, and large high houſes, adorned with balconies. The market-place, called *El Campo*, is 700 paces in circumference, ſurrounded with a great number of convents, and is the place where the fairs are kept. There is another ſquare in the middle of the city, ſurrounded with handſome brick houſes, having under them piazzas, where people may walk dry in all weathers. Within theſe piazzas merchants and tradeſmen keep their ſhops. All the houſes are of the ſame height, being four ſtories; and there are balconies at every window, of iron gilt. In the whole there are 70 monaſteries and nunneries; the fineſt of which is that of the Dominicans, remarkable for its church, which is one of the moſt magnificent in the city. The kings reſided a long while at this place; and the royal palace, which ſtill remains, is of very large extent, though but two ſtories high; within are fine paintings of various kinds, and at one of the corners a curious clock, made in the ſame manner as that of Straſburg. The houſe of the inquiſition is an odd ſort of ſtructure, for there are no windows, but a few holes to let in the light. The evirons of the city are a fine plain, covered with gardens, orchards, vineyards, meadows, and fields. It is ſeated on the rivers Eſcurva and Peſuerga, in W. Long. 4. 25. N. Lat. 41. 50.

VALUE, in commerce, denotes the price or worth of any thing.

VALVE, in hydraulics, pneumatics, &c. is a kind of lid or cover of a tube or veſſel ſo contrived as to open one way, but which, the more forcibly it is preſſed the other way, the cloſer it ſhuts the aperture; ſo that it either admits the entrance of a fluid into the tube or veſſel, and prevents its return; or admits its eſcape, and prevents its re-entrance.

Valve, in anatomy, a thin membrane applied on ſeveral cavities and veſſels of the body, to afford a paſſage to certain humours going one way, and prevent their reflux towards the place from whence they came.

VAMPYRE, a ſpecies of bat. See Vespertilio.

VAN, a term derived from the French *avant* or *avaunt*, ſignifying before or foremoſt of any thing; thus we ſay, the van-guard of the army, &c.

VANBRUGH (Sir John), a celebrated Engliſh dramatic writer and architect, was deſcended of a family in Cheſhire which came from France, though by his name he appears to have been originally of Dutch extraction. He was born about the middle of the reign of Charles II. and received a liberal education. His firſt comedy, called the *Relapſe* or *Virtue in Danger*, was acted in the year 1697 with great applauſe; which gave him ſuch encouragement, that he wrote eleven more comedies. He was the friend of Mr Congreve, whoſe genius was naturally turned for dramatic performances; and theſe two gave new life to the Engliſh ſtage, and reſtored its reputation, which had been for ſome time ſinking: but their making vicious perſons their moſt amiable and ſtriking characters, and their bordering too much on obſcenity, could be of no ſervice to the cauſe of virtue; and therefore it was not without reaſon that they were attacked by Mr Collier, in his piece on the Immorality and Profaneneſs of the Stage. However, either the reputation Sir John gained by his comedies, or his ſkill in architecture, procured him very conſiderable advantages. He was appointed Clarencieux king at arms, which he afterwards diſpoſed of. In 1716 he was appointed ſurveyor of the works at Greenwich hoſpital; he was likewiſe made comptroller-general of his majeſty's works, and ſurveyor of all the gardens and waters. He was an able architect; but his performances in that way are eſteemed heavy. Under his direction were raiſed Blenheim-houſe in Oxfordſhire, Claremont in Surry, and his own houſe at Whitehall. He died of a quinſey in 1726.

VANDELLIA, in botany; a genus of plants belonging to the claſs *didynamia* and order *angioſpermia*. The calyx is ſubquadrifid; the corolla ringent; the two exterior filaments proceed from the diſc of the lip of the corolla; the antheræ are connected; the capſule is unilocular and polyſpermous. There is only one ſpecies known, the *diffuſa*.

VAN-DIEMEN's LAND. See DIEMEN.

VANDYCK (Sir Anthony), a celebrated painter, was born at Antwerp in the year 1599. It is ſaid that Vandyck's mother was paſſionately fond of embroidery, that ſhe excelled in it, and embroidered ſeveral hiſtorical ſubjects with ſuch ſurpriſing ſkill, that they have been eſteemed maſterpieces by proficients in that art. Being deſirous to have her ſon inſtructed in the firſt rudiments of grammar, ſhe began by ſending him to ſchool to learn reading and writing. As he had ink, paper, and pens, at command, he amuſed himſelf more with drawing figures and other ſlight ſketches, than with making letters. One day his maſter having threatened to whip one of his ſchool-fellows, Vandyck poſitively aſſured him, that he need not fear his maſter's threats, as he would take care to prevent his receiving the threatened correction.—"How ſo?" replied his ſchool-fellow, "I'll paint (replied Vandyck) a face on your poſteriors;" which he did with ſuch ſkill, that when the maſter drew up the curtain, he laughed ſo immoderately that he forgave the culprit. After giving ſeveral early proofs of his excellent genius, he became the diſciple of the illuſtrious Rubens. In the church of the Auguſtines at Antwerp, at the high altar, is a celebrated picture of Rubens, repreſenting, in one part, the Virgin Mary ſitting with the child Jeſus in her lap, and in another part ſeveral ſaints, male and female, ſtanding. The breaſt of one of theſe, St Sebaſtian, is ſaid to have been painted by Vandyck when he was only a diſciple of Rubens. This great maſter being engaged one day abroad, his diſciples went into his painting-room, where, after having been ſome time employed in admiring his works, they began to play or romp in ſuch a manner, that the breaſt of St Sebaſtian, which was not yet dry, was bruſhed away by a hat thrown at random. This accident put an end to their play: they were very anxious to reſtore it, fearing that if Rubens diſcovered it they ſhould all be diſcarded. At length it was agreed that Anthony ſhould undertake to mend the ſaint's breaſt. In ſhort, taking his maſter's pallet and bruſhes, he ſucceeded ſo well, that his companions imagined Rubens would overlook it. They were miſtaken; for Rubens at his return knew immediately that ſome one had touched upon his performance: calling his diſciples, he aſked them why any one had dared to meddle with his painting? They were ſome time doubtful whether they ſhould confeſs or deny the fact. Threats at length prevailed: they owned that Vandyck had thrown his hat upon it. Upon this, cloſeting Vandyck, inſtead of chiding him, he told him, that "it was proper and even neceſſary for him to travel into Italy, the only ſchool that produced excellent painters; and that, if he would take his advice, he would arrive at the higheſt perfection." Vandyck replyed, that "he was very deſirous of it; but that his purſe was not equal to ſuch a journey, and that he feared he ſhould be obliged to ſell his hat on the road." Rubens aſſured him that that ſhould be his concern; and accordingly, a few days after, he made him a preſent of a purſe full of piſtoles, and added to that gift a dapple grey horſe, of great beauty, to carry him thither. In return for this, Vandyck painted his maſter a chimney-piece; and afterwards ſet out for Italy, about the year 1621, being then about 21 or 22 years of age. Having ſtaid a ſhort time at Rome, he removed to Venice, where he attained the beautiful colouring of Titian, Paul Veroneſe, and the Venetian ſchool, which appeared from the many excellent pictures he drew at Genoa.

After having ſpent a few years abroad, he returned to Flanders, with ſo noble, ſo eaſy, and natural a manner of painting, that Titian himſelf was hardly his ſuperior; and no other maſter could equal him in portraits. Soon after his return, he accidentally met with D. Teniers, who accoſted him with great politeneſs, and aſked him whether he had much buſineſs ſince he came from Rome? "What buſineſs, think you, can I have had time to do (replied Vandyck)? I am only juſt arrived here. Would you believe, that I offered to draw that fat brewer's picture who juſt paſſed by us for two piſtoles, and that the looby laughed in my face, ſaying it was too dear? I aſſure you, that if the cards do not turn up better, I ſhall make no long ſtay at Bruſſels." Soon after this, he painted thoſe two famous pictures, the Nativity and a dying Chriſt; the firſt in the pariſh church, the ſecond in that of the Capuchins, at Termond.

When he was in Holland he was very deſirous to ſee Francis Hals the painter, who had great reputation then for portraits. On entering his room, he aſked to have his picture drawn. Hals, who knew Vandyck only by fame, undertook it, and went to work. The latter ſeeing his head finiſhed, roſe up, ſaying, that it was a ſtriking likeneſs. Afterwards he propoſed to Hals, that if he would ſit in return, he would alſo draw his picture; to which Hals having agreed, merely from curioſity, exclaimed, on ſeeing his picture ſo ſoon finiſhed, "Thou art the devil, or elſe Vandyck." This picture of Hals has been engraved by Coſter at the Hague.

Vandyck, finding he could not make a fortune in his own country, took a reſolution of going over into England. Accordingly he borrowed ſome guineas of Teniers, and ſet out, furniſhed with letters of recommendation. His ſuperior genius ſoon brought him into great reputation; and above all, he excelled in portraits, which he drew with an inconceivable facility, and for which he charged a very high price, according to the inſtructions which had been given him on that head. Is is affirmed, that for ſome of them he received 400 guineas apiece. He ſoon found himſelf loaded with honours and riches; and as he had a noble and generous heart, he made a figure ſuitable to his fortune. He married one of the faireſt ladies of the Engliſh court, a daughter of the lord

Ruthven, earl of Gowry; and, though ſhe had but little fortune, maintained her with a grandeur anſwerable to her birth. He himſelf was generally richly dreſſed; his coaches and equipage were magnificent, and his retinue was numerous; his table was elegant, and plentifully furniſhed; and he often entertained his gueſts after dinner with a concert performed by the beſt Engliſh muſicians of London. In ſhort, his houſe was ſo frequented by perſons of the greateſt quality of both ſexes, that his apartments rather reſembled the court of a prince than the lodgings of a painter. Notwithſtanding this expence, he amaſſed great wealth; when a chemiſt had the art to inſinuate himſelf into his eſteem, and inſpired him with a deſire of converting copper into gold: but the ſecret had no other effect, than making him convert his gold into ſmoke. Rubens being informed of it, wrote to his diſciple: he acknowledged his error, and corrected it. At length Vandyck being at an early age ſubject to the gout, it undermined him by degrees, and carried him to the grave in the year 1641, at the age of 42. He was buried in St Paul's: and left to his heirs a conſiderable eſtate, which ſome have made to amount to 40,000l. ſterling.

VANE, a thin ſlip of bunting hung to the maſt-head, or ſome other conſpicuous place in the ſhip, to ſhow the direction of the wind. It is commonly ſewed upon a wooden frame called the *ſtock*, which contains two holes whereby to ſlip over the ſpindle, upon which it turns about as the wind changes.

VANILLA, or VANILLO. See EPIDENDRUM.

VAPOUR, in philoſophy, the particles of bodies rarefied by heat, and thus rendered ſpecifically lighter than the atmoſphere, in which they riſe to a conſiderable height. See EVAPORATION, DAMP, GAS, &c.

Many kinds of vapour are unfriendly to animal life, but the moſt noxious are thoſe which ariſe from metallic ſubſtances. In the ſmelting and refining of lead, a white vapour ariſes, which, falling upon the graſs in the neighbourhood, imparts a poiſonous quality to it, ſo that the cattle which feed there will die; and in like manner ſtagnant waters impregnated with this vapour will kill fiſh. In ſome places the earth exhales vapours of a very noxious quality: ſuch as the Grotto del Cani, and other places in Italy, where a mephitic vapour conſtantly hovers over the ſurface of the ground, proving inſtantly fatal to ſuch animals as are immerſed in it. In ſome parts of the world there have been inſtances of people killed, and almoſt torn to pieces, by a vapour ſuddenly burſting out of the earth under their feet.

Of the aqueous vapour raiſed from the earth by the ſun's heat are formed the clouds; but though theſe are commonly at no great diſtance from the earth, we cannot from thence determine the height to which the vapours aſcend. Indeed, conſidering the great propenſity of water, and even quickſilver, to evaporate in the moſt perfect vacuum we can make, it is by no means probable that any limit can be fixed for this aſcent. See WEATHER.

VAPOURS, noxious, method of diſſipating. The following ingenious method of diſſipating the noxious vapours commonly found in wells and other ſubterraneous places, is related in the Tranſ. Philadel. by Mr Robinſon of Philadelphia the inventor. After various unſucceſsful trials (ſays he), I was led to conſider how I could convey a large quantity of freſh air from the top to the bottom of the well, ſuppoſing that the foul would neceſſarily give way to the pure air. With this view I procured a pair of ſmith's bellows, fixed in a wooden frame, ſo as to work in the ſame manner as at the forge. This apparatus being placed at the edge of the well, one end of a leathern tube (the hoſe of a fire-engine) was cloſely adapted to the noſe of the bellows, and the other end was thrown into the well, reaching within one foot of the bottom. At this time the well was ſo infected, that a candle would not burn at a ſhort diſtance from the top; but, after blowing with my bellows only half an hour, the candle burned bright at the bottom; then, without farther difficulty, I proceeded in the work, and finiſhed my well. Wells are often made in a very ſlight manner, owing to the difficulty of working in them, and there have been ſeveral fatal inſtances of the danger attending the workmen; but, by the above method, there is neither difficulty nor danger in completing the work with the utmoſt ſolidity. It is obvious, that in cleanſing vaults, and working in any other ſubterraneous place, ſubject to damps as they are called, the ſame method muſt be attended with the ſame beneficial effect."

VAPOURS, in medicine, a diſeaſe properly called *hyps*, or the *hypochondriacal diſeaſe*; and in men particularly, the *ſpleen*. See MEDICINE, n° 276 and 321.

VAPOUR-Bath, in chemiſtry, a term applied to a chemiſt's bath or heat, wherein a body is placed ſo as to receive the fumes of boiling water. It conſiſts of two veſſels, diſpoſed over one another in ſuch manner as that the vapour raiſed from the water contained in the lower heats the matter incloſed in the upper. It is very commodious for the diſtilling of odoriferous waters, and the drawing of ſpirit of wine.

We alſo uſe the term *vapour-bath*, when a ſick perſon is made to receive the vapours ariſing from ſome liquid matter placed over a fire. Many contrivances have been propoſed for this purpoſe; and their expediency and utility are beſt known to thoſe who are converſant in this buſineſs. A late writer has ſuggeſted a new conſtruction of vapour baths; and the whole apparatus is reduced to a tin-boiler, tin pipes wrapped in flannel, and a deal box with a cotton cover, for the reception of the body and circulation of the vapour.

VARI, in medicine, little, hard, and ruddy tumors, which frequently infeſt the faces of young perſons of a hot temperament of body.

VARIATION *of the compaſs*, is the deviation of the magnetic or mariner's needle from the meridian or true north and ſouth line. On the continent it is called the *declination* of the magnetic needle; and this is a better term, for reaſons which will appear by and by.

Our readers know, that the needle of a mariner's compaſs is a ſmall magnet, exactly poiſed on its middle, and turning freely in a horizontal direction on a ſharp point, ſo that it always arranges itſelf in the plane of the magnetic action. We need not add any thing on this head to what has been delivered in the articles COMPASS and *Azimuth* COMPASS.

About the time that the polarity of the magnet was firſt obſerved in Europe, whether originally, or as imported from China, the magnetic direction, both in Europe and in China, was nearly in the plane of the meridian. It was therefore an ineſtimable preſent to the mariner, giving him a ſure direction in his courſe through the pathleſs ocean. But by the time that the European navigators had engaged in their adventurous voyages to far diſtant ſhores, the deviation of the compaſs needle from the meridian was very ſenſible even in Europe; and it is ſomewhat ſurpriſing that the Dutch and Portugueſe navigators did not obſerve it on their own coaſts. The ſon of Columbus poſitively ſays, that it was obſerved by his father in his firſt voyage to America, and made his companions ſo anxious leſt they ſhould not find the way back again to their own country, that they mutinied and refuſed to proceed, It is ſurpriſing that any ſhould doubt of its being known to this celebrated navigator, becauſe he even endeavours to account for it by ſuppoſing the needle always to point to a fixed point of the heavens, different from the pole of the world, which he calls the *point attractive*. It is at any rate certain that Gonzales Oviedo and Sebaſtian Cabot obſerved it in their voyages. Indeed it could not poſſibly eſcape them; for in ſome parts of their ſeveral tracks the needle deviated above 25 degrees from the meridian; and the rudeſt dead reckoning, made on the ſuppoſition of the needle pointing due north and ſouth, muſt have thrown the navigators into the utmoſt confuſion. It would indeed be very difficult for them, unprepared for this ſource of error, to make any tolerable gueſs at its quantity, till they get to ſome place on ſhore, where they could draw a meridian line. But we know that ſpherical trigonometry was at that time abundantly familiar to the mathematicians of Europe, and that no perſon pretended to take the command of a ſhip bound to a diſtant port that was not much more informed in this ſcience than moſt maſters of ſhips are now-a-days. It could not be long, therefore, before the methods were given them for diſcovering the variation of the compaſs by obſervation of AMPLITUDES and AZIMUTHS, as is practiſed at preſent (ſee each of theſe articles). But the deviation of the compaſs from the meridian was not generally allowed by mathematicians, who had not yet become ſenſible of the neceſſity of quitting the Ariſtotelean trammels, and inveſtigating nature by experiments. They rather choſe to charge the navigators with inaccuracy in their obſervations than the ſchoolmen with error in principles. Pedro de Medina at Valladolid, in his *Arte de Naviggar*, publiſhed in 1545, poſitively denies the variation of the compaſs. But the concurring reports of the commanders of ſhips on diſtant voyages, in a few years, obliged the landſmen in their cloſets to give up the point; and Martin Cortez, in a treatiſe of navigation, printed at Seville before 1556, treats it is a thing completely eſtabliſhed, and gives rules and inſtruments for diſcovering its quantity. About the year 1580 Norman publiſhed his diſcovery of the *dip* of the needle, and ſpeaks largely of the horizontal deviation from the plane of the meridian, and attributes it to the attraction of a point, not in the heavens, but in the earth, and deſcribes methods by which he hoped to find its place. To the third, and all the ſubſequent editions of Norman's book (called the *new attractive*), was ſubjoined a diſſertation by Mr Burroughs, comptroller of the navy, on the variation of the compaſs, in which are recorded the quantity of this deviation in many places; and he laments the obſtacle which it cauſes to navigation by its total uncertainty previous to obſervation. The author indeed offers a ſort of rule for computing it *a priori*, founded on ſome conjecture as to its cauſe; but, with the modeſty and candour of a gentleman, acknowledges that this is but a gueſs, and intreats all navigators to be aſſiduous in their obſervations, and liberal in communicating them to the public; conjuring them to conſider, that an intereſted regard to their own private advantage, by concealing their knowledge, may prove the ſhipwreck of thouſands of brave men. Accordingly obſervations were liberally contributed from time to time, and were publiſhed in the ſubſequent treatiſes on navigation.

But in 1635 the mariners were thrown into a new and great perplexity, by the publication of a *Diſcourſe mathematical on the variation of the Magnetical Needle*, by Mr Henry Gillebrand, Greſham profeſſor of aſtronomy. He had compared the variations obſerved at London by Burroughs, Gunter, and himſelf, and found that the north end of the mariner's needle was gradually drawing more to the weſtward. For Norman and Burroughs had obſerved it to point about $11\frac{1}{2}$ degrees to the eaſt of the north in 1580; Gunter found its deviation only $6\frac{1}{4}$ in 1622, and he himſelf had obſerved only 4° in 1634; and it has been found to deviate more and more to the weſtward ever ſince, as may be ſeen from the following little table in Waddington's Navigation.

London.

1576	Norman	11°15′ Eaſt.
1580	Burroughs	11.17
1622	Gunter	6.12
1634	Gillebrand	4. 5
1662		0. 0
1666	Sellers	0.34 Weſt
1670		2.06
1672		2.30
1700		9.40
1720		13.—
1740		16.10
1760		19.30
1774		22.20
1778	Phil. Tranſ.	22.11

Mr Bond, teacher of mathematics in London, and employed to take care of and improve the impreſſions of the popular treatiſes of navigation, about the year 1650, declared, in a work called the "Seaman's Kalendar," that he had diſcovered the true progreſs of the deviation of the compaſs; and publiſhed in another work, called the "Longitude Found," a table of the variation for 50 years. This was, however, a very gratuitous ſort of prognoſtication, not founded on any well-grounded principles; and though it tallied very well with the obſervations made in London, which ſhowed a gradual motion to the weſtward at the rate of—.12′ annually, by no means agreed with the obſervations made in other places. See Phil. Tranſ. 1668.

But this glad news to navigators ſoon loſt its credit; for the inconſiſtency with obſervation appeared more and more every day, and all were anxious to diſcover ſome general rule, by which a near gueſs at leaſt might be made as to the direction of the needle in the moſt frequented ſeas. Mr Halley, one of the firſt geometers and moſt zealous philoſophers of the laſt century, recommended the matter in the moſt earneſt manner to the attention of government; and, after much unwearied ſolicitation, obtained a ſhip to be ſent on a voyage of diſcovery for this very purpoſe. He got the command of this ſhip, in which he repeatedly traverſed the Atlantic Ocean, and went as far as the 50th degree of ſouthern latitude. See his very curious ſpeculations on this ſubject in the Phil. Tranſ. 1683 and 1692.

After he had collected a prodigious number of obſervations made by others, and compared them with his own, he publiſhed in 1700 a ſynoptical account of them in a very ingenious form of a ſea-chart, where the ocean was croſſed by a number of lines paſſing through thoſe planes where the compaſs had the ſame deviation. Thus, in every point of one line there was no variation in 1700; in every point of another line the compaſs had 20 degrees of eaſt variation; and in every point of a third line it had 20° of weſt variation. Theſe lines have ſince been called *Halleyan lines*, or curves. This chart was received with univerſal applauſe, and was undoubtedly one of the moſt valuable preſents that ſcience has made to the arts. But though recommended with all the earneſtneſs which its importance merited, it was offered with the candour and the caution that characteriſes a real philoſopher ardently zealous for the propagation of true knowledge. Its illuſtrious author reminds the public of the inaccuracy of obſervations collected from every quarter, many of them made by perſons not ſufficiently inſtructed, nor provided with proper inſtruments; many alſo without dates, and moſt of them differing in their dates, ſo that ſome reduction was neceſſary for all, in order to bring them to a common epoch; and this muſt be made without having an unqueſtionable principle on which to proceed. He ſaid, that he plainly ſaw that the change of variation was very different in different places, and in the ſame place at different times; and confeſſes that he had not diſcovered any general principle by which theſe changes could be connected.

Halley's *Variation Chart*, however, was of immenſe uſe; but it became gradually leſs valuable, and in 1745 was exceedingly erroneous. This made Meſſrs Mountaim and Dodſon, fellows of the Royal Society, apply to the admiralty and to the great trading companies for permiſſion to inſpect their records, and to extract from them the obſervations of the variations made by their officers. They got all the aſſiſtance they could demand; and, after having compared above 50,000 obſervations, they compoſed new variation charts, fitted for 1745 and 1756.

The polarity of the magnetic needle, and a general tho' intricate connection between its poſitions in all parts of the world, naturally cauſes the philoſopher to ſpeculate about its cauſe. We ſee that Cortez aſcribed it to the attraction of an eccentric point, and that Bond thought that this point was placed not in the heavens, but in the earth. This notion made the baſis of the famous Theory of Magnetiſm of Dr Gilbert of Colcheſter, the firſt ſpecimen of experimental philoſophy which has been given to the public. It was publiſhed about the year 1600: he was an intimate acquaintance of the great experimental philoſopher lord Bacon, and proceeded entirely according to the plan laid down by that illuſtrious leader in his *Novum Organum Scientiarum*.

Gilbert aſſerted that the earth was a great magnet, and that all the phenomena of the mariner's compaſs were the effects of this magnetiſm. He ſhowed at leaſt that theſe phenomena were preciſely ſuch as would reſult from ſuch a conſtitution of the earth; that is, that the poſitions of the mariner's needle in different parts of the earth were preciſely the ſame with thoſe of a ſmall magnet ſimilarly ſituated with reſpect to a very large one. Although he had made more magnetic experiments than all that had gone before him put together, ſtill the magnetical phenomena were but ſcantily known till long after. But Gilbert's theory (for ſo it muſt be truly eſteemed) of the magnetical phenomena is now completely confirmed. The whole of it may be underſtood from the following general propoſition.

Plate DXIII. Let NS (fig. 1) be a magnet, of which N is the north and S the ſouth pole: Let ns be any oblong piece of iron, poiſed on a point c like a compaſs needle. It will arrange itſelf in a poſition ncs preciſely the ſame with that which would be aſſumed by a compaſs needle of the ſame ſize and ſhape, having n for its north and s its ſouth pole. And while the piece of iron remains in this poſition, it will be in all reſpects a magnet ſimilar to the real compaſs needle. The pole n will attract the ſouth pole of a ſmall magnetiſed needle, and repel its north pole. If a paper be held over ns, and fine iron-filings be ſtrewed on it, they will arrange themſelves into curves iſſuing from one of its ends and terminating at the other, in the ſame manner as they will do when ſtrewed on a paper held over a real compaſs needle. But this magnetiſm is quite temporary; for if the piece of iron ns be turned the other way, placing n where s now is, it will remain there, and will exhibit the ſame phenomena. We may here add, that if ns be almoſt infinitely ſmall in compariſon of NS, the line ns will be in ſuch a poſition that if sa, sb, be drawn parallel to Nc, Sc, we ſhall have sa to sb as the force of the pole N to the force of the pole S. And this is the true cauſe of that curious diſpoſition of iron-filings when ſtrewed round a magnet. Each fragment becomes a momentary magnet, and arranges itſelf in the true magnetic direction; and when ſo arranged, attracts the two adjoining fragments, and co-operates with the forces, which alſo arrange them. We throw this out to the ingenious mechanician as the foundation of a *complete* theory of the magnetical phenomena. When the filings are infinitely fine, the curves NcS have this property, that, drawing the tangent ncs, we always have $sa : sb =$ force of N : force of S; and thus we may approximate at pleaſure to the law of magnetic attraction and repulſion. The public may expect to have ſoon a theory of magnetiſm founded on this principle, and applied with the completeſt ſucceſs to every phenomenon yet obſerved.

Now, to apply this theory to the point in hand.—Let ns (fig. 2.) be a ſmall compaſs needle, of which n is the north and s the ſouth pole: let this needle be poiſed horizontally on the pin cd; and let $n's'$ be the poſition of the *dipping needle*. Take any long bar of common iron, and hold it upright, or nearly ſo, as repreſented by AB. The lower end B will repel the pole n and will attract the pole s, thus exhibiting the properties of a north pole of the bar AB. Keeping B in its place, turn the bar round B′ as a centre, till it come into the poſition A′B′ nearly parallel to $n's'$. You will obſerve the compaſs needle ns attract the end B′ with either pole n or s, when B′A′ is in the poſition B′a perpendicular to the direction $n's'$ of the dipping needle: and when the bar has come into the poſition B′A′, the upper end B′ will ſhow itſelf to be a ſouth pole by attracting n and repelling s. This beautiful experiment was exhibited to the Royal Society in 1673 by Mr Hindſhaw.

From this it appears, that the great magnet in the earth induces a momentary magnetiſm on ſoft iron preciſely as a common magnet would do. Therefore (ſays Dr Gilbert) it induces permanent magnetiſm on magnetiſable ores of iron, ſuch as loadſtones, in the ſame manner as a great loadſtone would do; and it affects the magnetiſm already imparted to a piece of tempered ſteel preciſely as any other great magnet would.

Therefore the needle of the mariner's compaſs in every part of the world arranges itſelf in the magnetic direction, ſo that, if poiſed as a dipping needle ſhould be, it will be a tangent to one of the curves NcS of fig. 1. The horizontal needle being ſo poiſed as to be capable of playing only in a horizontal plane, will only arrange itſelf *in the plane* of the triangle NcS. That end of it which has the ſame magnetiſm with the ſouth pole S of the great magnet included in the earth will be turned towards its north pole N. Therefore what we call the north pole of a needle or magnet really has the magnetiſm of the ſouth pole of the great primitive magnet. If the line NS be called the axis, and N and S the poles of this great magnet, the plane of any one of theſe curves NcS will cut the earth's ſurface in the circumference of a circle, great or ſmall according as the plane does or does not paſs through the centre of the earth.

Dr Halley's firſt thought was, that the north pole of the great magnet or loadſtone which was included in the bowels of the earth was not far from Baffin's Bay, and its ſouth pole in the Indian ocean ſouth-weſt from New Zealand. But he could not find any poſitions of theſe two poles which would give the needle that particular poſition which it was obſerved to aſſume in different parts of the world; and he concluded that the great terreſtrial loadſtone had four irregular poles (a thing not unfrequent in natural loadſtones, and eaſily producible at pleaſure), two of which are ſtronger and two weaker. When the compaſs is at a great diſtance from the two north poles, it is affected ſo as to be directed nearly in a plane paſſing through the ſtrongeſt. But if we approach it much more to the weakeſt, the greater vicinity will compenſate for the ſmaller abſolute force of the weak pole, and occaſion conſiderable irregularities. The appearances are favourable to this opinion. If this be the real conſtitution of the great magnet, it is almoſt a deſperate taſk to aſcertain by computation what will be the poſition of the needle. Halley ſeems to have deſpaired; for he was both an elegant and a moſt expert mathematician, and it would have coſt *him* little trouble to aſcertain the places of two poles only, and the direction which theſe would have given to the needle. But to ſay what would be its poſition when acted on by four poles, it was neceſſary to know the law by which the magnetic action varied by a variation of diſtance; and even when this is known, the computation would have been exceedingly difficult.

In order to account for the change of variation, Dr Halley ſuppoſes this internal magnet not to adhere to the external ſhell which we inhabit, but to form a nucleus or kernel detached from it on all ſides, and to be ſo poiſed as to revolve freely round an axis, of which he hoped to diſcover the poſition by obſervation of the compaſs. The philoſopher will find nothing in this ingenious hypotheſis inconſiſtent with our knowledge of nature. Dr Halley imagined that the nucleus revolved from eaſt to weſt round the ſame axis with the earth. Thus the poles of the magnet would change their poſitions relatively to the earth's ſurface, and this would change the direction of the compaſs needle.

The great Euler, whoſe delight it was always to engage in the moſt difficult mathematical reſearches and computations, undertook to aſcertain the poſition of the needle in every part of the earth. His diſſertation on this ſubject is to be ſeen in the 13th volume of the Memoirs of the Royal Academy of Berlin, and is exceedingly beautiful, abounding in thoſe analytical *tours d'adreſſe* in which he ſurpaſſed all the world. He has reduced the computation to a wonderful ſimplicity.

He found, however, that four poles would engage him in an analyſis which would be exceſſively intricate, and has contented himſelf with computing for two only; obſerving that this ſuppoſition agrees ſo well with obſervation, that it is highly probable that this is the real conſtitution of the terreſtrial magnet, and that the coincidence would have been perfect if he had hit on the due poſitions of the two poles. He places one of them in lat. 76° north, and long. 96° weſt from Teneriffe. The ſouth pole is placed in lat. 58° ſouth, and long. 158° weſt from Teneriffe. Theſe are their ſituations for 1757.—Mr Euler has annexed to his diſſertation a chart of Halleyan curves ſuited to theſe aſſumptions, and fitted to the year 1757.

It muſt be acknowledged, that the *general* courſe of the variations according to this theory greatly reſembles the real ſtate of things; and we cannot but own ourſelves highly indebted to this great mathematician for having made ſo fine a firſt attempt. He has improved it very conſiderably in another diſſertation in the 22d volume of theſe memoirs. But there are ſtill ſuch great differences, that the theory is of no ſervice to the navigator, and it only ſerves as an excellent model for a farther proſecution of the ſubject. Since that time another large variation chart has been publiſhed, fitted to a late period; but the public has not ſufficient information of the authorities or obſervations on which it is founded.

The great object in all theſe charts is to facilitate the diſcovery of a ſhip's longitude at ſea. For the lines of variation being drawn on the chart, and the variation and the latitude being obſerved at ſea, we have only to look on the chart for the interſection of the parallel of obſerved latitude and the Halleyan curve of obſerved variation. This interſection muſt be the place of the ſhip. This being the purpoſe, the Halleyan lines are of great ſervice; but they do not give us a ready conception of the direction of the needle. We have always to *imagine* a line drawn through the point, cutting the meridian in the angle correſponding to the Halleyan line. We ſhould learn the general magnetic affections of the globe much better if a number of magnetic meridians were drawn. Theſe are the interſections of the earth's ſurface with planes paſſing through the magnetical axis, cutting one another in angles of 5° or 10°. This would both ſhow us the places of the magnetic poles much more clearly, and would, in every place, ſhow us at once the direction of the needle. In all thoſe places where theſe magnetical curves touch the meridians, there is no variation; and the variation in every other place is the angle contained between theſe magnetical meridians and the true ones.

The program of a work of this kind has been publiſhed by a Mr Churchman, who appears to have engaged in the inveſtigation with great zeal and conſiderable opportunities. He had been employed in ſome operations connected with ſurveys of the back ſettlements in North America. It is pretty certain that the north magnetic pole (or point, as Mr Churchman chooſes to call it) is not far removed from the ſtations given it by Halley and Euler; and there ſeems no doubt but that in the countries between Hudſon's Bay and the weſtern coaſts of North America the needle will have every poſition with reſpect to the terreſtrial meridian, ſo that the north end of a compaſs needle will even point due ſouth in ſeveral places. Mr Churchman has ſolicited aſſiſtance from all quarters, to enable him to traverſe the whole of that inhoſpitable country with the compaſs in his hand. It were greatly to be wiſhed that our gracious ſovereign, who has always ſhown ſuch a love for the promotion of nautical ſcience, and who has ſo munificently contributed to it, already enriching the world with the moſt valuable diſcoveries, and thus laying poſterity under unſpeakable obligations; it were greatly to be wiſhed that he would put this almoſt finiſhing ſtroke to the noble work, and enable Mr Churchman, or ſome fitter perſon, if ſuch can be found, to proſecute this moſt intereſting inquiry. Almoſt every thing that can be deſired would be obtained by a few *well choſen* obſervations made in thoſe regions. It would be of immenſe advantage to have the *dips* aſcertained with great preciſion. Theſe would enable us to judge at what depth under the ſurface the pole is ſituated; for the well informed mechanician, who will ſtudy ſeriouſly what we have ſaid about the magnetical curves, will ſee that a compaſs needle, when compared with the great terreſtrial magnet, is but as a particle of iron-filings compared to a very large artificial magnet. Therefore, from the poſition of the dipping needle, we may infer the place of the pole, if the law of magnetic action be given; and this law may be found by means of other experiments which we could point out.

Mr Churchman has adopted the opinion of only two poles. According to him, the north pole lies (in 1800) in Lat. 58° N. and Long. 134° weſt from Greenwich, very near Cape Fair-weather; and the ſouth pole lies in Lat. 58° S. and Lon. 165° E. from Greenwich. He alſo imagines that the north pole has moved to the eaſtward, on a parallel of latitude, about 65° ſince the beginning of laſt century (from 1600), and concludes that it makes a revolution in 1096 years. The ſouthern pole has moved leſs, and completes its revolution in 2289 years. This motion he aſcribes to ſome influences which he calls *magnetic tides*, and which he ſeems to conſider as celeſtial. This he infers from the changes of variation. He announces a phyſical theory on this ſubject, which, he ſays, enables him to compute the variation with preciſion for any time paſt or to come; and he even gives the proceſs of trigonometrical computation illuſtrated by examples. But as this publication (entitled *The Magnetic Atlas*, publiſhed for the Author, by Darton and Harvey, 1794) is only a program, he expreſſes himſelf obſcurely, and ſomewhat enigmatically, reſpecting his theory, waiting for encouragement to make the obſervations which are neceſſary for completing it. He has, in the mean time, accompanied his account of the theory with a chart, in the form of guſſets, for covering a globe of 15 inches diameter, objecting very juſtly to the great diſtortion which Wright's charts occaſion in every part near the poles. This diſtortion is ſuch as totally to change the appearance of the curves in thoſe very places where their appearance and magnitude are of the greateſt moment.

Mr Churchman has alſo accompanied his work with the returns which he has received from ſeveral perſons eminent for their rank or learning, to whom he had applied for encouragement and aſſiſtance. They are polite, but, we think, not ſo encouraging as ſuch zeal in ſuch a cauſe had good reaſon to expect. We acknowledge that there are circumſtances which juſtify caution in promiſes of this nature. His profers are very great, and not qualified with any doubt. Some of his proofs are not very convincing, and there are ſome conſiderable defects in the ſcientific part. He ſpeaks in ſuch terms of the magnetic influences as plainly lead us to conclude that they reſemble, in effect at leaſt, the ordinary actions of magnets. He ſpeaks of the influence of one pole being greater than that of the other; and ſays, that in this caſe the magnetic equator, where the needle will be parallel to the axis, will not be in the middle between the poles. This is true of a common magnet. He muſt therefore abide by this ſuppoſition in its other conſequences. The magnetic meridians muſt be planes paſſing through this axis, and therefore muſt be circles on the ſurface of the earth. This is incompatible with the obſervations; nay, his charts are ſo in many places, particularly in the Pacific Ocean, where the variations by his chart are three times greater than what has been obſerved.—His parallels of dip are ſtill more different from obſervation, and are incompatible with any phenomena that could be produced by a magnet having but two poles. His rules of computation are exceedingly exceptionable. He has in fact but one example, and that ſo particular, that the mode of computation will not apply to any other. This circumſtance is not taken notice of in the enunciation of his firſt problem; and the reader is made to imagine that he has got a rule for computing the variation, whereas all the rules of calculation are only running in a circle. The variation computed for the port of St Peter and Paul in Kamtſchatka, by the rule, is ten times greater than the truth. This is like the artifice of a book-maker. We do not meet with any addition to our knowledge on the ſubject. The author ſeems to know ſomething of Euler's merit; but inſtead of proſecuting the ſubject in his way, he gives us an unintereſting account of the ſurmiſes of a number of obſcure writers about the difficulty of the taſk; and we think that Mr Churchman has left us as much in the dark as ever. The obſervation of the connection of the polarity of the needle with the aurora borealis occurred to the writer of this article as early as 1759, when a midſhipman on board the Royal William in the river St Laurence. Some of the gentlemen of the quarter deck are ſtill alive, and may remember this circumſtance being pointed out to them one evening, when at anchor off the Iſle aux Coudres, during a very brilliant aurora borealis. The point of the heavens to which all the rays of light converged was preciſely that which was oppoſite to the ſouth end of the dipping-needle. The obſervation was inſerted in the St James's Chronicle, and afterwards (about 1776) in the London Chronicle, with a requeſt to navigators to take notice of it, and communicate their obſervations.

For our own part, we have little hopes of this problem ever being ſubjected to accurate calculation. We believe, indeed, that there is a coſmical change going on in the earth, which will produce a progreſſive change in the variation of the needle; and we ſee none more likely than Dr Halley's notion. There is nothing repugnant to our knowledge of the univerſe on the ſuppoſition of a magnetic nucleus revolving within this earth; and it is very eaſy to conceive a very ſimple motion of revolution, which ſhall produce the very motion of the ſenſible poles which Mr Churchman contends for. We need only ſuppoſe that the magnetical axis of this nucleus is not its axis of revolution. It may not even biſect that axis; and this circumſtance will cauſe the two poles to have different degrees of motion in relation to the ſhell which ſurrounds it.

But this regular progreſs of the magnet within the earth may produce very irregular motions of the compaſs needle, by the intervention of a third body ſuſceptible of magnetiſm. The theory of which we have juſt given a hint comes here to our aſſiſtance. Suppoſe NS (fig. 3.) to repreſent the primitive magnet in the earth, and *n s* to be a ſtratum of iron-ore ſuſceptible of magnetiſm. Alſo let *n' s'* be another ſmall maſs of a ſimilar ore; and let their ſituations and magnitudes be ſuch as is exhibited in the figure. The fact will be, that *n* will be the north pole and *s* the ſouth pole of the great ſtratum, and *n'* and *s'* will be the north and ſouth poles of the ſmall maſs or loadſtone. Any perſon may remove all doubts as to this, by making the experiment with a magnet NS, a piece of iron or ſoft tempered ſteel *n s*, and another piece *n's'*. The well informed and attentive reader will eaſily ſee, that by ſuch interventions every conceiveable anomaly may be produced. While the great magnet makes a revolution in any direction, the needle will change its poſition gradually, and with a certain regularity; but it will depend entirely on the ſize, ſhape, and ſituation, of theſe intervening maſſes of magnetiſable iron-ore, whether the change of variation of the compaſs ſhall be ſuch as the primitive magnet alone would have produced, or whether it ſhall be of a kind wholly different.

Now, that ſuch intervening diſturbances *may* exiſt, is paſt contradiction. We know that even on the film of earth which we inhabit, and with which only we are acquainted, there are extenſive ſtrata or otherwiſe diſpoſed maſſes of iron-ores in a ſtate ſuſceptible of magnetiſm; and experiments made on bars of hard tempered ſteel, and on bits of ſuch ores, aſſure us that the magnetiſm is not induced on ſuch bodies in a moment, but propagated gradually along the maſs.—That ſuch diſturbances do actually exiſt, we have many relations. There are many inſtances on record of very extenſive magnetic rocks, which affect the needle to very conſiderable diſtances. The iſland of Elbe in the Mediterranean is a very remarkable inſtance of this. The iſland of Cannay alſo, on the weſt of Scotland, has rocks which affect the needle at a great diſtance.

A ſimilar effect is obſerved near the Feroe Iſlands in the North ſea; the compaſs has no determined direction when brought on ſhore. *Journ. des Sçavans*, 1679, p. 174.

In Hudſon's Straits, in latitude 63°, the needle has hardly polarity. *Ellis's Voyage to Hudſon's Bay*.

Bouguer obſerved the ſame thing in Peru. Nay, we believe that almoſt all rocks, eſpecially of whin or trappe ſtone, contain iron in a proper ſtate.

All this refers only to the thin cruſt through which the human eye has occaſionally penetrated. Of what may be below we are ignorant; but when we ſee appearances which tally ſo remarkably with what would be the effects of great maſſes of magnetical bodies, modifying the general and regularly progreſſive action of a primitive magnet, whoſe exiſtence and motion is inconſiſtent with nothing that we know of this globe, this manner of accounting for the obſerved change of variation has all the probability that we can deſire. Nay, we apprehend that very conſiderable changes may be produced in the direction of the compaſs needle even without the ſuppoſition of any internal motion. If the great magnet reſembles many loadſtones we are acquainted with, having more than two poles, we know that theſe poles will act on each other, and gradually change each other's force, and conſequently the direction of the compaſs. This proceſs, to be ſure, tends to a ſtate of things which will change no more. —But the period of human hiſtory, or of the hiſtory of the race of Adam, may make but a ſmall part of the hiſtory of this globe; and therefore this objection is of little force.

There can be no doubt of the operation of the general terreſtrial magnetiſm on every thing ſuſceptible of magnetic properties; and we cannot heſitate to explain in this way many changes of magnetic direction which have been obſerved. Thus, in Italy, Father de la Torré obſerved, that during a great eruption of Veſuvius the variation was 16° in the morning, at noon it was 14°, and in the evening it was 10°, and that it continued in that ſtate till the lava grew ſo dark as no longer to be viſible in the night; after which it ſlowly increaſed to 13½, where it remained. Daniel Bernoulli found the needle change its poſition 45′ by an earthquake. Profeſſor Muller at Manheim obſerved that the declination of the needle in that place was greatly affected by the earthquake in Calabria. Such ſtreams of lava as flowed from Hekla in the laſt dreadful eruption muſt have made a transference of magnetic matter that would conſiderably affect the needle. But no obſervations ſeem to have been made on the occaſion; for we know that common iron-ſtone, which has no effect on the needle, will, by mere cementation with any inflammable ſubſtance, become magnetic. In this way Dr Knight ſometimes made artificial loadſtones.—But theſe are partial things, and not connected with the general change of variation now under conſideration.

We have ſaid ſo much on this ſubject, chiefly with the view of cautioning our readers againſt too ſanguine expectations from any pretenſions to the ſolution of this great problem. We may certainly gather from theſe obſervations, that even although the theory of the variation ſhould be completed, we muſt expect (by what we already know of magnetiſm in general) that the diſturbances of the needle, by local cauſes intervening between it and the great influence by which it is chiefly directed, may be ſo conſiderable as to affect the poſition of the compaſs needle in a very ſenſible manner: for we know that the metallic ſubſtances in the bowels of the earth are in a ſtate of continual change, and this to an extent altogether unknown.

There is another irregularity of the mariner's needle that we have taken no notice of, namely, the daily variation. This was firſt obſerved by Mr. George Graham in 1722 (*Philoſophical Tranſactions*, n° 383), and reported to the Royal Society of London. It uſually moves (at leaſt in Europe) to the weſtward from 8 morning till 2 P. M. and then gradually returns to its former ſituation. The diurnal variations are ſeldom leſs than 0° 5′, and often much greater. Mr Graham mentions (*Philoſophical Tranſactions*, n° 428) ſome obſervations by a captain Hume, in a voyage to America, where he found the variation greateſt in the afternoon. This being a general phenomenon, has alſo attracted the attention of philoſophers. The moſt detailed accounts of it to be met with are thoſe of Mr Canton, in *Philoſophical Tranſactions*, Vol. LI. Part 1. p. 399, and thoſe of Van Swinden, in his *Treatiſe on Electricity and Magnetiſm*.

It appears from Canton's obſervations, that although there be great irregularities in this diurnal change of poſition of the mariner's needle, there is a certain average, which is kept up with conſiderable ſteadineſs. The following table ſhows the average of greateſt daily change of poſition in the different months of the year, obſerved in Mr Canton's houſe, Spital Square, in 1759.

January	7′. 8″	July	13′.14″
February	8 .58	Auguſt	12 .19
March	11 .27	Sept.	11 .43
April	12 .26	October	10 .36
May	13 .—	Nov.	8 . 9
June	13 .21	Dec.	6 .58

Mr Canton attempts to account for theſe changes of poſition, by obſerving that the force of a magnet is weakened by heat. A ſmall magnet being placed near a compaſs needle, ENE from it, ſo as to make it deflect 45° from the natural poſition, the magnet was covered with a braſs veſſel, into which hot water was poured. The needle gradually receded from the magnet ¾ths of a degree, and returned gradually to its place as the water cooled. This is confirmed by uniform experience.

The parts of the earth to the eaſtward are firſt heated in the morning, and therefore the force of the earth is weakened, and the needle is made to move to the weſtward. But as the ſun warms the weſtern ſide of the earth in the afternoon, the motion of the needle muſt take the contrary direction.

But this way of explaining by a change in the force of the earth ſuppoſes that the changing cauſe is acting in oppoſition to ſome other force. We do not know of any ſuch. The force, whatever it is, ſeems ſimply to produce its own effect, in deranging the needle from the direction of terreſtrial magnetiſm. If Æpinus's theory of magnetic action be admitted, *viz.* that a bar of ſteel has magnetiſm induced on it by propelling the quieſcent and mutually repelling particles of magnetic fluid to one end, or attracting them to the other, we may ſuppoſe that the ſun acts on the earth as a magnet acts on a piece of ſoft iron, and in the morning propels the fluid in the north-weſt parts. The needle directs itſelf to this conſtipated fluid, and therefore it points to the eaſtward of the magnetic north in the afternoon. And (to abide by the ſame theory) this induced magnetiſm will be ſomewhat greater when the earth is warmer; and therefore the diurnal variation will be greateſt in ſummer. This change of poſition of the conſtipated fluid muſt be ſuppoſed to bear a very ſmall ratio to the whole fluid, which is naturally ſuppoſed to be conſtipated in one pole of the great magnet in order to give it magnetiſm. Thus we ſhall have the diurnal variation of a very ſmall quantity. This is departing, however, from the principle of Mr Canton's explanation; and indeed we cannot ſee how the weakening the general force of the terreſtrial magnet ſhould make any change in the needle in reſpect to its direction; nor does it appear probable that the change of temperature produced by the ſun will penetrate deep enough to produce any ſenſible effect on the magnetiſm. And if this be the caſe, we think that the derangements of the needle ſhould vary as the thermometer varies, which is not true. The other method of explaining is much better, if Æpinus's theory of magnetic attraction and repulſion be juſt; and we may ſuppoſe that it is only the ſecondary magnetiſm (*i. e.* that of the magnetiſable minerals) that is ſenſibly affected by the heat; this will account very well for the greater mobility of the fluid in ſummer than in winter.

A great objection to either of theſe explanations is the prodigious diverſity of the diurnal variations in different places. This is ſo very great, that we can hardly aſcribe the diurnal variation to any change in the magnetiſm of the

primitive

VARIATION. Plate DXIII.

Fig. 1.

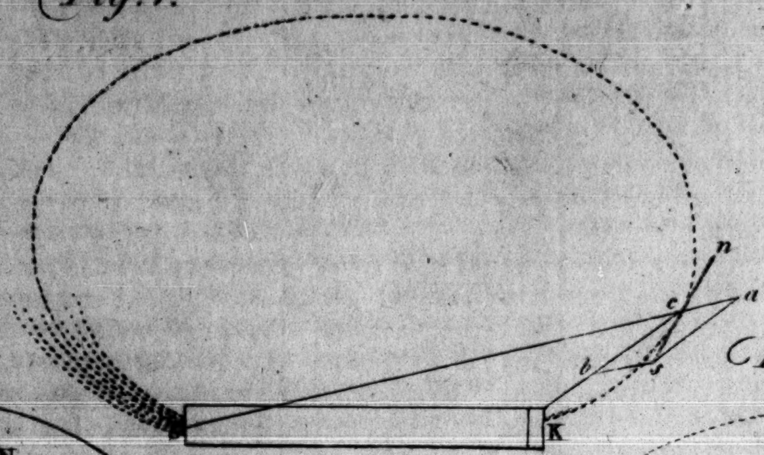


Fig. 3.

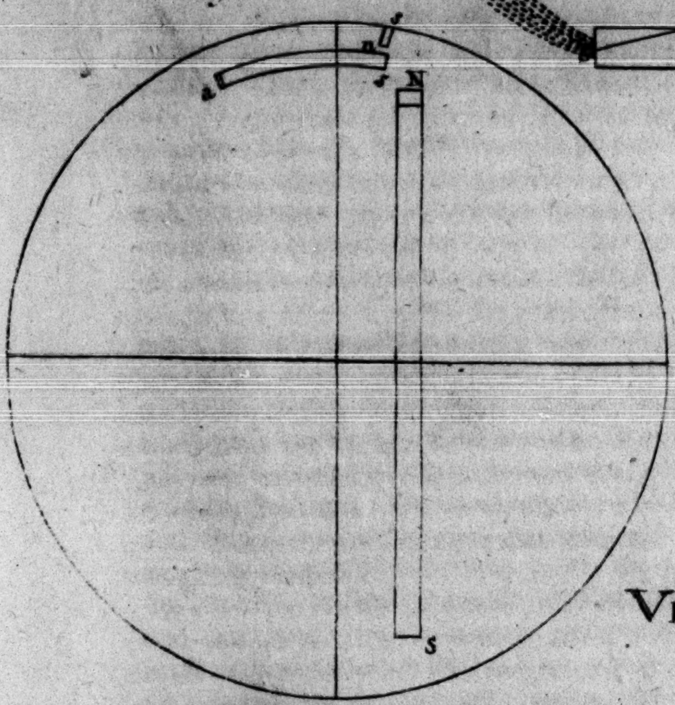
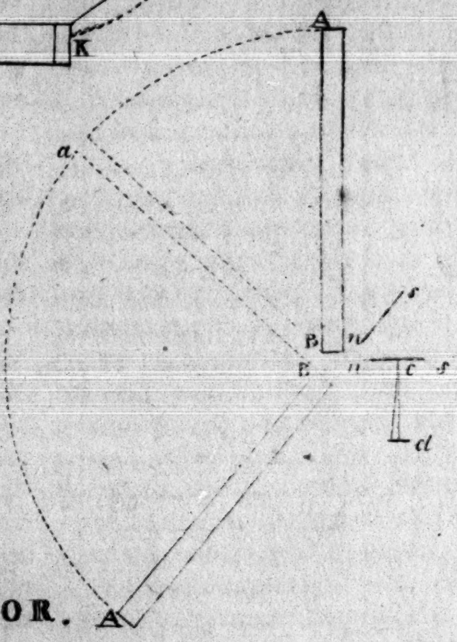


Fig. 2.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VENTILATOR.

Fig. 1.

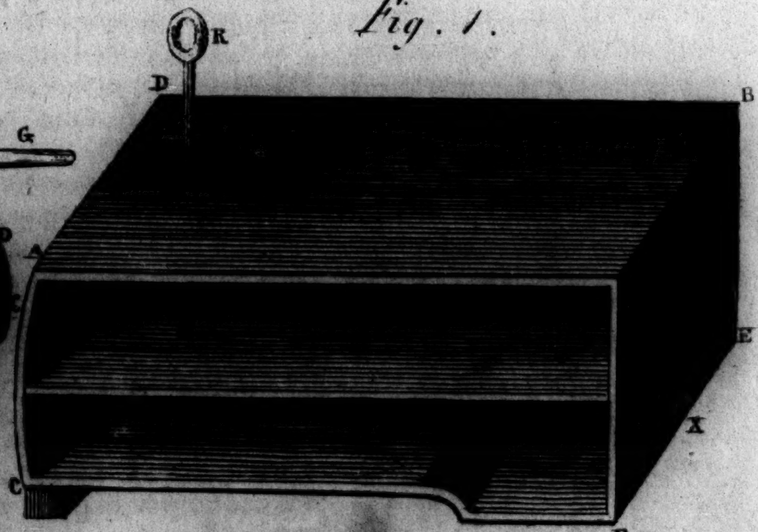

Fig. 2.

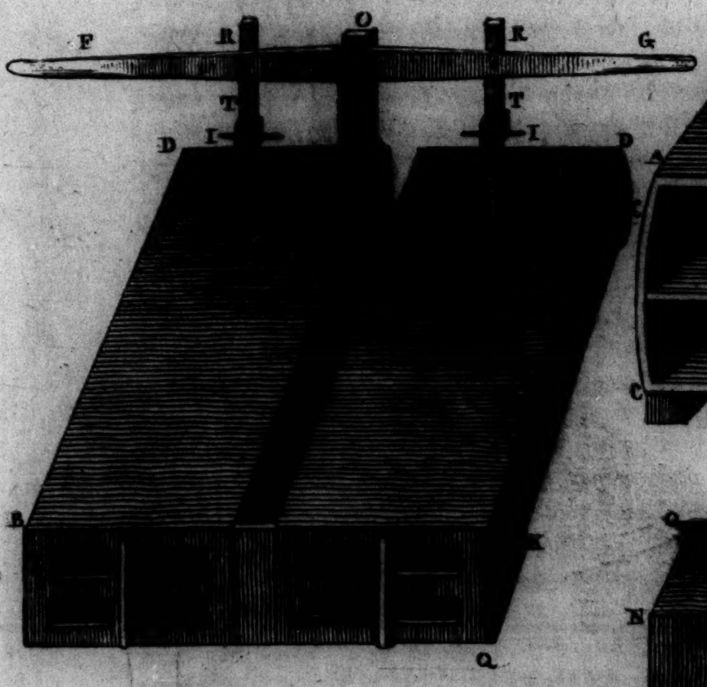
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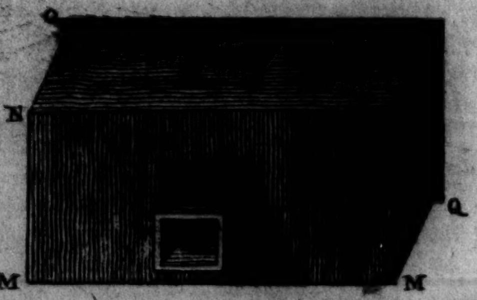
Fig. 3.



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primitive terreſtrial magnet, and muſt rather look for its cauſe in local circumſtances. This concluſion becomes more probable, when we learn that the deviation from the meridian and the deviation from the horizontal line are not affected at the ſame time. Van Swinden aſcribes them ſolely to changes produced on the needles themſelves. If their magnetiſm be greatly deranged by the ſun's poſition, it may throw the magnetic centre away from the centre of the needle's motion, and thus may produce a very ſmall change of poſition. But if this be the cauſe, we ſhould expect differences in different needles. Van Swinden ſays, that there are ſuch, and that they are very great; but as he has not ſpecified them, we cannot draw any concluſion.

But, beſides this regular diurnal variation, there is another, which is ſubjected to no rule. The aurora borealis is obſerved (in Europe) to diſturb the needle exceedingly, ſometimes drawing it ſeveral degrees from its poſition. It is always obſerved to increaſe its deviation from the meridian, that is, an aurora borealis makes the needle point more weſterly. This diſturbance ſometimes amounts to ſix or ſeven degrees, and is generally obſerved to be greateſt when the aurora borealis is moſt remarkable.

This is a very curious phenomenon, and we have not been able to find any connection between this meteor and the poſition of a magnetic needle. It is to be obſerved, that a needle of copper or wood, or any ſubſtance beſides iron, is not affected. We long thought it an electric phenomenon, and that the needle was affected as any other body balanced in the ſame manner would be; but a copper needle would then be affected. Indeed it may ſtill be doubted whether the aurora borealis be an electric phenomenon. They are very frequent and remarkable in Sweden; and yet Bergman ſays, that he never obſerved any electric ſymptoms about them, though in the mean time the magnetic needle was greatly affected.

We ſee the needle frequently diſturbed both from its general annual poſition, and from the change made on it by the diurnal variation. This is probably the effect of auroræ boreales which are inviſible, either on account of thick weather or day-light. Van Swinden ſays, he ſeldom or never failed to obſerve auroræ boreales immediately after any anomalous motion of the needle; and concluded that there had been one at the time, though he could not ſee it. Since no needle but a magnetic one is affected by the aurora borealis, we may conclude that there is ſome natural connection between this meteor and magnetiſm. This ſhould farther incite us to obſerve the circumſtance formerly mentioned, *viz.* that the ſouth end of the dipping needle points to that part of the heavens where the rays of the aurora appear to converge. We wiſh that this were diligently obſerved in places which have very different variation and dip of the mariner's needle.

For the diurnal and this irregular variation, conſult the Diſſertations of Celſius and of Hiorter, in the *Memoirs of Stockholm*; Wargentin, *Philoſophical Tranſactions*, Vol. 48. Braun (*Comment. Petropol. Novi*, T. V. VII. IX); Graham and Canton as above.

VARIETY, a change, ſucceſſion, or difference, in the appearance or nature of things; in oppoſition to *uniformity*.

VARIETY, in botany, is a change in ſome leſs eſſential part or quality; as colour, ſize, pubeſcence or age.—Externally; by the plaiting or interweaving of the branches—by bundling or uniting of ſeveral ſtalks into one broad flat one; by the greater breadth, or narrowneſs, or curling of leaves—by becoming awnleſs, or ſmooth, or hirſute. Internally; by becoming mutilated in the corolla; or having one larger than ordinary—by luxuriancy, multiplication, or fulneſs—by becoming proliferous, or creſted—by bearing bulbs inſtead of ſeeds—or being viviparous.

The uſual cauſes of variation are, climate, ſoil, expoſure, heat, cold, winds, culture.

VARIOLA, the SMALL-POX. See MEDICINE, nº 222.—224.

VARIX, in medicine, the dilatation of a vein, ariſing from the too great abundance or thickneſs of the blood.

VARNISH, a clear limpid fluid, capable of hardening without loſing its tranſparency, uſed by painters, gilders, &c. to give a luſtre to their works, to preſerve them and defend them from the air.

A coat of varniſh ought to poſſeſs the following properties: 1. It muſt exclude the action of the air; becauſe wood and metals are varniſhed to defend them from decay and ruſt. 2. It muſt reſiſt water; for otherwiſe the effect of the varniſh could not be permanent. 3. It ought not to alter ſuch colours as are intended to be preſerved by this means. It is neceſſary therefore that a varniſh ſhould be eaſily extended or ſpread over the ſurface, without leaving pores or cavities; that it ſhould not crack or ſcale; and that it ſhould reſiſt water. Now reſins are the only bodies that poſſeſs theſe properties. Reſins conſequently muſt be uſed as the baſes of varniſh. The queſtion which of courſe preſents itſelf muſt then be, how to diſpoſe them for this uſe? and for this purpoſe they muſt be diſſolved, as minutely divided as poſſible, and combined in ſuch a manner that the imperfections of thoſe which might be diſpoſed to ſcale may be corrected by others.

Reſins may be diſſolved by three agents. 1. By fixed oil. 2. By volatile oil. 3. By alcohol. And accordingly we have three kinds of varniſh: the fat or oily varniſh, eſſential varniſh, and ſpirit varniſh. Before a reſin is diſſolved in a fixed oil, it is neceſſary to render the oil drying. For this purpoſe the oil is boiled with metallic oxides; in which operation the mucilage of the oil combines with the metal, while the oil itſelf unites with the oxigene of the oxide. To accelerate the drying of this varniſh, it is neceſſary to add oil of turpentine. The eſſential varniſhes conſiſt of a ſolution of reſin in oil of turpentine. The varniſh being applied, the eſſential oil flies off, and leaves the reſin. This is uſed only for paintings. When reſins are diſſolved in alcohol, the varniſh dries very ſpeedily, and is ſubject to crack; but this fault is corrected by adding a ſmall quantity of turpentine to the mixture, which renders it brighter, and leſs brittle when dry.

We ſhall now give the method of preparing a number of varniſhes for different purpoſes.

A Varniſh for Toilet-boxes, Caſes, Fans, &c.—Diſſolve two ounces of gum maſtich and eight ounces of gum ſandarach in a quart of alcohol; then add four ounces of Venice turpentine.

A Varniſh for Wainſcots, Cane-chairs, Iron-chairs, Grates.—Diſſolve in a quart of alcohol eight ounces of gum ſandarach, two ounces of ſeed lac, four ounces of roſin; then add ſix ounces of Venice turpentine. If the varniſh is wiſhed to produce a red colour, more of the lac and leſs of ſandarach ſhould be uſed, and a little *dragon's blood* ſhould be added. This varniſh is ſo thick that two layers of it are equal to four or five of another.

A Varniſh for Fiddles, and other Muſical Inſtruments.—Put four ounces of gum ſandarach, two ounces of lac, two ounces of gum maſtich, an ounce of gum elemi, into a quart of alcohol, and hang them over a ſlow fire till they are diſſolved; then add two ounces of turpentine.

Varniſh in order to employ Vermilion for painting Equipages.—Diſſolve in a quart of alcohol ſix ounces of ſandarach, three ounces of gum lac, and four ounces of roſin: afterwards add ſix ounces of the cheapeſt kind of turpentine; mix with it a proper quantity of vermilion when it is to be uſed.

Gold-coloured Varniſh.—Pound ſeparately four ounces of ſtick lac, four ounces of gamboge, four ounces of dragon's blood, four ounces of anotta, and one ounce of ſaffron: put each of them ſeparately into a quart of alcohol, and expoſe them for five days in a narrow-mouthed bottle to the ſun, or keep them during that time in a very warm room, ſhaking them every now and then to haſten the ſolution. When they are all melted, mix them together. More or leſs of each of theſe ingredients will give the different tints of gold according as they are combined. In order to make ſilver imitate gold exactly when covered with this varniſh, the quantity of ingredients muſt be ſomewhat greater. The method of gilding ſilver-leaf, &c. with this varniſh is as follows: The ſilver-leaf being fixed on the ſubject, in the ſame manner as gold-leaf, by the interpoſition of proper glutinous matters, the varniſh is ſpread upon the piece with a bruſh or pencil. The firſt coat being dry, the piece is again and again waſhed over with the varniſh till the colour appears ſufficiently deep. What is called *gilt leather*, and many picture-frames, have no other than this counterfeit gilding. Waſhing them with a little rectified ſpirit of wine affords a proof of this; the ſpirit diſſolving the varniſh, and leaving the ſilver leaf of its own whiteneſs. For plain frames, thick tin-foil may be uſed inſtead of ſilver. The tin-leaf, fixed on the piece with glue, is to be burniſhed, then poliſhed with emery and a fine linen cloth, and afterwards with putty applied in the ſame manner: being then lacquered over with the varniſh five or ſix times, it looks very nearly like burniſhed gold. The ſame varniſh, made with a leſs proportion of the colouring materials, is applied alſo on works of braſs; both for heightening the colour of the metal to a reſemblance with that of gold, and for preſerving it from being tarniſhed or corroded by the air.

Oil Varniſhes.—Gum copal and amber are the ſubſtances principally employed in oil varniſhes; they poſſeſs the properties neceſſary for varniſhes, ſolidity and tranſparency.—The copal being whiteſt, is uſed for varniſhing light, the amber for dark colours. It is beſt to diſſolve them before mixing them with the oil, becauſe by this means they are in leſs danger of being ſcorched, and at the ſame time the varniſh is moſt beautiful. They ſhould be melted in a pot on the fire; they are in a proper ſtate for receiving the oil when they give no reſiſtance to the iron ſpatula, and when they run off from it drop by drop. The oil employed ſhould be a drying oil, and perfectly free from greaſe. It ſhould be poured into the copal or amber by little and little. conſtantly ſtirring the ingredients at the ſame time with the ſpatula. When the oil is well mixed with the copal or amber, take it off the fire; and when it is pretty cool, pour in a greater quantity of the eſſence of turpentine than the oil that was uſed. After the varniſh is made, it ſhould be paſſed through a linen cloth. Oil varniſhes become thick by keeping; but when they are to be uſed, it is only neceſſary to pour in a little eſſence of turpentine, and to put them for a little on the fire. The turpentine is neceſſary in oil varniſhes to make them dry properly; generally twice as much of it is uſed as of oil. Leſs is neceſſary in ſummer than in winter. Too much oil hinders the varniſh from drying; but when too little is uſed, it cracks and does not ſpread properly. We ſhall ſubjoin the moſt uſeful oil varniſhes:

White Copal Varniſh.—On 16 ounces of melted copal pour four, ſix, or eight ounces of linſeed oil, boiled and quite free from greaſe. When they are well mixed, take them off the fire (not forgetting to ſtir them properly); and when pretty cool, pour in ſixteen ounces of the eſſence of Venice turpentine. Paſs the varniſh through a cloth.—Amber varniſh is made in the ſame way.

Black Varniſh for Coaches and Iron Work.—This varniſh is compoſed of bitumen of Paleſtine, roſin, and amber, melted ſeparately, and afterwards mixed; the oil is then added, and afterwards the turpentine, as directed above. The uſual proportions are, 12 ounces of amber, two ounces of roſin, two ounces of bitumen, ſix of oil, and 12 of the eſſence of turpentine.—Golden-coloured varniſh may be made alſo by ſubſtituting linſeed oil for alcohol.

Eſſential Oil Varniſhes.—The only eſſential oil varniſhes uſed are for pictures. Picture varniſhes ſhould be white, light, and quite tranſparent, which will preſerve the colours without giving them any diſagreeable tint; and it ſhould be poſſible to take them off the picture without injuring it. They are uſually made of gum maſtich and turpentine diſſolved together in ſome eſſential oil. The varniſh is paſſed through a cloth, and allowed to clarify. It is applied cold to the picture.

Varniſh for Glaſs, in order to preſerve it from the Rays of the Sun.—Pulveriſe a quantity of gum adragant, and let it diſſolve for 24 hours in the white of eggs, well beat up; then rub it gently on the glaſs with a bruſh.

Varniſhes before they are uſed ſhould be carefully kept from duſt, which would ſpoil them; and they ſhould be kept in a veſſel quite clean and dry. When uſed, they ſhould be lifted lightly with a bruſh, and ſpread upon a ground altogether free from dirt and moiſture. The ſubſtance, after being varniſhed, ſhould be expoſed to the heat of the ſun, or placed in a warm room covered with a glaſs caſe, to keep out all filth. Oil varniſhes require more heat than alcohol varniſhes. The varniſh ſhould be put on very quickly, making great ſtrokes with the pencil or bruſh, taking care that theſe ſtrokes never croſs one another; it ſhould be ſpread equally, and never thicker than a leaf of paper; a ſecond coat ſhould not be put on till the firſt is quite dry. If the varniſh, after being put on, becomes dull and uneven, it muſt be taken off entirely, and new varniſh put on.

When wainſcot is to be varniſhed, it is firſt painted of a wooden colour. This colour is made by infuſing in water either red or yellow ochre (according to the colour wiſhed for), terra ombria (a kind of ochre) and white lead; into this as much as neceſſary is put of *parchment paſte.* Two thin coats of this are to be put on, and, after they are quite dry, the varniſh.

Varniſhes are poliſhed with pumice-ſtone and tripoli earth. The pumice-ſtone muſt be reduced to an impalpable powder, and put upon a piece of ſerge moiſtened with water; with this the varniſhed ſubſtance is to be rubbed lightly and equally. The tripoli muſt alſo be reduced to a very fine powder, and put upon a clean woollen cloth moiſtened with olive oil, with which the poliſhing is to be performed. The varniſh is then to be wiped with ſoft linen, and, when quite dry, cleaned with ſtarch or Spaniſh white, and rubbed with the palm of the hand or with a linen cloth.

To recover colours or varniſh, and to take off the dirt and filth which may adhere to them, a ley is uſed made of potaſh and the aſhes of lees of wine. Take 48 ounces of potaſh, and 16 of the above-mentioned aſhes, and put them into ſix quarts of water, and the ley is made: inſtead of the aſhes an equal quantity of potaſh would probably do as well. To clean dirty colours, dilute ſome of this ley with four times its quantity of water, and rub the picture with it; then waſh it with river water; and when dry, give it a coat or two of varniſh. In order to take off a varniſh, waſh it with the above mentioned ley, then with water, and then lift it off the ſubſtance on which it was with any iron inſtrument.—We ſhall finiſh this article with a deſcription of the famous Chineſe varniſh.

The Chineſe varniſh is not a compoſition, but a reſin which exudes from a tree called in China *tſi-chu*, "varniſh tree." This tree grows in ſeveral provinces of the ſouthern parts of China. The Chineſe take the following method of propagating this tree: In ſpring they chooſe a vigorous ſhoot about a foot in length, which proceeds immediately from the trunk; and coat over the lower part, by which it adheres to the tree, with a kind of yellow earth, at leaſt three inches in thickneſs. This coat is carefully covered with a mat, to defend it from the rain, and the injuries of the air. Towards the autumnal equinox they detach a little of the earth, to obſerve in what condition the ſmall roots are, which begin to ſpring forth from the ſhoot. If they find that the filaments which compoſe them are of a reddiſh colour, they judge it is time to make an amputation; but they defer it if the roots are white, becauſe this colour ſhows that they are yet too tender: they then cloſe up the coat again, and wait till the ſpring following. When the ſhoot is ſeparated from the trunk of the tree, it is put into the earth; but in whatever ſeaſon it is planted, whether in ſpring or autumn, great care muſt be taken to put plenty of cinders into the hole prepared for it; without this precaution the ants would deſtroy the yet tender roots, or at leaſt deprive them of all their moiſture, and cauſe them to decay.

The Chineſe do not procure varniſh from the tſi-chu until its trunk is nearly five inches in diameter, which ſize it ſeldom attains to before ſeven or eight years. Varniſh extracted from a tree ſmaller or of leſs age would not have the ſame body and ſplendor. This liquor diſtils only in the night-time, and during the ſummer ſeaſon. To cauſe the gum to flow, they make ſeveral rows of inciſions round the trunk, the number of which is proportioned to the vigour of the tree. The firſt row is ſeven inches from the earth, and the reſt are at the ſame diſtance one from the other, and continue to the top of the trunk, and even ſometimes on the boughs which are of a ſufficient ſtrength and ſize. The Chineſe uſe a crooked iron for making theſe inciſions, which muſt run a little obliquely, and be equal in depth to the thickneſs of the bark; they make them with one hand, and with the other hold a ſhell, the edges of which they inſert into the opening, where it remains without any ſupport. Theſe inciſions are made towards evening, and next morning they collect the varniſh which has fallen into the ſhells; the following evening they are again inſerted, and this operation is continued until the end of ſummer. A thouſand trees yield almoſt in one night 20 pounds of varniſh.

While the varniſh diſtils, it exhales a malignant vapour, the bad effects of which can only be prevented by preſervatives and great precaution. The merchant who employs the workmen is obliged to keep by him a large vaſe filled with rape-oil, in which a certain quantity of thoſe fleſhy filaments have been boiled that are found in hog's lard, and which do not melt. When the workmen are going to fix the ſhells to the trees, they carry ſome of this oil along with them, and rub their face and hands with it, which they do with greater care when they collect in the morning the varniſh that has diſtilled during night. After eating, they waſh their whole bodies with warm water, in which the bark of the cheſnut-tree, fir-wood, cryſtalliſed ſaltpetre, and ſome other drugs, have been boiled. When they are at work near the trees, they put upon their heads a ſmall cloth bag in which there are two holes, and cover the fore-part of their bodies with a kind of apron made of doe-ſkin, which is ſuſpended from their necks with ſtrings, and tied round them with a girdle. They alſo wear boots, and have coverings on their arms, made of the ſame kind of ſkin. The labourer who ſhould attempt to collect varniſh without uſing this precaution, would ſoon be puniſhed for his raſhneſs, and the moſt dreadful effects would enſue. The diſorder ſhows itſelf by tetters, which become of a bright red colour, and ſpread in a very ſhort time; the body afterwards ſwells, and the ſkin burſts and appears covered with an univerſal leproſy. The unhappy wretch could not long endure the excruciating pains which he feels, did he not find a ſpeedy remedy in thoſe preſervatives which are uſed againſt the malignant and noxious exhalations of the varniſh.

The ſeaſon of collecting varniſh being ended, the merchant puts it into ſmall caſks cloſely ſtopped. A pound of it newly made coſts him about one ſhilling and eight pence Sterling; but he gains *cent. per cent.* upon it, and ſometimes more, according to the diſtance of the place to which he tranſports it.

Beſides the luſtre and beauty which that varniſh gives to many of the Chineſe manufactures, it has alſo the property of preſerving the wood upon which it is laid, eſpecially if no other matter be mixed with it. It prevents it from being hurt either by dampneſs or worms.

Every workman has a particular art and method of uſing the varniſh. This work requires not only much ſkill and dexterity, but alſo great attention, to obſerve the proper degree of fluidity which the gum ought to have, as it muſt be neither too thick nor too liquid when it is laid on. Patience above all is neceſſary in thoſe who wiſh to ſucceed. To be properly varniſhed, a work muſt be done at leiſure; and a whole ſummer is ſcarcely ſufficient to bring it to perfection. It is therefore rare to ſee any of thoſe cabinets which are imported to us from Canton ſo beautiful and durable as thoſe manufactured in Japan, Tong-king, and Nang-king, the capital of the province of Kiang-nan: not that the artiſts do not employ the ſame varniſh; but as they work for Europeans, who are more eaſily pleaſed, they do not take the trouble of giving the pieces which come from their hands all the poliſh they are capable of receiving.

There are two methods of laying on the varniſh; the ſimpleſt is, when it is immediately laid on the wood. The work is firſt poliſhed, and then daubed over with a kind of oil which the Chineſe call *tong-yeou*. When this oil is dry, it receives two or three coats of varniſh; which remain ſo tranſparent, that all the ſhades and veins of the wood may be ſeen through them. If the artiſt is deſirous of entirely concealing the ſubſtance on which they are laid, nothing is neceſſary but to add a few more coats; theſe give the work a ſhining ſurface, the ſmoothneſs of which equals that of the moſt beautiful ice. When the work is dry, various figures are painted upon it in gold and ſilver, ſuch as flowers, birds, trees, temples, dragons, &c. A new coat of varniſh is then ſometimes laid over theſe figures, which preſerves them, and adds much to their ſplendor. The ſecond method requires more preparation. The Chineſe workmen fix to the wood by means of glue a kind of paſteboard, compoſed of paper, hemp, lime, and other ingredients, well beaten, that the varniſh may incorporate with them. Of this they make a ground perfectly ſmooth and ſolid, over which the varniſh is laid in thin coats, that are left to dry one after the other.

It often happens, that the luſtre of varniſhed tables and other pieces of furniture is inſenſibly deſtroyed by tea and warm liquors. "The ſecret of reſtoring to varniſh its ſhinning black colour (ſays a Chineſe author) is to expoſe it for one night to a white hoar-froſt, or to cover it ſome time with ſnow." For a method of imitating *Chineſe varniſh*, ſee Turning.

Varnish alſo ſignifies a ſort of ſhining coat, wherewith potter's ware, delft-ware, china-ware, &c. are covered, which gives them a ſmoothneſs and luſtre. Melted lead is generally uſed for the firſt, and ſmalt for the ſecond. See Glazing.

Varnish, among medaliſts, ſignifies the colours antique medals have acquired in the earth.

The beauty which nature alone is able to give to medals, and art has never yet attained to counterfeit, enhances the value of them: that is, the colour which certain ſoils in which they have a long time lain tinges the metals withal: ſome of which are blue, almoſt as beautiful as the torquoiſe; others with an inimitable vermilion colour; others with a certain ſhining poliſhed brown, vaſtly finer than Braſil figures.

The moſt uſual varniſh is a beautiful green, which hangs to the fineſt ſtrokes without effacing them, more accurately than the fineſt enamel does on metals.

No metal but braſs is ſuſceptible of this; for the green ruſt that gathers on ſilver always ſpoils it, and it muſt be got off with vinegar or lemon juice.

Falſifiers of medals have a falſe or modern varniſh, which they uſe on their counterfeits, to give them the appearance or air of being antique. But this may be diſcovered by its ſoftneſs; it being ſofter than the natural varniſh, which is as hard as the metal itſelf.

Some depoſit their ſpurious metals in the earth for a conſiderable time, by which means they contract a ſort of varniſh, which may impoſe upon the leſs knowing; others uſe ſal ammoniac, and others burnt paper.

VARRO (Marcus Terentius), the moſt learned of all the Romans, was born 28 years B. C. He was a ſenator of the firſt diſtinction, both for birth and merit; and bore many great offices. He was an intimate friend of Cicero; and this friendſhip was confirmed and immortalized by a mutual dedication of their learned works to each other. Thus Cicero dedicated his Academic Queſtions to Varro; and Varro dedicated his treatiſe on the Latin tongue to Cicero. In the civil wars he was zealouſly attached to Pompey; but after his defeat ſoon ſubmitted to Cæſar, who was reconciled to him. Afterwards he applied his whole time to letters, and had the charge of the Greek and Latin libraries at Rome. He was above 70 when Antony proſcribed him; however, he found means to eſcape and ſave his life, though he could not ſave ſome of his works and his library from being plundered by the ſoldiers. After this ſtorm was over, he purſued his ſtudies as uſual; and Pliny relates, that he continued to ſtudy and to write when he was 88 years of age. He was 80 when he wrote his three books *De re Ruſtica*, which are ſtill extant. Five of his books *De lingua Latina*, which he addreſſed to Cicero, are alſo extant. There remain, too, divers fragments of his works, particularly of his Menippean Satires, which are medleys of proſe and verſe; and Scalliger has collected ſome of his epigrams from among the *Catalecta Virgilii*. His books *De lingua Latina*, and *De re Ruſtica*, were printed with the notes of Joſeph Scaliger, Turnebus, and Victorius, by Henry Stephens at Paris 1573, in 8vo, and have been publiſhed ſeparately ſince among the *Auctores de lingua Latina*, and the *Auctores de re Ruſtica*.

There was another Varro of antiquity, called *Atacinus*, who was born about 10 years after the firſt, at a ſmall town near Narbonne. Though infinitely below the Roman in learning, he was at leaſt as good, if not a better, poet; which perhaps has made Lilius Gyraldus and other critics confound them. He compoſed many works in verſe; ſome fragments of which were collected, and publiſhed with thoſe of other ancient poets, at Lyons in 1603. His chief works were, A poem on the war with the Sequani, a people of Gaul; and the Aſtronomics, that went under the name of Planciades the grammarian. But the *Argonautics*, in four books, was what gained him the greateſt reputation: and though indeed nothing but a tranſlation of Apollonius Rhodius, yet was ſo well done as to be commended by Quintilian.

VARRONIA, in botany: A genus of plants belonging to the claſs of *pentandria*, and to the order of *monogynia*; and arranged in the natural ſyſtem under the 41ſt order, *Aſperifoliæ*. The corolla is quinquifid; the fruit a drupa, with a quadrilocular kernel. There are ſix ſpecies; none of which are natives of Britain.

VASCULAR, ſomething conſiſting of divers veſſels, as arteries, veins, &c.

VASE, a term frequently uſed for ancient veſſels dug from under ground, or otherwiſe found, and preſerved in the cabinets of the curious. In architecture, the appellation *vaſe* is alſo given to thoſe ornaments placed on corniches, ſochles, or pedeſtals, repreſenting the veſſels of the ancients, particularly thoſe uſed in ſacrifice, as incenſe-pots, flower-pots, &c. See *Portland-Vaſe*.

VASSAL, in our ancient cuſtoms, ſignified a tenant or feudatory; or perſon who vowed fidelity and homage to a lord, on account of ſome land, &c. held of him in fee; alſo a ſlave or ſervant, and eſpecially a domeſtic of a prince.—*Vaſſallus* is ſaid to be *quaſi inferior ſocius*; as the vaſſal is inferior to his maſter, and muſt ſerve him; and yet he is in a manner his companion, becauſe each of them is obliged to the other. See *Feodal-Syſtem*.

VATICAN, a magnificent palace of the Pope, in Rome, which is ſaid to conſiſt of ſeveral thouſand rooms; but the parts of it moſt admired, are the grand ſtaircaſe, the pope's apartment, and eſpecially the library, which is one of the richeſt in the world, both in printed books and manuſcripts.

VAUBAN (Sebaſtian le Preſtre, ſeigneur de), marſhal of France, and the greateſt engineer that country ever produced, was born 1633. He diſplayed his knowledge of fortification in the courſe of many ſieges, and his ſervices were rewarded with the firſt military honours. He was made governor of Liſle, in 1668, commiſſary-general of the fortifications of France in 1678, governor of the maritime parts of Flanders in 1689, and a marſhal of France in 1703. He died in 1707, after having brought the arts of attacking and defending fortified places to a degree of perfection unknown before. His writings on theſe ſubjects are in the higheſt eſteem.

VAUDOIS, Valdenses, or *Waldenſes*, in eccleſiaſtical hiſtory, a name given to a ſect of reformers, who made their firſt appearance about the year 1160.

The origin of this famous ſect, according to Moſheim, was as follows: Peter, an opulent merchant of Lyons, ſurnamed *Valdenſis*, or *Validiſius*, from Vaux or Waldum, a town in the marquiſate of Lyons, being extremely zealous for the advancement of true piety and Chriſtian knowledge, employed a certain prieſt called *Stephanus de Eviſa*, about the year 1160, in tranſlating from Latin into French the four Goſpels, with other books of Holy Scripture, and the moſt remarkable ſentences of the ancient doctors, which were ſo highly eſteemed in this century." But no ſooner had he peruſed theſe ſacred books with a proper degree of attention, than he perceived that the religion which was now taught in the Roman church, differed totally from that which was originally inculcated by Chriſt and his apoſtles.

Struck with this glaring contradiction between the doctrines of the pontiffs and the truths of the Goſpel, and animated with zeal, he abandoned his mercantile vocation, diſtributed his riches among the poor (whence the Waldenſes were called *poor men of Lyons*), and forming an aſſociation with other pious men, who had adopted his ſentiments and his turn of devotion, he began in the year 1180 to aſſume the quality of a public teacher, and to inſtruct the multitude in the doctrines and precepts of Chriſtianity.

Soon after Peter had aſſumed the exerciſe of his miniſtry, the archbiſhop of Lyons, and the other rulers of the church in that province, vigorouſly oppoſed him. However, their oppoſition was unſucceſsful; for the purity and ſimplicity of that religion which theſe good men taught, the ſpotleſs innocence that ſhone forth in their lives and actions, and the noble contempt of riches and honours which was conſpicuous in the whole of their conduct and converſation, appeared ſo engaging to all ſuch as had any ſenſe of true piety, that the number of their followers daily increaſed.—They accordingly formed religious aſſemblies, firſt in France, and afterwards in Lombardy, from whence they propagated their ſect throughout the other provinces of Europe with incredible rapidity, and with ſuch invincible fortitude, that neither fire, nor ſword, nor the moſt cruel inventions of mercileſs perſecution, could damp their zeal, or entirely ruin their cauſe.

The attempts of Peter Waldus and his followers were neither employed nor deſigned to introduce new doctrines into the church, nor to propoſe new articles of faith to Chriſtians. All they aimed at was, to reduce the form of eccleſiaſtical government, and the manners both of the clergy and people, to that amiable ſimplicity and primitive ſanctity that characteriſed the apoſtolic ages, and which appear ſo ſtrongly recommended in the precepts and injunctions of the divine Author of our holy religion. In conſequence of this deſign, they complained that the Roman church had degenerated, under Conſtantine the Great, from its primitive purity and ſanctity. They denied the ſupremacy of the Roman pontiff, and maintained, that the rulers and miniſters of the church were obliged, by their vocation, to imitate the poverty of the apoſtles, and procure for themſelves a ſubſiſtence by the work of their hands. They conſidered every Chriſtian as, in a certain meaſure, qualified and authoriſed to inſtruct, exhort, and confirm the brethren in their Chriſtian courſe, and demanded the reſtoration of the ancient penitential diſcipline of the church *i. e.* the expiation of tranſgreſſions by prayer, faſting, and alms, which the new-invented doctrine of indulgences had almoſt totally aboliſhed. They at the ſame time affirmed, that every pious Chriſtian was qualified and entitled to preſcribe to the penitent the kind or degree of ſatisfaction or expiation that their tranſgreſſions required; that confeſſion made to prieſts was by no means neceſſary, ſince the humble offender might acknowledge his ſins, and teſtify his repentance, to any true believer, and might expect from ſuch the counſel and admonition which his caſe demanded. They maintained, that the power of delivering ſinners from the guilt and puniſhment of their offences belonged to God alone; and that indulgences of conſequence were the criminal inventions of ſordid avarice. They looked upon the prayers and other ceremonies that were inſtituted in behalf of the dead, as vain, uſeleſs, and abſurd, and denied the exiſtence of departed ſouls in an intermediate ſtate of purification; affirming, that they were immediately, upon their ſeparation from the body, received into heaven, or thruſt down to hell. Theſe, and other tenets of a like nature, compoſed the ſyſtem of doctrine propagated by the Waldenſes. It is alſo ſaid that ſeveral of the Waldenſes denied the obligation of infant-baptiſm, and that others rejected water-baptiſm entirely; but Wall has laboured to prove that infant-baptiſm was generally practiſed among them.

Their rules of practice were extremely auſtere; for they adopted as the model of their moral diſcipline the ſermon of Chriſt on the mount, which they interpreted and explained in the moſt rigorous and literal manner, and conſequently prohibited and condemned in their ſociety all wars, and ſuits of law, and all attempts towards the acquiſition of wealth, the inflicting of capital puniſhments, ſelf-defence againſt unjuſt violence, and oaths of all kinds.

During the greateſt part of the 17th century, thoſe of them who lived in the valleys of Piedmont, and who had embraced the doctrine, diſcipline, and worſhip of the church of Geneva, were oppreſſed and perſecuted, in the moſt barbarous and inhuman manner, by the miniſters of Rome. This perſecution was carried on with peculiar marks of rage and enormity in the years 1655, 1656, and 1696, and ſeemed to portend nothing leſs than the total extinction of that unhappy nation. The moſt horrid ſcenes of violence and bloodſhed were exhibited in this theatre of papal tyranny; and the few Waldenſes that ſurvived were indebted for their exiſtence and ſupport to the interceſſion made for them by the Engliſh and Dutch governments, and alſo by the Swiſs cantons, who ſolicited the clemency of the duke of Savoy in their behalf.

VAULT, in architecture, an arched roof, ſo contrived that the ſtones which form it ſuſtain each other.

Vaults are on many occaſions to be preferred to ſoffits or flat ceilings, as they give a greater height and elevation, and are beſides more firm and durable.

VAYER. See MOTHE.

VAYVODE, or VAIVODE. See WAYWODE.

UBES (St), a ſea-port town of Portugal, in the province of Eſtremadura, ſeated on a bay of the Atlantic Ocean, 21 miles ſouth of Liſbon. It ſtands on an eminence, with a very ſtrong caſtle built on a rock. The ſoil about it is fertile in corn, wine, and fruits; and it is furniſhed with good fiſh from the ſea, and a ſmall lake in the neighbourhood. Here they make great quantities of fine ſalt, which is carried to the American plantations. E. Long. 8. 54. N. Lat. 38. 22.

UBIQUITARIANS, formed from *ubique*, "every-where," in eccleſiaſtical hiſtory, a ſect of Lutherans which roſe and ſpread itſelf in Germany; and whoſe diſtinguiſhing doctrine was, that the body of Jeſus Chriſt is every where, or in every place.

Brentius, one of the earlieſt reformers, is ſaid to have firſt broached this error, in 1560. Luther himſelf, in his controverſy with Zuinglius, had thrown out ſome unguarded expreſſions, that ſeemed to imply a belief of the omnipreſence of the body of Chriſt; but he became ſenſible afterwards, that this opinion was attended with great difficulties, and particularly that it ought not to be made uſe of as a proof of Chriſt's corporal preſence in the euchariſt. However, after the death of Luther, this abſurd hypotheſis was renewed, and dreſſed up in a ſpecious and plauſible form by Brentius, Chemnitius, and Andræas, who maintained the communication of the properties of Chriſt's divinity to his human nature. It is indeed obvious, that every Lutheran who believes the doctrine of conſubſtantiation (ſee SUPPER *of the Lord*), whatever he may pretend, muſt be an Ubiquitarian.

UBIQUITY, OMNIPRESENCE; an attribute of the Deity, whereby he is always intimately preſent to all things; gives the *eſſe* to all things; knows, preſerves, and does all in all things.

UDDER, in comparative anatomy, that part in brutes wherein the milk is prepared, anſwering to the mammæ or breaſts in women. See COMPARATIVE ANATOMY, n° 44.

VEDAS, the ſacred books of the Hindoos, believed to be revealed by God, and called *immortal*. They are conſidered as the fountain of all knowledge human and divine, and are four in number; of which we have the following account in the firſt volume of the Aſiatic Reſearches: The *Rigveda* conſiſts of five ſections; the *Yajurveda* of eighty-ſix; the *Samaveda* of a thouſand; and the *At'harvaveda* of nine; with eleven hundred *ſac'ha's*, or branches, in various diviſions and ſubdiviſions. The *Veda's* in truth are infinite; but have been long reduced to this number and order; the principal part of them is that which explains the duties of man in a methodical arrangement; and in the fourth is a ſyſtem of divine ordinances.

From theſe are reduced the four *Upavedas*, the firſt of which was delivered to mankind by BRAHMA, INDRA, DHANWANTARI, and five other deities; and comprizes the theory of diſorders and medicines, with the practical methods of curing diſeaſes.

The ſecond conſiſts of muſic, invented for the purpoſe of raiſing the mind by devotion to the felicity of the Divine nature; the third treats of the fabrication and uſe of arms: and the fourth of *ſixty-four* mechanical arts. Of however little value we may eſteem the mechanical arts of the Hindoos, and however deſpicable their theological ſyſtem may really be, the *Upaveda*, which treats of diſeaſes and the method of curing them, ſurely deſerves to be ſtudied by every European phyſician practiſing in India. There are indeed a great number of medical books in the Shanſcrit language worthy of attention; for though the theories of their authors may be groundleſs and whimſical, they contain the names and deſcription of many Indian plants and minerals, with their uſes, diſcovered by *experience*, in the cure of diſeaſes.

VEDETTE, in war, a centinel on horſeback, with his horſe's head towards the place whence any danger is to be feared, and his carabine advanced, with the butt-end againſt his right thigh. When the enemy has encamped, there are vedettes poſted at all the avenues, and on all the riſing grounds, to watch for its ſecurity.

To VEER *and* HAUL, to pull a rope tight, by drawing it in and ſlackening it alternately, till the body to which it is applied acquires an additional motion, like the increaſed vibrations of a pendulum, ſo that the rope is ſtraitened to a greater tenſion with more facility and diſpatch. This method is particularly uſed in hauling the bowlines.

The wind is ſaid to veer and haul when it alters its direction, and becomes more or leſs fair. Thus it is ſaid to veer aſt and to haul forward.

VEER, *Ter-Veer*, anciently *Camp-Veer*, a town of Zealand in the United Provinces, ſtanding at the mouth of the Eaſt Schelde, about four miles from Middleburgh, and eight from Fluſhing. Veer, in Dutch, ſignifies a paſſage or ferry over an arm of the ſea or a river; and as there was once a ferry here over the Schelde to the village of Compen, on the iſland of North Beveland, the town thereby got the name of *Veer*, *Camp-Veer*, and *Ter-Veer*. It is well fortified, and formerly enjoyed a good trade, eſpecially to Scotland; the natives enjoying particular privileges here. The harbour is very good, and the arſenal the beſt furniſhed in the world. Hence the Veres, anciently earls of Oxford, are ſaid to have derived both their origin and name.

VEERING, or WEARING, the operation by which a ſhip, in changing her courſe from one board to the other, turns her ſtern to windward. Hence it is uſed in oppoſition to TACKING, wherein the head is turned to the wind and the ſtern to leeward. See SEAMANSHIP, Vol. XVII. p. 219.

Hayley's Works, vol. ii.

VEGA (Lopez de), a celebrated Spaniſh poet. He was the ſon of Felix de Vega and Franciſca Fernandez, who were both deſcended from honourable families, and lived in the neighbourhood of Madrid. Our poet was born in that city on the 25th of November 1562. He was, according to his own expreſſion, a poet from his cradle; and beginning to make verſes before he had learned to write, he uſed to bribe his elder ſchool-fellows with part of his breakfaſt, to commit to paper the lines he had compoſed. Having loſt his father while he was yet ſtill a child, he engaged in a frolic very natural to a lively boy, and wandered with another lad to various parts of Spain, till, having ſpent their money, and being conducted before a magiſtrate at Segovia for offering to ſell a few trinkets, they were ſent home again to Madrid. Soon after this adventure, our young poet was taken under the protection of Geronimo Manrique, biſhop of Avila, and began to diſtinguiſh himſelf by his dramatic compoſitions, which were received with great applauſe by the public, though their author had not yet completed his education; for, after this period, he became a member of the univerſity of Alcala, where he devoted himſelf for four years to the ſtudy of philoſophy. He was then engaged as ſecretary to the duke of Alva, and wrote his Arcadia in compliment to that patron: who is frequently mentioned in his occaſional poems. He quitted that employment on his marriage with Iſabel de Urbina, a lady (ſays his friend and biographer Perez de Montalvan) beautiful without artifice, and virtuous without affectation. His domeſtic happineſs was ſoon interrupted by a painful incident:—Having written ſome lively verſes in ridicule of a perſon who had taken ſome injurious freedom with his character, he received a challenge in conſequence of his wit; and happening, in the duel which enſued, to give his adverſary a dangerous wound, he was obliged to fly from his family, and ſhelter himſelf in Valencia. He reſided there a conſiderable time; but connubial affection recalled him to Madrid. His wife died in the year of his return. His affliction on this event led him to relinquiſh his favourite ſtudies, and embark on board the Armada which was then preparing for the invaſion of England. He had a brother who ſerved in that fleet as a lieutenant; and being ſhot in an engagement with ſome Dutch veſſels, his virtues were celebrated by our afflicted poet, whoſe heart was peculiarly alive to every generous affection. After the ill ſucceſs of the Armada, the diſconſolate Lopez de Vega returned to Madrid, and became ſecretary to the Marquis of Malpica, to whom he has addreſſed a grateful ſonnet. From the ſervice of this patron he paſſed into the houſehold of the Count of Lemos, whom he celebrates as an inimitable poet. He was once more induced to quit his attendance on the great, for the more inviting comforts of a married life. His ſecond choice was Juana de Guardio, of noble birth and ſingular beauty. By this lady he had two children, a ſon who died in his infancy, and a daughter named *Feliciana*, who ſurvived her father. The death of his little boy is ſaid to have haſtened that of his wife, whom he had the misfortune to loſe in about ſeven years after his marriage. Having now experienced the precariouſneſs of all human enjoyments, he devoted himſelf to a religious life, and fulfilled all the duties of it with the moſt exemplary piety: ſtill continuing to produce an aſtoniſhing variety of poetical compoſitions. His talents and his virtues procured him many unſolicited honours. Pope Urban VIII. ſent him the croſs of Malta, with the title of Doctor in Divinity, and appointed him to a place of profit in the Apoſtolic Chamber; favours for which he expreſſed his gratitude by dedicating his *Corona Tragica* (a long poem on the fate of Mary Queen of Scots) to that liberal pontiff. In his 73d year he felt the approaches of death, and prepared himſelf for it with the utmoſt compoſure and devotion. His laſt hours were attended by many of his intimate friends, and particularly his chief patron the Duke of Seſſa, whom he had made his executor; leaving him the care of his daughter Feliciana, and of his various manuſcripts. The manner in which he took leave of thoſe he loved was moſt tender and affecting. He ſaid to his diſciple and biographer Montalvan, That true fame conſiſted in being good; and that he would willingly exchange all the applauſes he had received to add a ſingle deed of virtue to the actions of his life. Having given his dying benediction to his daughter, and performed the laſt ceremonies of his religion, he expired on the 25th of Auguſt 1635.

VEGETATION, in phyſiology, the act whereby plants receive nouriſhment and growth.

The proceſs of nature in the vegetation of plants is very accurately delivered by Malpighi: The egg or ſeed of the plant being excluded out of the ovary, called *pod* or *huſk*, and requiring further foſtering and brooding, is committed to the earth; which having received it into her fertile boſom, not only does the office of incubation by her own warm vapours and exhalation, joined with the heat of the ſun, but by degrees ſupplies what the ſeed requires for its further growth; as abounding everywhere with canals and ſinuſes, wherein the dew and rain water, impregnated with fertile ſalts, glide, like the chyle and blood in the arteries, &c. of animals. This moiſture meeting with a new depoſited ſeed, is percolated, or ſtrained through the pores or pipes of the outer rind or huſk, correſponding to the ſecundines of the fœtuſes, on the inſide whereof lies one or more, commonly two, thick ſeminal leaves, anſwering to the placenta in women, and the cotyledons in brutes.

Theſe ſeed-leaves conſiſt of a great number of little veſiculæ, or bladders, with a tube correſponding to the navel-ſtring in animals. In theſe veſiculæ is received the moiſture of the earth, ſtrained through the rind of the ſeed; which makes a ſlight fermentation with the proper juice before contained therein. This fermented liquor is conveyed by the umbilical veſſel to the trunk of the little plant; and to the germ or bud which is contiguous thereto: upon which a vegetation and increaſe of the parts ſucceed.

Such is the procedure in the vegetation of plants: which the illuſtrious author exemplifies in a grain of wheat, as follows: The firſt day the grain is ſown it grows a little turgid; and the ſecundine, or huſk, gapes a little in ſeveral places: and the body of the plant, being continued by the umbilical veſſel to a conglobated leaf (which is called the *pulp* or *fleſh* of the ſeed, and is what conſtitutes the flower) ſwells; by which means, not only the germ or ſprout (which is to be the future ſtem) opens, and waxes green, but the roots begin to bunch out; whence the placenta, or ſeed leaf, becoming looſe, gapes. The ſecond day, the ſecundine or huſk, being broke through, the ſtem, or top of the future ſtraw, appears on the outſide thereof, and grows upward by degrees; in the mean time, the ſeed-leaf guarding the roots becomes turgid with its veſiculæ, and puts forth a white down. And the leaf being pulled away, you ſee the roots of the plants bare; the future buds, leaves, and reſt of the ſtalk, lying hid. Between the roots and the aſcending ſtem the trunk of the plant is knit by the navel-knot to the flower-leaf, which is very moiſt, though it ſtill retains its white colour and its natural taſte. The third day, the pulp of the conglobated, or round leaf, becomes turgid with the juice which it received from the earth fermenting with its own.

Thus the plant increaſing in bigneſs, and its bud or ſtem becoming taller, from whitiſh turns greeniſh; the lateral roots alſo break forth greeniſh and pyramidal from the gaping ſheath, which adheres chiefly to the plant; and the lower root grows longer and hairy, with many fibres ſhooting out of the ſame.

Indeed there are hairy fibres hanging all along on all the roots, except on their tips; and theſe fibres are ſeen to wind about the ſaline particles of the ſoil, little lumps of earth, &c. like ivy; whence they grow curled. Above the lateral roots there now break out two other little ones.

The fourth day, the ſtem mounting upwards, makes a right angle with the ſeminal leaf: the laſt roots put forth more; and the other three growing larger, are clothed with more hairs, which ſtraitly embrace the lumps of earth; and where they meet with any vacuity, unite into a kind of network.

From this time forward the root puſhes with more regularity downward, and the ſtalk upward, than before. There is, however, this great difference in their growth, that the ſtalk and branches find no reſiſtance to their ſhooting up, while the roots find a great deal to their ſhooting downward, by means of the ſolidity of the earth; whence the branches advance much faſter and farther in their growth than the roots; and theſe laſt often finding the reſiſtance of a tough earth unſurmountable, turn their courſe, and ſhoot almoſt horizontally.

From a number of experiments made by Mr Gough, and related by him in the fourth volume of the Mancheſter Tranſactions, it appears, that ſeeds will not vegetate without air; and that during their vegetation, they abſorb oxygen, part of which they retain, and that carbonic acid is formed with the reſt. Theſe facts were aſcertained in the following manner: He put ſeveral parcels of ſteeped peas and barley, at different times, into phials, which were left to ſtand for three or four minutes in ſpring water, of the heat of 46, 5°, to reduce them to a known temperature. They were then ſecurely corked, and removed into a room, the temperature of which was never leſs than 53°. After remaining from four to ſix days in this ſituation, they were again placed in the ſame ſpring water, and opened in an inverted poſition, care being taken that the barometer ſtood at the time nearly where it did at firſt. When a cork was thus drawn, a quantity of water ruſhed in immediately, more than was ſufficient to fill the neck. The air being paſſed through lime water, contracted very ſenſibly, and precipitated the lime. The reſiduum, freed in this manner from carbonic acid, extinguiſhed a lighted taper like water; and this it did repeatedly. He made one of theſe experiments with more attention than the reſt, from which it appeared, that four ounces, one dram, forty grains, by meaſure, of atmoſpheric air, loſt one-ſixth of its original bulk, by being confined five days with one ounce of ſteeped barley. It is plain, from this experiment, that ſeeds in the act of vegetation take oxygen from the atmoſphere, part of which they retain, and reject the reſt charged with carbon. The ſubſtance of the ſeed-lobes is hereby changed, an additional quantity of oxygen being introduced into their compoſition; and a part of their carbon loſt. This change, in the proportion of their alimentary principles, generates ſugar, as is evident from the proceſs of malting. But ſugar and carbonic acid are more ſoluble in water than the farinaceous oxyd. They therefore combine with the humidity in the capillary tubes of the ſeed, and find a ready paſſage to the germ, the vegetative principle of which they call into action by a ſtimulus ſuited to its nature. A nutritious liquor being thus prepared by the decompoſition of the ſeed-lobes, and diſtributed through the infant plant, its organs begin to exert their ſpecific actions, by decompounding the nouriſhment conveyed to them, and forming new oxyds from the elementary principles of it, for the increaſe of the veſſels and fibres; and in this manner the firſt ſtage of vegetation commences.

Mr Gough has aſcertained, that a germ in the act of vegetation requires to be continually excited by the ſtimulus of oxygen; but that as ſoon as the ſeed lobes are exhauſted, the young plant is in a ſtate to derive its nutrition from the ground; and then (and not till then) it finds itſelf in a ſituation capable of making future advances, unaſſiſted by the ſtimulus of reſpirable air.

The infant ſprout at firſt ſuffers only a ſuſpenſion of its energy from the abſence of pure air; but if this neceſſary ſupport be withheld too long, it periſhes by the putrefactive fermentation.

The lively green which the ſtems and leaves of plants receive from the action of light, cannot be imparted to them, provided the energy of the vegetative principle in them be ſuſpended: for after permitting a number of peas to produce both extremities of their ſprouts in wet ſand covered from the light by an earthen pot, Mr Gough placed five of them, on the 29th of April, in an inverted glaſs jar, containing azot confined by water; and three in another jar, in which a portion of common air was alſo incloſed by the ſame means. On the 30th the upper extremities of the ſprouts of the parcel laſt mentioned were green; but though the experiment was prolonged to the 2d of May, thoſe in the other glaſs did not exhibit any perceptible alteration in ſize or colour. Two of them were now placed in a glaſs filled with atmoſpheric air, where they were left unobſerved to the 5th, at the end of which time the germs had vegetated conſiderably; the lower parts of them ſtill remained white, but their oppoſite extremities had changed to their proper green. Hence it may be ſafely inferred, that greenneſs cannot be imparted to the ſprouts of ſeeds without the joint action of light and oxygen; in which they are very different from the ſhoots that frequently proceed from maturer plants, when ſecluded from the atmoſphere: for, as theſe grow freely in cloſe glaſs veſſels, placed in a window, and containing water and azot, the parts which are recently produced continue to vegetate, in conſequence of their connection with the parent ſtock, and acquire the colour in queſtion without the aſſiſtance of reſpirable air. See PLANT, TREE, GERMINATION, BOTANY, &c.

VEGETATIVE SOUL, among philoſophers, denotes that principle in plants by virtue of which they vegetate, or receive nouriſhment and grow. See the preceding article.

VEHICLE, in general, denotes any thing that carries or bears another along; but is more particularly uſed in pharmacy for any liquid ſerving to dilute ſome medicine, in order that it may be adminiſtered more commodiouſly to the patient.

VEII (anc. geog.), a city of Etruria, the long and powerful rival of Rome; diſtant about 100 ſtadia, or 12 miles, to the north-weſt; ſituated on a high and ſteep rock. Taken after a ſiege of 10 years by Camillus, ſix years before the taking of Rome by the Gauls: and thither the Romans, after the burning of their city, had thoughts of removing; but were diſſuaded from it by Camillus (Livy). It remained ſtanding after the Punic war; and a colony was there ſettled, and its territory aſſigned to the ſoldiers. But after that it declined ſo gradually, as not to leave a ſingle trace ſtanding. Famous for the ſlaughter of the 300 Fabii on the Cremera (Ovid). The ſpot on which it ſtood lies near Iſola, in St Peter's patrimony (Holſtenius).

VEIL, a piece of ſtuff, ſerving to cover or hide any thing.

In the Romiſh churches, in time of Lent, they have veils or curtains over the altar, crucifix, images of ſaints, &c.

A veil of crape is worn on the head by nuns, as a badge of their profeſſion: the novices wear white veils, but thoſe who have made the vows black ones. See the article NUN.

VEIN, in anatomy, is a veſſel which carries the blood from the ſeveral parts of the body to the heart. See ANATOMY, n° 123.

VEIN, among miners, is that ſpace which is bounded with woughs, and contains ore, ſpar, canck, clay, chirt, croil, brownhen, pitcher-chirt, cur, which the philoſophers call the *mother of metals*, and ſometimes *ſoil of all colours*. When it bears ore, it is called a *quick vein*; when no ore, a *dead vein*.

VELA, a remarkable cape on the coaſt of Terra Firma, in South America. W. Long. 71. 25. N. Lat. 12. 30.

VELARIUS, in antiquity, an officer in the court of the Roman emperors, being a kind of uſher, whoſe poſt was behind the curtain in the prince's apartment, as that of the chancellor's was at the entry of the balluſtrade; and that of the oſtiarii at the door. The velarii had a ſuperior of the ſame denomination, who commanded them.

VELEZ-DE-GOMARA, a town of Africa, in the kingdom of Fez, and in the province of Eriff. It is the ancient ACARTH. With a harbour and a handſome caſtle, where the governor reſides. It is ſeated between two high mountains, on the coaſt of the Mediterranean Sea. W. Long. 4. 0. N. Lat. 35. 10.

VELITES, in the Roman army, a kind of ancient ſoldiery, who were armed lightly with a javelin, a caſk, cuiraſs, and ſhield.

VELLEIUS PATERCULUS. See PATERCULUS.

VELLUM, is a kind of parchment, that is finer, evener, and more white than the common parchment. The word is formed from the French *velin*, of the Latin *vitulinus*, "belonging to a calf."

VELOCITY, in mechanics, ſwiftneſs; that affection of motion whereby a moveable is diſpoſed to run over a certain ſpace in a certain time. It is alſo called *celerity*, and is always proportional to the ſpace moved. Huyghens, Leibnitz, Bernoulli, Wolfius, and the foreign mathematicians, hold, that the momenta or forces of falling bodies, at the end of their falls, are as the ſquares of their velocities into the quantity of matter; the Engliſh mathematicians, on the contrary, maintain them to be as the velocities themſelves into the quantity of matter. See QUANTITY, n° 11 and 14, &c.

VELVET, a rich kind of ſtuff, all ſilk, covered on the outſide with a cloſe, ſhort, fine, ſoft ſhag, the other ſide being a very ſtrong cloſe tiſſue.

The nap or ſhag, called alſo the *velveting*, of this ſtuff, is formed of part of the threads of the warp, which the workman puts on a long narrow-channelled ruler or needle, which he afterwards cuts, by drawing a ſharp ſteel tool along the channel of the needle to the ends of the warp. The principal and beſt manufactories of velvet are in France and Italy, particularly in Venice, Milan, Florence, Genoa, and Lucca: there are others in Holland, ſet up by the French refugees; whereof that at Haerlem is the moſt conſiderable: but they all come ſhort of the beauty of thoſe in France, and accordingly are ſold for 10 or 15 *per cent.* leſs. There are even ſome brought from China; but they are the worſt of all.

VENAL, or VENOUS, in anatomy, ſomething that bears a relation to the veins. This word is alſo uſed for ſomething bought with money, or procured by bribes.

VENEERING, Vaneering, or *Fineering*, a kind of marquetry, or inlaying, whereby ſeveral thin ſlices or leaves of fine wood, of different kinds, are applied and faſtened on a ground of ſome common wood.

There are two kinds of inlaying: the one, which is the more ordinary, goes no farther than the making of compartments of different woods; the other requires much more art, and repreſents flowers, birds, and the like figures. The firſt kind is what we properly call *veneering;* the latter we have already deſcribed under Marquetry.

The wood intended for veneering is firſt ſawed out into ſlices or leaves, about a line thick: in order to ſaw them, the blocks or planks are placed upright in a kind of vice or ſawing-preſs: the deſcription of which may be ſeen under the article juſt referred to. Theſe ſlices are afterwards cut into ſlips, and faſhioned divers ways, according to the deſign propoſed; then the joints being carefully adjuſted, and the pieces brought down to their proper thickneſs, with ſeveral planes for the purpoſe, they are glued down on a ground or block of dry wood, with good ſtrong Engliſh glue. The pieces thus joined and glued, the work, if ſmall, is put in a preſs; if large, it is laid on the bench, covered with a board, and preſſed down with poles, or pieces of wood, one end whereof reaches to the ceiling of the room, and the other bears on the boards. When the glue is quite dry they take it out of the preſs and finiſh it; firſt with little planes, then with divers ſcrapers, ſome whereof reſemble raſps, which take off dents, &c. left by the planes. When ſufficiently ſcraped, the work is poliſhed with the ſkin of a ſea-dog, wax, and a bruſh and poliſher of ſhave-graſs: which is the laſt operation.

VENEREAL, ſomething belonging to venery; as the lues venerea, &c. See Medicine-*Index*.

VENERY, is uſed for the act of copulation, or coition, of the two ſexes.

VENESECTION, or Phlebotomy, in ſurgery. See Surgery, n°

VENETIAN Bole, a fine red earth uſed in painting, and called in the colour ſhops *Venetian red.*—It is dug in Carinthia, and ſent from Venice to all parts of the world; but the uſe of it here is very much ſuperſeded by a bright colcothar of vitriol.

VENICE, a celebrated city of Italy, and capital of a republic of the ſame name, ſituated on the Lagunes or Small Iſlands, about five miles from the continent; in E. Long. 130. N. Lat. 45. 40.

1 Derivation of the name.

The name of Venice is evidently derived from *Venetia*, one of the Roman provinces of Italy; and this again from the *Henetians*, a people of Paphlagonia, who ſettled in that part of the country. The city is ſaid to have been founded about the year 451 or 452; when Attila, having deſtroyed the cities of Aquileia, Verona, Mantua, Trevigio, &c. ſuch of the inhabitants as eſcaped the ſlaughter fled to the iſlands on their coaſt, and there took up their reſidence.

2 Excellent character of the firſt inhabitants.

Hiſtorians are profuſe in their commendations of the virtue of the Venetians during the infancy of their city; and Caſſiodorus informs us, that one would have taken the inhabitants rather for an aſſembly of philoſophers, living at their eaſe and cultivating the duties of religion, than for what they really were, a diſtreſſed and confuſed rabble who had eſcaped from the calamities of war. Nothing remarkable, however, occurs in the hiſtory of Venice for ſome time, excepting the change of government from the conſular to the tribunitial form, which happened about 30 years after the building of the city.

3 When the republic began to make a figure.

The republic firſt began to be of conſequence after the deſtruction of Padua by the Lombards. About this time they were become maſters of a fleet and a body of land-forces. They engaged in a quarrel with the Lombards, of which we know not the particulars. In a ſhort time, however, they diſtinguiſhed themſelves againſt the Iſtrian pirates, who had committed depredations on their coaſts, and the Tergeſtines, or inhabitants of Trieſte, who had ſuddenly carried off a number of the citizens of Venice. Theſe exploits procured them a conſiderable degree of reputation and eſteem among their neighbours; and by improving every opportunity of increaſing their trade, and augmenting the number of manufactures, &c. the city very ſoon arrived at a high pitch of affluence and power.

4 Aſſiſts the Roman general Narſes, and honoured by him on that account.

In the war carried on by Juſtinian with the Goths in Italy, the Venetians gave conſiderable aſſiſtance to Narſes the Roman general, inſomuch that he expreſſed his gratitude by ſeveral rich preſents, ſome high marks of diſtinction, and particularly by building two fine churches dedicated to the ſaints Theodore and Germinian; the oldeſt public buildings, beſide St Mark's and St Peter's, in Venice.

From the time of Juſtinian to the year 697, hiſtorians are ſilent with regard to the Venetian affairs.

5 Firſt election of a doge or duke.

A great revolution now took place in the government: the tribunes having abuſed their power were aboliſhed; and in their ſtead was elected a *doge* or duke, in whom was veſted the ſupreme authority. He was to repreſent the honour and majeſty of the ſtate; to have reſpect and diſtinction paid him beyond what the tribunes, or even the conſuls, enjoyed: he was to aſſemble and preſide at the great council; to have a caſting vote in all diſputed points; to nominate to all offices, places, and preferments; and laſtly, to enjoy the ſame authority in the church as in the ſtate.

6 Changes of government.

This form of government was changed in 737, for what reaſon we know not, and a ſupreme magiſtrate choſen, with the title of *maſter of the horſe* or *general of the forces*. His power was to continue only for a year, the ſhortneſs of its duration being thought a ſufficient ſecurity againſt the abuſe of it. But in five years afterwards the doges were reſtored, and Giovanni Fabritio, the fourth and laſt maſter of the horſe, was depoſed, and his eyes put out, but for what fault we know not.

7 Quarrel with Charlemagne.

Under the doges, the power and wealth of the Venetian republic continued to increaſe. In 764 the Heracleans and Jeſulans, ſubjects to the republic, having formed ſome deſigns againſt the ſtate, put themſelves under the protection of Charlemagne. That conqueror, not finding it convenient to give them preſent aſſiſtance, ſettled them in Malamoc until he could give them more effectual ſuccour. The Venetians, however, diſregarding the protection of that powerful monarch, attacked and inſtantly drove them out of the place where he had ſettled them.

8 Pepin declares war againſt the republic.

Incenſed at this, Charlemagne ordered his ſon Pepin to declare war againſt the republic. This was immediately done; but the blow was for ſome time diverted by Aſtolphus king of the Lombards, who, committing great devaſtations in the territories of the pope, obliged Pepin to come to the aſſiſtance of his holineſs. However, after having afforded the neceſſary ſuccour to the pope, Pepin proſecuted the war with Venice.

9 The Venetians declare themſelves independent.

The event is uncertain: all we know is, that about this time the Venetians declared themſelves a free and independent ſtate; which makes it probable that his ſucceſs had not been great. But in 804 the war was renewed with the utmoſt fury. Pepin having quarrelled with Nicephorus the Greek emperor, and finding Obelerio the Venetian doge inclined to favour his adverſary, determined to exterminate the very name of the republic.

10 The city beſieged by Pepin.

After having laid waſte the province of Venetia, he led his army directly to Venice, blocking the city up at the ſame time by his fleet. The Venetians were not diſheartened at the number of their enemies,

mies, the reputation of Pepin, or the civil diviſions among themſelves; their animoſities were laid aſide, and a ſtrict union formed againſt the common enemy: the chief command was given to Valentin, as Obelerio was ſuppoſed too nearly allied to Pepin to fight with that good-will and cheerfulneſs the ſervice of his country required.

11 The citizens reduced to great ſtraits.

The Venetians, notwithſtanding the moſt obſtinate defence, the moſt vigorous ſallies, and their ſelling every inch of ground at an incredible expence of blood, were at length reduced to that part of the city ſouth of the Rialto; this ſtream, and their own bravery, being now their only defence. While Pepin was preparing to lay a bridge over the canal, they reſolved, as a laſt effort, to attack Pepin's fleet, and to vanquiſh or die in defence of their liberty. Embarking all the troops they could ſpare, they bore down, with the advantage of the wind and tide, upon the enemy, and began the attack with ſuch fury, as obliged the French admiral to give way.

12 The French fleet entirely deſtroyed,

The lightneſs of their ſhips, and the knowledge of the ſoundings, gave the Venetians every advantage they could wiſh: the enemy's fleet was run aground, and the greater part of their troops periſhed in attempting to eſcape; the ſhips were all, to a few, either taken or deſtroyed. During this action at ſea, Pepin reſolved to aſſault the city by land, not doubting but the garriſon was ſo weakened by the number of forces they had ſent on board the fleet, as to be able to make but a ſlight reſiſtance. Having for this purpoſe thrown a bridge over the Rialto, he was marching his troops acroſs it, when he found himſelf attacked on every ſide by the Venetians from their boats, and others who had poſted themſelves on the bridge. The battle was long, bloody, and doubtful, until the Venetians employed all their power to break down the bridge; which at laſt yielding to their obſtinate endeavours, a prodigious ſlaughter of the French enſued: however, they fought like men in deſpair, ſeeing no hopes of ſafety but in victory; but all communication being cut off with the troops on ſhore, they were to a man either killed or drowned.

13 And great part of their army.

The number of ſlain was ſo great, that the ſpace between the Rialto and Malamoc was covered with dead bodies, and has ever ſince gone by a name expreſſive of the prodigious ſlaughter.

14 The ſiege raiſed.

Pepin was ſo ſtruck with the intrepidity of the Venetians, that he raiſed the ſiege, abandoned the enterpriſe, and concluded a peace with the republic: he afterwards came to Venice to intercede for Obelerio, that he might be reſtored; which the Venetians granted, more out of reſpect to the requeſt of ſo great a prince, than love to the unhappy Obelerio. The people had a notion that Obelerio had encouraged Pepin to declare war upon the republic, and that a correſpondence between them was carried on during the ſiege;

15 The doge torn in pieces by the populace.

Pepin was therefore no ſooner withdrawn, than the populace ſeizing upon Obelerio, tore his body in pieces, and ſcattered his limbs and bowels about the city. His wife ſhared the ſame fate; for as ſhe was the ſiſter of Pepin, it was not doubted but her influence was the cauſe of her huſband's perfidy.

In 839 we find the Venetians engaged in an alliance offenſive and defenſive againſt the Saracens with Michael the Greek emperor. A fleet of 60 galleys was immediately equipped, who joined the Grecian fleet and engaged the enemy:

16 The Venetians defeated at ſea by the Saracens.

but during the heat of the engagement, the Greeks having baſely deſerted their allies, the Venetians were ſo completely defeated, that ſcarce a ſingle veſſel remained to carry the news of their misfortune to Venice. This defeat threw the city into the utmoſt conſternation, as it was not doubted that the Saracens would immediately lay ſiege to the capital; but from theſe fears they were ſoon relieved, by certain intelligence that the Saracens had gone to Ancona, which they had pillaged and deſtroyed. The Narentines, however, a piratical people, no ſooner heard of the defeat of the Venetians, than they laid waſte the coaſts of Dalmatia, and ravaged the country for a conſiderable way; at the ſame time that the city was diſtracted by internal diſſenſions and tumults, in one of which the doge was murdered.

17 Affairs of the republic reſtored.

It was not till the year 881 that the Venetian affairs were thoroughly re-eſtabliſhed. By the prudent and vigorous adminiſtration of Orſo Participato the power of the Saracens was checked, the Narentines utterly defeated, and peace and domeſtic tranquillity reſtored.

18 A great victory gained over the Hunns.

From this time the republic continued to flouriſh; and in 903 her reputation for arms became famous all over the world by a great victory gained over the Hunns, who had invaded Italy, defeated Berengarius, and threatened the country with total deſtruction. For a long time after, we meet with no remarkable tranſactions in the Venetian hiſtory; but in general the republic increaſed in wealth and power by its indefatigable application to maritime affairs and to commerce. About the year 1040 it was ordained that no prince ſhould aſſociate a colleague with him in the ſupreme power, a ſtatute which has ever ſince continued unaltered.

19 Venetians become powerful.

Towards the cloſe of the 11th century, Venice began to make a very conſiderable figure among the Italian ſtates, and to carry on wars with ſeveral of them. In 1084 the republic was by the emperor of Conſtantinople inveſted with the ſovereignty of Dalmatia and Croatia, which, however, had been held long before by right of conqueſt.

20 Take a principal ſhare in the cruſades.

As ſoon as the Croiſade was preached up, the Venetians fitted out a fleet of 200 ſail againſt the infidels; but before this armament was in a condition to put to ſea, war broke out with Piſa.

21 Exploits of the doge Vitalis Michael, &c.

The doge Vitalis Michael took upon him the command of the fleet, when, after having defeated the Piſans in a bloody action at ſea, he ſet ſail for Smyrna, and from thence to Aſcalon, at that time beſieged by the Chriſtians. To his valour was owing the conqueſt of this city, as well as thoſe of Caipha and Tiberias; but before he had time to puſh his good fortune further, he was recalled on account of an invaſion of the Normans of Dalmatia. Here he was equally ſucceſsful: the Normans were everywhere defeated; and Michael returned home loaded with booty; but died ſoon after, to the great grief of all his ſubjects. He was ſucceeded by Ordelapho Faliero, under whom the Venetians aſſiſted Baldwin in the ſiege of Ptolemais, and are ſaid to have been the chief inſtruments of its conqueſt; and Baldwin, in recompenſe for the ſervices of the republic, inveſted her with the ſovereignty of that city, which he endowed with many extraordinary privileges, in order to render his preſent more valuable.

22 The Venetians receive a great defeat in Croatia.

This good fortune, however, was overbalanced by a rebellion in Dalmatia and Croatia. The former was reduced; but, in a battle with the Croatians, the doge was killed, and his army entirely defeated: by which diſaſter the Venetians were ſo much diſpirited, that they clapped up a peace on the beſt terms they could, giving up all thoughts of Croatia for the preſent.

23 Great armament againſt the Infidels.

Under the government of Domenico Micheli, who ſucceeded Ordelapho, the pope's nuncio arrived at Venice, and excited ſuch a ſpirit of enthuſiaſm among all ranks and degrees of men, that they ſtrove whoſe names ſhould be firſt enrolled for the holy war. The doge, having fitted out a fleet of 60 galleys, ſailed with it to Joppa, which place the Saracens were at that time beſieging. The garriſon was reduced to the laſt extremity when the Venetian fleet arrived, ſurpriſed, and defeated that of the enemy with great ſlaughter; ſoon after which the Saracens raiſed the ſiege with precipitation.

24 Emperor of Conſtantinople reſolves to attack Venice.

Tyre was next beſieged, and ſoon was obliged to capitulate; on which occaſion, as well as on the taking of Aſcalon, the Venetians ſhared two-thirds of the ſpoils. But in the mean time the emperor of Conſtantinople, jealous of the increaſing power and wealth of the republic, reſolved to make an attack upon Venice, now weakened by the abſence of the doge and ſuch a powerful fleet. But the ſenate having timely notice of the emperor's intentions, recalled the doge, who inſtantly obeyed the ſummons. Stopping at Rhodes, in his way home to refreſh and water the fleet, the inhabitants refuſed to furniſh him with the neceſſaries he demanded.

25 Great ſucceſs of the doge againſt him.

Incenſed at this denial, he levelled their city with the ground; and from thence ſailing to Chios, he laid waſte and deſtroyed the country, carrying off the body of St Iſidore, in thoſe days accounted an ineſtimable treaſure. After this he ſeized on the iſlands of Samos, Leſbos, Andros, and all thoſe in the Archipelago belonging to the emperor; and having reduced Zara, Spolatro, and Trahu, places in Dalmatia which had revolted during his abſence, he returned in triumph to Venice, where he was received with great joy.

The Venetians now became very formidable throughout all Europe. The Sicilians, Paduans, with the ſtates of Verona and Ferrara, felt the weight of their power; and in 1173 they ventured to oppoſe Frederic Barbaroſſa emperor of Germany.

26 Quarrel with the emperor Barbaroſſa.

The occaſion of this quarrel was, that pope Alexander had taken ſhelter in Venice in order to avoid the reſentment of Barbaroſſa, who had conceived an implacable averſion againſt him.

27 Haughty meſſage of the emperor.

The Venetians diſpatched ambaſſadors to him; but he anſwered them in a rage, "Go tell your prince and people, that Frederic the Roman emperor demands his enemy, who is protected by them. If they ſend him not inſtantly bound hand and foot, he will overturn every law, human and divine, to accompliſh his revenge; he will bring his army before their city, and fix his victorious ſtandards in the market-place, which ſhall float in the blood of its citizens." On the return of the ambaſſadors with this terrible menace, it was agreed to equip a fleet with all expedition, and prepare for repelling the attacks of ſuch a formidable and haughty enemy.

28 His ſon Otho defeated and taken priſoner by the Venetians.

But before the armament could be prepared, Otho, the emperor's ſon, arrived before the city with a fleet of 75 galleys. The doge Sebaſtiano Ziani ſailed out with the few veſſels he had got equipped, to give the enemy battle. The fleets met off the coaſt of Iſtria, and a terrible engagement enſued, in which the imperial fleet was totally defeated, Otho himſelf taken priſoner, and 48 of his ſhips deſtroyed.

29 Inſtitution of the cuſtom of marrying the ſea.

On the doge's return, the pope went out to meet him, and preſented him with a ring, ſaying, "Take this Ziani, and give it to the ſea, as a teſtimony of your dominion over it. Let your ſucceſſors annually perform the ſame ceremony, that poſterity may know that your valour has purchaſed this prerogative, and ſubjected this element to you even as a huſband ſubjecteth his wife." Otho was treated with the reſpect due to his rank; and ſoon conceived a great friendſhip for Ziani.

30 Peace concluded with the emperor.

At laſt, being permitted to viſit the imperial court on his parole, he not only prevailed on his father to make peace with the Venetians, but even to viſit their city, ſo famed for its commerce and naval power. He was received with all poſſible reſpect, and on his departure attended to Ancona by the doge, the ſenate, and the whole body of the nobility. During this journey he was reconciled to the pope; and both agreed to pay the higheſt honours to the doge and republic.

31 Venetians invited to the aſſiſtance of the emperor of Conſtantinople.

In the beginning of the 13th century, the Venetians, now become exceedingly powerful and opulent, by reaſon of the commerce which they carried on with the richeſt countries of the world, were invited by young Alexis, ſon to the emperor of Conſtantinople, to his father's aſſiſtance, who had been depoſed by a rebellious faction. In conjunction with the French they undertook to reſtore him; and eaſily ſucceeded. But the old emperor dying ſoon after his ſon was elected in his room, and a few days after murdered by his own ſubjects; on which the empire was ſeized by Myrtillus, a man of mean birth, who had been raiſed by the favour of old Alexis. As the allied army of French and Venetians was encamped without the city, Myrtillus reſolved immediately to drive them out of his dominions, and for this purpoſe attempted to ſurpriſe their camp; but being repulſed, he ſhut himſelf up in the city, with a reſolution to ſtand a ſiege.

32 The city taken by the French and Venetians.

The allies aſſaulted it with ſo much vigour, that the uſurper was obliged to fly; and though the citizens held out after his departure, they were obliged in leſs than three months to capitulate. This proved a ſource of greater acquiſition to Venice than all that had yet happened. All the chief offices in the city were filled up with Venetians, in recompenſe for their ſervices: the allies entered Thrace, and ſubdued it; Candia, and all the Greek iſlands, alſo fell under the dominion of the republic.

33 Wars between Venice and Genoa.

In the mean time the Genoeſe, by their ſucceſsful application to commerce, having raiſed themſelves in ſuch a manner as to be capable of rivalling the Venetians, a long ſeries of wars took place between the republics; in which the Venetians generally had the advantage, though ſometimes they met with terrible overthrows. Theſe expenſive and bloody quarrels undoubtedly weakened the republic in the main, notwithſtanding its ſucceſſes.

34 The Genoeſe put themſelves under the protection of the duke of Milan.

In the year 1348, however, the Genoeſe were obliged to implore the protection of Viſconti duke of Milan, in order to ſupport them againſt their implacable enemies the Venetians. Soon after this, in the year 1352, the latter were utterly defeated, with ſuch loſs, that it was thought the city itſelf muſt have fallen into the hands of the Genoeſe had they known how to improve their victory. This was in a ſhort time followed by a peace; but from this time the power of the republic began to decline.

35 Cauſes of the decline of the Venetian power.

Continual wars with the ſtates of Italy, with the Hungarians, and their own rebellious ſubjects, kept the Venetians employed ſo that they had no leiſure to oppoſe the Turks, whoſe rapid advances ought to have alarmed all Europe. After the deſtruction of the eaſtern empire, the Turks came more immediately to interfere with the republic. The conſequences are related under the article TURKEY. Whatever valour might be ſhown by the Venetians, or whatever ſucceſſes they might boaſt of, it is certain that the Turks ultimately prevailed; ſo that for ſome time it ſeemed ſcarce poſſible to reſiſt them. What contributed alſo greatly to the decline of the republic, was the diſcovery of a paſſage to the Eaſt Indies by the Cape of Good Hope in 1497. To this time the greateſt part of the Eaſt India goods imported into Europe paſſed thro' the hands of the Venetians; but as ſoon as the above-mentioned diſcovery took place, the carriage by the way of Alexandria almoſt entirely ceaſed. Still, however, the Venetian power was ſtrong, and in the beginning of the 16th century they maintained a war againſt almoſt the whole power of France, Germany, and Italy; but ſoon after we find them entering into an alliance with ſome Italian ſtates and the king of France againſt the emperor. Theſe wars, however, produced no conſequences of any great moment; and in 1573 tranquillity was reſtored by the concluſion of a peace with the Turks. Nothing of conſequence happened in the affairs of the Venetian republic till the year 1645, when the Turks made a ſudden and unexpected deſcent on the iſland of Candia.

36 Candia invaded by the Turks.

The ſenate of Venice did not diſplay their uſual vigilance on this occaſion. They had ſeen the immenſe warlike preparations going forward, and yet allowed themſelves to be amuſed by the grand ſeignior's declaring war againſt Malta, and pretending that the armament was intended againſt that iſland. The troops landed without oppoſition; and the town of Canéa was taken after an obſtinate defence.

37 Extraordinary methods taken by the Venetians to carry on the war.

This news being brought to Venice, excited an univerſal indignation againſt the Turks; and the ſenate reſolved to defend to the utmoſt this valuable part of the empire. Extraordinary ways and means of raiſing money were fallen upon: among others, it was propoſed to ſell the rank of nobility. Four citizens offered 100,000 ducats each for this honour; and, notwithſtanding ſome oppoſition, this meaſure was at laſt carried. Eighty families were admitted into the grand council, and to the honour and privileges of the nobility. What an idea does this give of the wealth of the inhabitants of Venice!

38 Remarkable ſiege of the capital of Candia.

The ſiege of Candia, the capital of the iſland of that name, is, in ſome reſpects, more memorable than that of any town which hiſtory, or even which poetry has recorded. It laſted 24 years. The amazing efforts made by the republic of Venice aſtoniſhed all Europe; their courage intereſted the gallant ſpirits of every nation: volunteers from every country came to Candia to exerciſe their valour, to acquire knowledge in the military art, and aſſiſt a brave people whom they admired.

39 Deſperate valour of the Venetians.

During this famous ſiege the Venetians gained many important victories over the Turkiſh fleet. Sometimes they were driven from the walls of Candia, and the Turkiſh garriſon of Canéa was even beſieged by the Venetian fleets. Great ſlaughter was made of the Turkiſh armies: but new armies were ſoon found to ſupply their place, by a government which boaſts ſuch populous dominions, and which has deſpotic authority over its ſubjects.

40 Cruelty of the Turkiſh ſultan.

Mahomet the fourth, impatient at the length of this ſiege, came to Negropont, that he might have more frequent opportunities of hearing from the vizir, who carried on the ſiege. An officer, ſent with diſpatches, was directed by the vizir to explain to Mahomet the manner in which he made his approaches, and to aſſure him that he would take all poſſible care to ſave the lives of the ſoldiers. The humane emperor anſwered, That he had ſent the vizir to take the place, and not to ſpare the lives of the ſoldiers; and he was on the point of ordering the head of the officer who brought this meſſage to be cut off, merely to quicken the vizir in his operations, and to ſhow him how little he valued the lives of men.

41 The city capitulates.

In ſpite of the vizir's boaſted parſimony, this war is ſaid to have coſt the lives of 200,000 Turks. Candia capitulated in the year 1668. The conditions on this occaſion were honourably fulfilled. Morſini, the Venetian general, marched out of the rubbiſh of this well-diſputed city with the honours of war.—The expence of ſuch a tedious war greatly exhauſted the reſources of Venice, which could not now repair them ſo quickly as formerly, when ſhe enjoyed the rich monopoly of the Aſiatic trade.

42 New war with the Turks.

This republic remained in a ſtate of tranquillity, endeavouring, by the arts of peace and cultivation of that ſhare of commerce which ſhe ſtill retained, to fill her empty exchequer, till ſhe was drawn into a new war, in the year 1683, by the inſolence of the Ottoman court. The Venetians had for ſome time endeavoured, by negociation and many conciliatory repreſentations, to accommodate matters with the Turks; and though the haughty conduct of their enemies afforded ſmall hopes of ſucceſs, yet ſuch was their averſion to war on the preſent occaſion, that they ſtill balanced, whether to bear thoſe inſults or repel them by arms; when they were brought to deciſion by an event which gave the greateſt joy to Venice, and aſtoniſhed all Europe. This was the great victory gained over the Turkiſh army before the walls of Vienna by Sobieſki king of Poland.

43 The Morea conquered by the Venetians.

In this new war, their late general Morſini again had the command of the fleets and armies of the republic, and ſuſtained the great reputation he had acquired in Candia. He conquered the Morea, which was ceded formally to Venice, with ſome other acquiſitions, at the peace of Carlowitz, in the laſt year of the laſt century.

44 They are obliged to relinquiſh it again.

During the war of the ſucceſſion, the ſtate of Venice obſerved a ſtrict neutrality. They conſidered that diſpute as unconnected with their intereſts, taking care, however, to keep on foot an army on their frontiers in Italy, of ſufficient force to make them reſpected by the contending powers. But, ſoon after the peace of Utrecht, the Venetians were again attacked by their old enemies the Turks; who, beholding the great European powers exhauſted by their late efforts, and unable to aſſiſt the republic, thought this the favourable moment for recovering the Morea, which had been ſo lately raviſhed from them. The Turks obtained their object; and at the peace of Paſſarowitz, which terminated this unſucceſsful war, the Venetian ſtate yielded up the Morea; the grand ſeignior, on his part, reſtoring to them the ſmall iſlands of Cerigo and Cerigotto, with ſome places which his troops had taken during the courſe of the war in Dalmatia. Thoſe, with the iſlands of Corfou, Santa Maura, Zante, and Cephalonia, the remains of their dominions in the Levant, they have ſince fortified at a great expence, as their only barriers againſt the Turks.

45 State of Venice ſince that time.

Since this period no eſſential alteration has taken place in the Venetian government, nor has there been any eſſential increaſe or diminution in the extent of their dominions. They have little to fear at preſent from the Turks, whoſe attention is ſufficiently occupied by a more formidable enemy than the republic and the houſe of Auſtria united. Beſides, if the Turks were more diſengaged, as they have now ſtripped the republic of Cyprus, Candia, and their poſſeſſions in Greece, what remains in the Levant is hardly worth their attention.

The declenſion of Venice did not, like that of Rome, proceed from the increaſe of luxury, or the revolt of their own armies in the diſtant colonies, or from civil wars of any kind. Venice has dwindled in power and importance from cauſes which could not be foreſeen, or guarded againſt by human prudence although they had been foreſeen. In their preſent ſituation, there is little probability of their attempting new conqueſts; happy if they are allowed to remain in the quiet poſſeſſion of what they have.

46 Deſcription of the capital.

We have already mentioned the ſituation of Venice, the capital of this republic. Its appearance at a diſtance is very ſtriking, looking like a great town half floated by a deluge. Betwixt the city and the Terra Firma are a great many ſhallows, on which at low water you may almoſt every where touch the bottom with a pole; but all poſſible care is taken to prevent their becoming dry land. On the ſouth ſide of the city are alſo ſhallows; but on theſe there is a greater depth of water. The channels betwixt them are marked out by ſtakes or poles, which on the approach of an enemy would certainly be taken away. The city is divided by a vaſt number of canals, on which ply the gondoliers, or watermen, in their black gondolas or boats. The ſtreets are very clean and neat, but narrow and crooked. There are no carriages, not ſo much as a chair, to be ſeen in them. Though the city, by its ſituation and the great number of ſteeples towering above the water, ſtrikes one with admiration at a diſtance, yet when he is got into it, it does not anſwer his expectation; for excepting the ſquare of St Mark and a few other places, there is nothing grand or beautiful in it, at leaſt in compariſon of many other cities of Italy. Of the canals, that called *Il Canale Maggiore*, or the "great canal," is by far the largeſt and longeſt, and conſequently the moſt beautiful. Here races are ſometimes run for prizes in the gondolas. On its banks are alſo ſeveral ſtately houſes. Over theſe canals are a great number of handſome bridges

of

Venice.

of one arch, but without any fence on either ſide: they are alſo built of white ſtone, with which the ſtreets are all paved, except the Rialto over the great canal which is all of marble, and coſt the republic 250,000 ducats, the arch being 90 feet wide. The canals in ſummer emit a bad ſmell, from the great quantities of filth continually running into them. The fineſt gondolas are thoſe in which the foreign miniſters make their public entries, being richly decorated with gilding, painting, and ſculpture. The number of iſlands on which the city ſtands, according to ſome, is 60; according to others, 72. The circumference is about ſix Italian miles; and it takes up about two hours to make the circuit of it in a gondola. The inhabitants are ſuppoſed to be about 150,000 including thoſe of the iſlands of Murano, La Guideca, and thoſe who live on board the barges. There are near 200 ſprings of freſh water in the city; but the water of many of them is ſo indifferent, that the principal families preſerve rain-water in ciſterns, or are ſupplied with water from the Brenta. The moſt remarkable places in the city are the ducal palace, the ſquare and church of St Mark, who is the tutelar ſaint of Venice; the mint, public library, grand arſenal, ſeveral of the palaces of the nobles, churches, convents, and hoſpitals. In theſe laſt is a prodigious collection of the fineſt paintings; Venice, in this reſpect, even ſurpaſſing Rome itſelf. The diverſions of the Venetians are chiefly maſquerading, eſpecially during the carnival and other feſtivals; ridottos, operas, plays, which are generally wretched performances, and concerts of vocal and inſtrumental muſic. During their feſtivals, debauchery, riot, and licentiouſneſs, are carried to the greateſt height. The courtezans, here, we are told, are abſolutely loſt to all ſenſe of modeſty and common decency. The grand ſcene of all the ſhows and follies of the feſtivals, is the ſquare of St Mark, in which bulls are ſometimes baited. In the doge's palace all the high colleges hold their aſſemblies; but we are told by ſeveral travellers, which ſeems very ſtrange, that the ſtairs are no better than a privy. In this palace is a ſmall arſenal, furniſhed with arms againſt any ſudden inſurrection of the people, together with a ſtate-priſon, a great many exquiſite paintings, and ſeveral curioſities, among which are ſome *clauſtra caſtitatis*. One ſide of it is towards St Mark's ſquare, and the lower gallery on that ſide, with the hall under the new procuratie facing it, are called the *Broglio*, where the nobility and none elſe, at leaſt while they are preſent, are allowed to walk. The ſquare of St Mark is the greateſt ornament of the city, and hath the form of a parallelogram. In this ſquare, beſides the church and palace of St Mark, are two towers, on one ſide of which is a curious clock; and the other has ſtairs ſo conſtructed that one may ride up on horſeback. Oppoſite to the ducal palace is the public library of the commonwealth; containing a large collection of books and manuſcripts, with ſome fine paintings, ſtatues, and curioſities. Hard by St Mark's ſquare is the zecca, or mint: from zecca the gold coin called *zecchino* takes its name. One of the ſmalleſt pieces of money at Venice is called *gazetta*; and the firſt newſpapers publiſhed there, on a ſingle leaf, having been ſold for that a-piece, all kinds of newſpapers were from thence ſtyled *gazettes*. The grand arſenal is two and a half Italian miles in circuit, and contains vaſt quantities of naval and other warlike ſtores: ſome pretend that it could furniſh arms for 10,000 horſe and 100,000 foot: here are the trophies of Scanderbeg and others, with the helmet of Attila, &c. The rope walk is 444 common paces in length, and the ropes and cables are valued at 2,000,000 of ſilver ducats. In the foundery none but braſs cannon are caſt; and 100 men are generally at work in the forges. The ſalt-petre works here deſerve a traveller's notice: there is a veſſel filled with wine and water four times a-day, where the workmen, though 1000 or more, may drink as much and as often as they pleaſe. Cloſe to the Rialto is the bank. The trade of the city at preſent is far ſhort of what it was formerly. Their chief manufactures are cloth; eſpecially ſcarlet, ſilks, gold and ſilver ſtuffs, brocades, velvets, and paper, of which, and wine, oil, fruit, ſweetmeats, anchovies, and ſeveral ſorts of drugs uſed in phyſic and painting, the exports are ſtill conſiderable. Venice has neither walls, gates, nor citadel, to defend it; its ſituation ſupplying the want of all theſe. In the treaſury of relics is the protocoll, or original manuſcript, as they pretend, of St Mark's goſpel: it is rarely ſhown; and the writing, by length of time, is ſo defaced, that the greateſt connoiſſeurs in manuſcripts cannot determine whether it was wrote in Greek or Latin. Beſides what is properly called the city, there is a multitude of little iſlands lying round, which are covered with buildings, and make each of them a kind of ſeparate town; the moſt conſiderable of which is that called *Guideca*, or the "Jews Quarter," which is large and populous; with St Eroimo, St Helena, St Georgio, Chioſa, Il Lido de Paleſtrina, Il Lido de Malamocco, and Murano: theſe iſlands are a ſort of fence to the city, breaking the violence of the waves. To diſtinguiſh them from others, the Jews here muſt wear a bit of red cloth in their hats. The gardens in this city are few and inconſiderable. In the iſland of Murano are made thoſe beautiful looking-glaſſes, and other glaſs-works, for which Venice is ſo much noted: here the family of Cornaro hath a palace, with a gallery of paintings, little ſhort of an Italian mile in length. The ſalt-works in the iſland of Chioſa are of great benefit to the Venetians, and yield a very conſiderable revenue. There are ſeveral other ſmall iſlands about Venice beſides thoſe we have mentioned; but they are inconſiderable.

47
Government, &c. of Venice.

As to the government of this ſtate, it was, as above related, at firſt veſted in conſuls, afterwards in tribunes. About the beginning of the 8th century, a doge or duke was elected, and veſted with unlimited power, but in 1171, the power of the doge was much abridged, and a council of 240 perſons, compoſed of commons as well as nobles, was appointed. Soon after, under duke Marino Moroſini, the preſent form of electing the doge was introduced. In 1296, the government became ariſtocratical; the privilege of ſitting in the great council being then confined to the nobility, in whom alone the ſupreme authority at preſent is veſted. The number of nobles amounts to about 2000. All thoſe are members of the ſenate; but, according to their antiquity, ſome are accounted more honourable than others. One claſs, and that the loweſt, conſiſts of the poſterity of thoſe who, in the neceſſitous times of the commonwealth, purchaſed their nobility for 100,000 ducats. The nobles have the title of *Excellency*; and wear, at leaſt when in the city, a black furred gown reaching to their heels, with long caps and periwigs. Some of them are ſo poor, that they are fain to beg of the rich. At the head of the government is the doge, whoſe office was once hereditary and power abſolute; but the former is now elective, and the latter very much circumſcribed: indeed he is no more than a gaudy ſlave, loaded with fetters, which one would think could not be much the lighter for being gilt; yet ſo much is the human heart captivated with external pomp and pageantry, that the office, for the moſt part, is eagerly ſought after: but ſhould one otherwiſe inclined be choſen, he cannot decline it, without expoſing himſelf to baniſhment and confiſcation of his effects. Though the power of the doge is very ſmall, his ſtate and retinue are very ſplendid: his title is that of *Serenity*, and his office for life: he is ſaid to be a king with regard to his robes, a ſenator in the council-houſe, a priſoner in the city, and a private man out of it. The yearly revenue of his office is about

4000l. ; and though he may be depoſed, he cannot reſign his dignity. All the nobility have a ſeat in the great council, unleſs they are under 25 years of age. In this council the ſupreme authority and legiſlative power is veſted. Next to it is the ſenate or pregradi, which conſiſts of about 250 members, who have the power of making peace or war, and foreign alliances ; of appointing ambaſſadors ; fixing the ſtandard of the coins ; impoſing duties and taxes ; and all offices by ſea and land are in their gift. The third council conſiſts of the doge and his ſix counſellors, in which all letters and inſtruments relating to the ſtate are read, ambaſſadors admitted to audience, and other important affairs tranſacted. The other colleges are the council of ten ; which decides all criminal caſes without appeal, and to which even the doge himſelf is ſubject : the procurators of St Mark, whoſe office is very lucrative, and who decide with reſpect to wills, guardianſhips, and the making a proper proviſion for the poor ; and the ſtate inquiſition, whoſe buſineſs it is to provide for the public tranquillity. In the wall of the ducal palace are heads of lions and leopards, with open mouths, to receive informations of any plot or treaſon againſt the ſtate. Here is alſo a particular college for the regulation of dreſs, but their juriſdiction does not extend to ſtrangers. 48 Method of choosing the doge. The method of electing the doge is no leſs ſingular than complicated, and effectually calculated to prevent all kinds of bribery or corruption. All the members of the grand council who are paſt 30 years of age, being aſſembled in the hall of the palace, as many balls are put into an urn as there are members preſent ; 30 of theſe balls are gilt, and the reſt white. Each counſellor draws one ; and thoſe who get the gilt balls go into another room, where there is an urn containing 30 balls, nine of which are gilt. The 30 members draw again ; and thoſe who by a ſecond piece of good fortune get the gilt balls are the firſt electors, and have a right to chooſe 40, among whom they comprehend themſelves.

Theſe 40, by balloting in the ſame manner as in the former inſtances, are reduced to 12 ſecond electors, who chooſe 25 ; the firſt of the 12 naming three, and the remaining 11 two a-piece. All thoſe being aſſembled in a chamber apart, each of them draws a ball from an urn containing 25 balls, among which are 9 gilt. This reduces them to 9 third electors, each of whom chooſes five, making in all 45 ; who, as in the preceding inſtances, are reduced by ballot to 11 fourth electors, and they have the nomination of 41, who are the direct electors of the doge. Being ſhut up by themſelves, they begin by chooſing three chiefs and two ſecretaries ; each elector being then called, throws a little billet into an urn which ſtands on a table before the chiefs. On this billet is inſcribed the perſon's name whom the elector wiſhes to be doge.

The ſecretaries then, in the preſence of the chiefs and of the whole aſſembly, open the billets. Among all the 41 there are generally but a very few different names ; as the election for the moſt part balances between two or three candidates. Their names, whatever is the number, are put into another urn, and drawn out one after another. As ſoon as a name is extracted the ſecretary reads it, and if the perſon to whom it belongs is preſent, he immediately retires. One of the chiefs then demands with a loud voice, whether any crime can be laid to this perſon's charge, or any objection made to his being raiſed to the ſovereign dignity ? If any objection is made, the accuſed is called in and heard in his own defence ; after which the electors proceed to give their deciſion, by throwing a ball into one of the two boxes, one of which is for the Ayes, the other for the Noes. The ſecretaries then count the balls ; and if there are 25 in the firſt, the election is finiſhed ; if not, another name is read, and the ſame inquiſition made as before, till there are 25 appearing balls.

49 Order of knighthood. The principal Venetian order of knighthood is that of St Mark ; the badge of which is a large gold medal dependent on the breaſt. The order of Conſtantine knights wear a croſs hanging from a gold chain.

50 Religion. With reſpect to religion, that of the Venetians is the Roman Catholic ; but they are no bigots. The court of inquiſition is here under very great reſtrictions ; and the pope is conſidered as little more than a temporal prince, his ſupremacy being rejected.

51 Military force and revenues. The Venetians are ſtill the greateſt naval power in Italy. They pretend they could fit out, in caſe of neceſſity, 60 men of war, 100 galleys, and 10 galeaſſes ; though one can hardly imagine how they could man half that number. The army is ſaid to conſiſt of between 20,000 and 30,000 men ; the greateſt part of which are Dalmatians and Switzers. The commander in chief, ſtyled *Capitano*, is always a foreigner of diſtinction. General Græme, a Scotchman, lately enjoyed that honourable poſt. The ordinary revenues of the ſtate are computed at about 1,200,000l. ſterling ; but in time of war they can raiſe them greatly. A conſiderable part of the revenue ariſes from the cuſtoms, and the duty on ſalt made at Corfu and Chioſa.

52 Character. The Venetians are in general tall and well made. They are a lively ingenious people, extravagantly fond of public amuſements, with an uncommon reliſh for humour, and yet more attached to the real enjoyments of life than to thoſe which depend on oſtentation and proceed from vanity. The women are of an eaſy addreſs, and have no averſion to cultivating an acquaintance with thoſe ſtrangers who are preſented to them by their relations, or have been properly recommended.

VENIRE FACIAS, in law, is a judicial writ lying where two parties plead and come to iſſue, directed to the ſheriff, to cauſe 12 men of the ſame neighbourhood to meet and try the ſame, and to ſay the truth upon the iſſue taken.

VENTER, ſignifies the belly ; but it is alſo uſed for the children by a woman of one marriage : there is in law a firſt and ſecond venter, &c. where a man hath children by ſeveral wives ; and how they ſhall take in deſcents of lands.

Venter Inſpiciendo, is a writ to ſearch a woman that ſaith ſhe is with child, and thereby withholdeth lands from the next heir ; the trial whereof is by a jury of women.

VENTILATOR, a machine by which the noxious air of any cloſe place, as an hoſpital, gaol, ſhip, chamber, &c. may be diſcharged and changed for freſh.

The noxious qualities of bad air have been long known ; and no one has taken greater pains to ſet the miſchiefs ariſing from foul air in a juſt light than Dr Hales ; who has alſo propoſed an eaſy and effectual remedy by the uſe of his ventilators ; his account of which was read to the Royal Society in May 1741. In the November following M. Triewald, military architect to the king of Sweden, informed Dr Mortimer, ſecretary to the Royal Society, that he had in the preceding ſpring invented a machine for the uſe of his majeſty's men of war, in order to draw out the bad air from under their decks, the leaſt of which exhauſted 36,172 cubic feet of air in an hour, or at the rate of 21,732 tons in 24 hours. In 1742 he ſent one of them, formed for a 60 gun ſhip to France ; which was approved of by the Royal Academy of Sciences at Paris : and the king of France ordered all the men of war to be furniſhed with the like ventilators.

Plate DXIII. The ventilators invented by Dr Hales conſiſt of a ſquare box ABCD (fig. 1.) of any ſize ; in the middle of one ſide of this box a broad partition or midriff is fixed by hinges X, and it moves up and down from A to C, by means of an

Ventilator.

an iron rod ZR, fixed at a proper diſtance from the other end of the midriff, and paſſing through a ſmall hole in the cover of the box up to R. Two boxes of this kind may be employed at once, and the two iron rods may be fixed to a lever FG (fig. 2.) moving on a fixed centre O; ſo that by the alternate raiſing and preſſing down of the lever FG, the midriffs are alſo alternately raiſed and depreſſed, whereby theſe double bellows are at the ſame time both drawing in air, and pouring it out, through apertures with valves made on the ſame ſide with, and placed both above and below, the hinges of the midriffs. In order to render the midriffs light, they are made of four bars lengthwiſe, and as many acroſs them breadthwiſe, the vacant ſpaces being filled up with thin pannels of fir-board; and that they may move to and fro with the greater eaſe, and without touching the ſides of the boxes, there is an iron regulator fixed upright to the middle of the end of the box AC (fig. 1.) from N to L, with a notch cut into the middle of the end of the midriff at Z; ſo that the midriffs, in riſing and falling, ſuffer no other friction than what is made between the regulator and the notch. Moreover, as the midriff ZX moves with its edges only one twentieth of an inch from the ſides of the box ABCDFE, very little air will eſcape by the edges; and, therefore, there will be no need of leathern ſides as in the common bellows. The end of the box at AC is made a little circular, that it may be better adapted between A and C to the riſing and falling midriff; and at the other end X of the midriff, a ſlip of leather may be nailed over the joints if needful. The eight large valves through which the air is to paſs, are placed at the hinge-end of the boxes BK (fig. 2.) as at 1, 2, 3, &c. The valve 1 opens inward to admit the air to enter, when the midriff is depreſſed at the other end by means of the lever FG. And at the ſame time the valve 3 in the lower ventilator is ſhut by the compreſſed air which paſſes out at the valve 4. But when that midriff is raiſed, the valve 1 ſhuts, and the air paſſes out at the valve 2. And it is the ſame with the valves 5, 6, &c. of the other box; ſo that the midriffs are alternately riſing and falling, and two of the ventilators drawing in air, and two blowing it out; the air entering at the valves 1, 3, 6, 8, and paſſing out at the valves 2, 4, 5, 7. Before theſe laſt valves there is fixed to the ventilators a box QQNM (fig. 3.) as a common receptacle for all the air which comes out of theſe valves; which air paſſes off by the trunk P, through the wall of a building.

For a farther account of this machine we refer to the author himſelf, who gives a full detail of it and of its manner of working. See Deſcription of Ventilators by Stephen Hales, D. D. Lond. 1743, 8vo.

The ventilators in large ſhips, ſince the order for ventilating the fleet iſſued by the lords of the admiralty in 1756, are fixed in the gunner's fore ſtore-room, and generally ahead of the ſail-room. The foul air is carried up through the decks and fore-caſtle near the fore-maſt, ſometimes afore it, and ſometimes abaft it, but more frequently on its ſtarboard ſide; the lever, by which the ventilators are worked, is under the fore-caſtle in two deck ſhips, and between the upper and middle decks in three-deckers; ſometimes the lever is hung athwart ſhips; in ſome ſhips afore and aft, and in others oblique. The iron rod, which communicates the motion from the lever, paſſes through the partners of the fore-maſt, and is connected with another lever, ſuſpended at or near the middle; in ſome ſhips over the ventilators, in others under them, when it is found neceſſary to fix them up to the deck. The beſt method to ſave room is to place the ventilators over one another with their circular ends together; the air-trunk ſhould be ſo high above deck, that the men on deck may not be incommoded by the foul air which blows out of it; and therefore the trunk comes through the upper deck, near and behind the foremaſt. For the method of freeing mines, ſhips, priſons, &c. from noxious air by means of fire-pipes, ſee PNEUMATICS, nº 371.

Ventricle, Ventriloquiſm.

VENTRICLE, properly denotes any little cavity; but is more particularly uſed by phyſicians and anatomiſts for the ſtomach and certain cavities of the heart and brain.

VENTRILOQUISM, an art by which certain perſons can ſo modify their voice, as to make it appear to the audience to proceed from any diſtance, and in any direction. Some faint traces of this art are to be found in the writings of the ancients: and it is the opinion of M. de la Chapelle, who in the year 1772 publiſhed an ingenious work on the ſubject, that the reſponſes of many of the oracles were delivered by perſons thus qualified to ſerve the purpoſes of prieſt-craft and deluſion. As the ancient ventriloquiſts, when exerciſing their art, ſeemed generally to ſpeak from their own bellies, the name by which they were deſigned was abundantly ſignificant; but it is with no great propriety that modern performers are called *ventriloquiſts*, and their art *ventriloquiſm*, ſince they appear more frequently to ſpeak from the pockets of their neighbours, or from the roof or diſtant corners of the room, than from their own mouths or their own bellies.

From Brodeau, a learned critic of the 16th century, we have the following account of the feats of a capital ventriloquiſt and cheat, who was valet de chambre to Francis the Firſt. The fellow, whoſe name was *Louis Brabant*, had fallen deſperately in love with a young, handſome, and rich heireſs; but was rejected by the parents as an unſuitable match for their daughter, on account of the lowneſs of his circumſtances. The young lady's father dying, he made a viſit to the widow, who was totally ignorant of his ſingular talent. Suddenly, on his firſt appearance, in open day, in her own houſe, and in the preſence of ſeveral perſons who were with her, ſhe heard herſelf accoſted, in a voice perfectly reſembling that of her dead huſband, and which ſeemed to proceed from above, exclaiming, "Give my daughter in marriage to Louis Brabant: He is a man of great fortune, and of an excellent character. I now endure the inexpreſſible torments of purgatory, for having refuſed her to him. If you obey this admonition, I ſhall ſoon be delivered from this place of torment. You will at the ſame time provide a worthy huſband for your daughter, and procure everlaſting repoſe to the ſoul of your poor huſband."

The widow could not for a moment reſiſt this dread ſummons, which had not the moſt diſtant appearance of proceeding from Louis Brabant; whoſe countenance exhibited no viſible change, and whoſe lips were cloſe and motionleſs, during the delivery of it. Accordingly, ſhe conſented immediately to receive him for her ſon-in-law. Louis's finances, however, were in a very low ſituation; and the formalities attending the marriage contract rendered it neceſſary for him to exhibit ſome ſhow of riches, and not to give the ghoſt the lie direct. He accordingly went to work upon a freſh ſubject, one Cornu, an old and rich banker at Lyons; who had accumulated immenſe wealth by uſury and extortion, and was known to be haunted by remorſe of conſcience on account of the manner in which he had acquired it.

Having contracted an intimate acquaintance with this man, he, one day while they were ſitting together in the uſurer's little back parlour, artfully turned the converſation on religious ſubjects, on demons and ſpectres, the pains of purgatory, and the torments of hell. During an interval of ſilence between them, a voice was heard, which to the aſtoniſhed banker ſeemed to be that of his deceaſed father, complaining, as in the former caſe, of his dreadful ſituation in purgatory, and calling upon him to deliver him inſtantly from thence, by putting into the hands of Louis Brabant, then with him, a large ſum for the redemption of Chriſtians then in ſlavery with the Turks; threatening him at the ſame time with eternal damnation if he did not take this method to expiate likewiſe his own ſins. The reader will naturally ſuppoſe that Louis Brabant affected a due degree of aſtoniſhment on the occaſion; and further promoted the deception, by acknowledging his having devoted himſelf to the proſecution of the charitable deſign imputed to him by the ghoſt. An old uſurer is naturally ſuſpicious. Accordingly the wary banker made a ſecond appointment with the ghoſt's delegate for the next day; and, to render any deſign of impoſing upon him utterly abortive, took him into the open fields, where not a houſe, or a tree, or even a buſh, or a bit, were in ſight, capable of ſcreening any ſuppoſed confederate. This extraordinary caution excited the ventriloquiſt to exert all the powers of his art. Wherever the banker conducted him, at every ſtep his ears were ſaluted on all ſides with the complaints and groans not only of his father, but of all his deceaſed relations, imploring him for the love of God, and in the name of every ſaint in the kalendar, to have mercy on his own ſoul and theirs, by effectually ſeconding with his purſe the intentions of his worthy companion. Cornu could no longer reſiſt the voice of heaven, and accordingly carried his gueſt home with him, and paid him down 10,000 crowns; with which the honeſt ventriloquiſt returned to Paris, and married his miſtreſs.—The cataſtrophe was fatal. The ſecret was afterwards blown, and reached the uſurer's ears, who was ſo much affected by the loſs of his money, and the mortifying railleries of his neighbours, that he took to his bed and died.

This trick of Louis Brabant is even exceeded by an innocent piece of waggery played off not 40 years ago by another French ventriloquiſt on a whole community. We have the ſtory from M. de la Chapelle, who informs us, that M. St Gile the ventriloquiſt and his intimate friend, returning home from a place whither his buſineſs had carried him, ſought for ſhelter from an approaching thunder ſtorm in a neighbouring convent. Finding the whole community in mourning, he inquired the cauſe and was told that one of their body had died lately, who was the ornament and delight of the whole ſociety. To paſs away the time, he walked into the church, attended by ſome of the religious, who ſhowed him the tomb of their deceaſed brother, and ſpoke feelingly of the ſcanty honours they had beſtowed on his memory. Suddenly a voice was heard, apparently proceeding from the roof of the quire, lamenting the ſituation of the defunct in purgatory, and reproaching the brotherhood with their lukewarmneſs and want of zeal on his account. The friars, as ſoon as their aſtoniſhment gave them power to ſpeak, conſulted together, and agreed to acquaint the reſt of the community with this ſingular event, ſo intereſting to the whole ſociety. M. St Gile, who wiſhed to carry on the joke ſtill farther, diſſuaded them from taking this ſtep; telling them that they would be treated by their abſent brethren as a ſet of fools and viſionaries. He recommended to them, however, the immediately calling of the whole community into the church, where the ghoſt of their departed brother might probably reiterate his complaints. Accordingly all the friars, novices, lay-brothers, and even the domeſtics of the convent, were immediately ſummoned and collected together. In a ſhort time the voice from the roof renewed its lamentation and reproaches, and the whole convent fell on their faces, and vowed a ſolemn reparation. As a firſt ſtep, they chanted a *De profundis* in a full choir; during the intervals of which the ghoſt occaſionally expreſſed the comfort he received from their pious exerciſes and ejaculations on his behalf. When all was over, the prior entered into a ſerious converſation with M. St Gile; and on the ſtrength of what had juſt paſſed, ſagaciouſly inveighed againſt the abſurd incredulity of our modern ſceptics and pretended philoſophers on the article of ghoſts or apparitions. M. St Gile thought it now high time to diſabuſe the good fathers. This purpoſe, however, he found it extremely difficult to effect, till he had prevailed upon them to return with him into the church, and there be witneſſes of the manner in which he had conducted this ludicrous deception.

A ventriloquiſt, who performed feats ſomewhat ſimilar to theſe, made his appearance in Edinburgh, and many of the other towns of Scotland, a few months before the writing of this article. He imitated ſucceſsfully the voice of a ſqueaking child, and made it appear to proceed from whatever place he choſe; from the pockets of the company, from a wooden doll, with which he held many ſpirited converſations; from beneath a hat or a wineglaſs, and out of any perſon's foot or hand. When the voice ſeemed to come from beneath a glaſs or hat, it was dull and on a low key, as ſounds confined always are; and what evinced his dexterity was, that when the glaſs was raiſed from the table during the time of his ſpeaking, the words or ſyllables uttered afterwards were on a higher key, in conſequence, one would have thought, of the air being readmitted to the ſpeaker. This part of the experiment failed, however, when the management of the glaſs was at a diſtance committed to any of the company; but as the room was not well illuminated, we are inclined to attribute this failure to the ventriloquiſt's not being able to perceive at what preciſe inſtant of time the glaſs was removed from the table. The ſame artiſt imitated the tones of a ſcolding old woman, diſturbed at unſeaſonable hours by a perſon demanding admiſſion into her houſe; but this exhibition did not to us appear maſterly. The tones of the old woman and the child were not accurately diſcriminated: the child was a young ſcold, and the ſcold ſpoke like an angry child. We have heard that, when in Edinburgh, the ſame practitioner aſtoniſhed a number of perſons in the Fiſhmarket, by making a fiſh appear to ſpeak, and give the lie to its vender, who affirmed that it was freſh, and caught in the morning; and whether this fact was really performed or not, we cannot doubt, from what we ſaw and heard him do, but that he was fully equal to its performance.

Our ventriloquiſt was an illiterate man; and though ſufficiently communicative, could not make intelligible to us the manner in which he produced theſe acouſtic deceptions. Indeed if he had, we ſhould hardly have deſcribed the practical rules of the art to the public; for though it is proper to make the exiſtence of ſuch an art univerſally known, it will readily occur to every reflecting mind, that the attainment of it ſhould not be rendered eaſy to thoſe who, like Louis Brabant, might make it ſubſervient to the purpoſes of knavery and deception. The ſpeculative principles on which it is founded muſt be obvious to every man who has ſtudied the philoſophy of the human mind, and has ever witneſſed the feats of mimickry.

It has been ſhown elſewhere (ſee METAPHYSICS, n° 47, 48.), that, previous to experience, we could not refer ſound to any external cauſe; that it does not therefore give immediate indication of the place or diſtance of the ſonorous body; and that it is only by the aſſociation of place with ſound that the latter becomes an indication of the former. This being admitted, nothing ſeems requiſite to fit a man for becoming an expert ventriloquiſt but a delicate ear, flexibility of the organs of ſpeech, and long practice of thoſe rules which repeated trials would enable him to diſcover. A delicate ear perceives every difference which change of place produces in the ſame ſound; and if a perſon poſſeſſed of ſuch an ear have ſufficient command over his organs of ſpeech, to produce by them a ſound in all reſpects ſimilar to another proceeding from any diſtant object, it is evident that to the audience the ſound which he utters muſt appear to proceed from that object. If this be the true theory of ventriloquiſm, it does not ſeem to be poſſible for the moſt expert ventriloquiſt to ſpeak in his uſual tones of converſation, and at the ſame time make the voice appear to come from a diſtance; for theſe tones muſt be ſuppoſed familiar to his audience, and to be in their minds aſſociated with the ideas of his figure, place, and diſtance. Hence the ventriloquiſt whom we ſaw appeared to ſpeak from various places only in the tones of the ſqueaking child, while Louis Brabant and M. St Gille, in their great feats, imitated the voices of ghoſts, to which no man could be familiar, and where terror would greatly contribute to the deception. There can, however, be no doubt, but that if, by a peculiar modification of the organs of ſpeech, a ſound of any kind can be produced, which in faintneſs, tone, body, and in ſhort every other ſenſible quality, perfectly reſembles a ſound delivered from the roof of an oppoſite houſe; the ear will naturally, without examination, refer it to that ſituation and diſtance, the ſound which the perſon hears being only a ſign, which he has from his infancy been conſtantly accuſtomed, by experience, to aſſociate with the idea of a perſon ſpeaking from a houſe-top. It is evident too, that when there is no particular ground of ſuſpicion, any ſmall diſparity between the two ſounds will not be perceptible. But if our theory be juſt, that experience or habit which miſleads a perſon who has ſeldom heard the ventriloquiſt, and is a ſtranger to his powers, at length ſets another perſon right who is acquainted with them, and has been a frequent witneſs of their effects. This was actually the caſe of M. de la Chapelle, with whom the illuſion at length ceaſed, in conſequence of repeated viſits to M. St Gille: ſo that while others, ignorant of his talent, and poſſeſſed only of their old or habitual experience with regard to articulate ſounds, conſidered his voice as coming from the top of a tree, or from a deep cellar under ground; our author, well acquainted with the powers of the ventriloquiſt, and having acquired a new kind of experience, at once referred it directly to the mouth of the ſpeaker.

VENUS, in Pagan worſhip, the goddeſs of love and beauty. Cicero mentions two other deities of this name. Venus, ſtyled *Urania* and *Celeſtis*; and the *Venus Pandemos* or *Popularis*, the wife of Vulcan, and the goddeſs of wanton and effeminate love. To the firſt the Pagans aſcribed no attributes but ſuch as were agreeable to the ſtricteſt chaſtity and virtue; and of this deity they admitted no corporeal reſemblance, ſhe being only repreſented by the form of a globe, ending conically. Her ſacrifices were termed *nephalia*, on account of their ſobriety. To her honey and wine were offered, and no animal except the heifer; and on her altars the wood of figs, vines, or mulberries, were not ſuffered to be burnt. The Romans dedicated a temple to this goddeſs, to whom they gave the name of *Verticordia*; becauſe ſhe turned the hearts of lewd women, and inſpired modeſty and virtue.

But the moſt famous of theſe goddeſſes is the wife of Vulcan; who is repreſented as ſpringing from the froth raiſed by the genitals of Saturn, when cut off by Jupiter and thrown into the ſea. As ſoon as ſhe was formed, ſhe was laid in a beautiful ſhell embelliſhed with pearl, and wafted by gentle zephyrs to the iſle of Cytherea, whence ſhe ſailed to Cyprus. At her landing, flowers roſe beneath her feet; ſhe was received by the Hours, who braided her hair with golden fillets; and then wafted her to heaven, where her charms appeared ſo attractive, that moſt of the gods deſired her in marriage; but Vulcan, by the advice of Jupiter, gained poſſeſſion by putting poppies into her nectar. As Venus was the goddeſs of love and pleaſure, the poets have been laviſh in the deſcription of her beauties; and the painters and ſtatuaries have endeavoured to give her the moſt lovely form. Sometimes ſhe is repreſented clothed in purple, glittering with gems, her head crowned with roſes, and drawn in an ivory car by ſwans, doves, or ſparrows; at others ſhe ſtands attended by the Graces; but in all poſitions, her ſon Cupid is her inſeparable companion. She was honoured as the mother of Hymeneus, Cupid, Æneas, and the Graces, and was paſſionately fond of Adonis and Anchiſes.

This goddeſs was principally worſhiped at Paphos and Cyprus; and the ſacrifices offered to her were white goats and ſwine, with libations of wine, milk, and honey. Her victims were crowned with flowers, or wreaths of myrtle.

Venus, in aſtronomy. See Astronomy-*Index*, and Pneumatics, n° 237.

Venus's Fly-trap. See *Dionæa Muſcipula*.

Venus, in zoology, a genus of inſects belonging to the order of vermes teſtaceæ. This animal is a tethys: the ſhell is bivalve; the hinge with three teeth near each other, one placed longitudinally and bent inwards. There are a great many ſpecies; of which the moſt remarkable is the *merenaria*, or commercial, with a ſtrong, thick, weighty ſhell, covered with a brown epidermis; pure white within; ſlightly ſtriated tranſverſely. Circumference above 11 inches.—Theſe are called in North America *clams*; they differ from other ſpecies only in having a purple tinge within. Wampum, or Indian money, is made of them.

VEPRECULÆ, diminutive from *vepres*, "a briar or bramble; the name of the 31ſt order in Linnæus's Fragments of a Natural Method. See Botany, Sect. 6.

Vera-Cruz, a ſea-port town of North America, in New Spain, with a very ſecure and commodious harbour, defended by a fort. Here the Flotilla annually arrives from Spain to receive the produce of the gold and ſilver mines of Mexico; and at the ſame time a fair is held here for all manner of rich merchandiſe brought from China and the Eaſt Indies by way of the South Sea, and for the merchandiſe of Europe by the way of the Atlantic Ocean. This town is not two miles in circumference; and about it there is a wall of no great ſtrength on the land-ſide. The air is unwholeſome; and there are very few Spaniards here unleſs when the Flotilla arrives, and then it is crowded with people from all parts of Spaniſh America. It is 200 miles ſouth-eaſt of Mexico. W. Long. 37. 25. N. Lat. 19. 12.

VERAGUA, a province of New Spain, bounded on the eaſt of that of Coſta Rica, on the weſt by Panama, on the north by Darien and the Gulf of Mexico, and on the ſouth by the South Sea. It is about 125 miles in length from eaſt to weſt, and 60 in breadth from north to ſouth. It is a mountainous barren country; but has plenty of gold and ſilver. Conception is the capital town.

VERATRUM, in botany: A genus of plants of the claſs of *polygamia*, and order of *monœcia*; and in the natural ſyſtem arranged under the 10th order, *Coronariæ*. There is no calyx; the corolla has ſix petals; there are ſix ſtamina: the hermaphrodite flowers have three piſtils and three capſules. There are three ſpecies, none of which are natives of Britain.

The moſt important is the *album*, or hellebore, the root of which is perennial, about an inch thick, externally brown, internally white, and beſet with many ſtrong fibres; the ſtalk is thick, ſtrong, round, upright, hairy, and uſually riſes four feet in height: the leaves are numerous, very large, oval, entire, ribbed, plaited, without footſtalks, of a yellowiſh green colour, and ſurround the ſtem at its baſe: the flowers are of a greeniſh colour, and appear from June to Auguſt in very long, branched, terminal ſpikes.

It appears from various inſtances, that every part of the plant is extremely acrid and poiſonous, as its leaves and even ſeeds prove deleterious to different animals.

Woodville's Medical Botany.

The ancients, though ſufficiently acquainted with the virulency of their white hellebore, were not deterred from employing it internally in ſeveral diſeaſes, eſpecially thoſe of a chronic and obſtinate kind, as mania, melancholia, hydrops, elephantiaſis, epilepſia, vitiligo, lepra, rabies canina, &c. They conſidered it the ſafer when it excited vomiting, and Hippocrates wiſhed this to be its firſt effect. To thoſe of weak conſtitutions, as women, children, old men, and thoſe labouring under pulmonary complaints, its exhibition was deemed unſafe; and even when given to the robuſt, it was thought neceſſary to moderate its violence by different combinations and preparations; for it was frequently obſerved to effect a cure, not only by its immediate action upon the primæ viæ, but when no ſenſible evacuation was promoted by its uſe.

Greding employed it in a great number of caſes of the maniacal and melancholic kind; the majority of theſe, as might be expected, derived no permanent benefit; ſeveral, however, were relieved, and five completely cured by this medicine. It was the bark of the root, collected in the ſpring, which he gave in powder, beginning with one grain: this doſe was gradually increaſed according to its effects. With ſome patients one or two grains excited nauſea and vomiting, but generally eight grains were required to produce this effect, though in a few inſtances a ſcruple and even more was given.

Veratrum has likewiſe been found uſeful in epilepſy, and other convulſive complaints; but the diſeaſes in which its efficacy ſeems leaſt equivocal, are thoſe of the ſkin; as ſcabies and different prurient eruptions, herpes, morbus pediculoſus, lepra, ſcrophula, &c. and in many of theſe it has been ſucceſsfully employed both internally and externally.

As a powerful ſtimulant, and irritating medicine, its uſe has been reſorted to only in deſperate caſes, and then it is firſt to be tried in very ſmall doſes in a diluted ſtate, and to be gradually increaſed according to the effects.

VERB, in grammar. See Grammar, Chap. IV.

VERBASCUM, in botany: A genus of plants of the claſs of *pentandria*, and order of *monogynia;* and in the natural ſyſtem arranged under the 28th order, *Luridæ*. The corolla is rotated, and rather unequal: the capſule is monolocular and bivalved. There are 12 ſpecies, five of which are natives of Britain; 1. The *thapſus*, or great mullein, which has a ſtem ſingle, ſimple, erect, covered with leaves, about ſix feet high. Leaves large, broad, white, woolly on both ſides, ſeſſile, decurrent. Flowers terminal, in a long ſpike, ſeſſile, yellow.

Catarrhal coughs and diarrhœas are the complaints for which it has been internally preſcribed. Dr Home tried it in both, but it was only in the latter diſeaſe that this plant ſucceeded. He relates four caſes in which a decoction of verbaſcum was given; and from which he concludes, that it "is uſeful in diminiſhing or ſtopping diarrhœas of an old ſtanding, and often in eaſing the pains of the inteſtines. Theſe acquire a great degree of irritability; and the ordinary irritating cauſes, aliment, bile, diſtenſion from air, keep up a quicker periſtaltic motion. This is obviated by the emollient and perhaps gentle aſtringent qualities of this plant."

2. The *nigrum*, or black mullein, having a ſtem beſet with hairs that are beautifully branched; the bloſſoms yellow, with purple tips. It is a beautiful plant, and the flowers are grateful to bees. Swine eat it; ſheep are not fond of it; cows, horſes, and goats, refuſe it. The other Britiſh ſpecies are the lychnitis, nigrum, blattaſi, and virgatum.

VERBENA, in botany: A genus of plants of the claſs of *diandria*, and order of *monogynia;* and in the natural ſyſtem arranged under the 40th order, *Perſonatæ*. There are 17 ſpecies, only one of which is a native of Britain; the *officinalis*, or common vervain, which grows on the road-ſides near towns and villages. The leaves have many jagged clefts, the bloſſoms are pale blue. It manifeſts a ſlight degree of aſtringency, and was formerly much in vogue as a deobſtruent; but is now diſregarded. Mr Millar ſays that it is never found above a quarter of a mile from a houſe; whence the common people in England call it *Simpler's joy*, becauſe, wherever it is found, it is a certain ſign of a houſe being near. Sheep eat it; cows, horſes, and goats, refuſe it.

VERD (Cape), a promontory on the weſt coaſt of Africa, 40 miles north-weſt of the mouth of the river Gambia. W. Long. 17. 38. N. Lat. 14. 45.

The iſlands of Cape de Verd are ſeated in the Atlantic Ocean, about 400 miles weſt of the Cape. They are between the 13th and 19th degree of latitude; and the principal are 10 in number, lying in a ſemicircle. Their names are, *St Anthony*, *St Vincent*, *St Lucia*, *St Nicholas*, the *Iſle of Sal*, *Bona Viſta*, *Mayo*, *St Jago*, *Fuego*, and *Brava*.

VERDICT (*Vere dictum*), is the anſwer of the jury given to the court concerning the matter of fact, in any caſe civil or criminal, committed by the court to their trial and examination. See Law, Nº clxxxvi. 51. and Trial.

VERDIGRISE, the acetite of copper, much uſed by painters as a green colour. It is chiefly manufactured at Montpelier; the vines of Languedoc being very convenient for this purpoſe. See Chemistry, nº 872.

The following proceſs for making verdigriſe is deſcribed by Mr Monet of the Royal Society of Montpelier, and is publiſhed among the memoirs of the academy for the years 1750 and 1753.

Vine-ſtalks well dried in the ſun are ſteeped during eight days in ſtrong wine, and afterwards drained. They are then put into earthen pots, and upon them wine is poured. The pots are carefully covered. The wine undergoes the acetous fermentation, which in ſummer is finiſhed in ſeven or eight days; but requires a longer time in winter, although this operation is always performed in cellars. When the fermentation is ſufficiently advanced, which may be known by obſerving the inner ſurface of the lids of the pots, which during the progreſs of the fermentation is continually wetted by the moiſture of the riſing vapours, the ſtalks are then to be taken out of the pots. Theſe ſtalks are by this method impregnated with all the acid of the wine, and the remaining liquor is but a very weak vinegar. The ſtalks are to be drained during ſome time in baſkets, and layers of them are to be put into earthen pots with plates of Swediſh copper, ſo diſpoſed that each plate ſhall reſt upon and be covered with layers of ſtalks. The pots are to be covered with lids; and the copper is thus left expoſed to the action of the vinegar, during three or four days, or more, in which time the plates become covered with verdigriſe. The plates are then to be taken out of the pots, and left in the cellar three or four days; at the end of which time they are to be moiſtened with water, or with the weak vinegar above mentioned, and left to dry. When this moiſtening and drying of the plates has been thrice repeated, the verdigriſe will be found to have conſiderably increaſed in quantity; and it may then be ſcraped off for ſale.

A ſolution or eroſion of copper, and conſequently of verdigriſe, may be prepared by employing ordinary vinegar inſtead of wine, as is directed in the above proceſs. But it would not have the unctuoſity of ordinary verdigriſe, which quality is neceſſary in painting. Good verdigriſe muſt be prepared by means of a vinous acid, or ſolvent half acid and half ſpirituous. Accordingly, the ſucceſs of the operation depends chiefly on the degree of fermentation to which the wine employed has been carried: for this fermentation muſt not have been ſo far advanced that no ſenſibly vinous or ſpirituous parts remained in the liquor.

Verdigriſe is employed externally for deterging foul ulcers, and as an eſcharotic. It is rarely or never given internally. Some recommend it indeed in the doſe of a grain or two as an emetic, which operates almoſt as ſoon as received into the ſtomach, and which may therefore be of uſe where poiſonous ſubſtances have been taken, to procure their immediate rejection. It appears, however, highly imprudent to have recourſe on ſuch occaſions to a remedy in itſelf ſo dangerous and ſo virulent; and more eſpecially as a ſpeedy evacuation may generally be obtained by means of ſubſtances which are not only innocent, but at the ſame time weaken the force of the poiſon by diluting and obtunding it, as warm water, milk, oils. It is accordingly excluded from the preſent pharmacopœiæ.

VERDITER, or VERDATER, a preparation of copper, ſometimes uſed by the painters, &c. for a blue; but more uſually mixed with a yellow for a green colour. See CHEMISTRY, nº 758, and *Colour-Making*, nº 28.

VERE (Sir Francis), a renowned Engliſh general, was the ſecond ſon of Geffrey de Vere, a branch of the ancient family of that name, earls of Oxford, and was born in the year 1554. Concerning his education we are uninformed. About the age of 31 he embarked with the troops ſent by Queen Elizabeth, under the command of the earl of Leiceſter, to the aſſiſtance of the ſtates of Holland; in which ſervice his courage and military genius became immediately conſpicuous: but his gallant behaviour in the defence of Bergen-op-Zoom, in the year 1588, when beſieged by the prince of Parma, eſtabliſhed his reputation. After the ſiege was raiſed, he received the honour of knighthood from lord Willoughby, who ſucceeded the earl of Leiceſter in the command. He continued in the ſervice of the ſtates till about the year 1595; during which time, namely, in 1593, he was elected member of parliament for Leominſter in Herefordſhire. The famous expedition againſt Cadiz being reſolved upon, Sir Francis Vere was called home, and appointed to a principal command under the earl of Eſſex. The ſucceſs of this enterpriſe is univerſally known. In 1597 we find him again in Holland, preſent at the battle of Turnhout, of which he has given a particular deſcription in his Commentaries. In the ſame year he embarked, with the earl of Eſſex, in the expedition to the Azores; and at his return was appointed governor of the Briel in Holland, with the command of the Engliſh troops in the ſervice of the ſtates. In 1600 he was one of the three generals at the battle of Newport, and had the honour of having the victory univerſally aſcribed to his conduct and reſolution. The ſtates of Holland, then at war with Spain, marched their army with an intention to beſiege Newport in Flanders. The commanders were, count Erneſt of Naſſau, count Somes, and Sir Francis Vere. The Spaniards marched to intercept them, and this battle enſued. Sir Francis was ſhot firſt through the leg, and then through the ſame thigh; notwithſtanding which, he rallied the flying army, and led them on to victory. The Spaniards loſt 120 enſigns, and moſt of their foot were ſlain. Queen Elizabeth on this occaſion declared him the *worthieſt captain of her time*. (See *Letters of the Sidney Family*, vol. ii. p. 104.) But the laſt and moſt glorious atchievement of his life was his gallant defence of Oſtend, with about 1600 men, againſt an army of 12,000, from July 1601 until March 1602, when he reſigned the government, and returned to Holland. An account of this memorable ſiege, which laſted above three years, to the deſtruction of the beſt troops of Holland, Spain, France, England, Scotland, and Italy, the reader may ſee in *Vere's Commentaries*, with the Continuation at the end. Queen Elizabeth died in the year 1603: the peaceful James ſucceeded to the throne; and Sir Francis Vere, with all the heroes of his time, ſheathed his ſword. He died in 1608, in the 54th year of his age; and was buried in St John's Chapel in Weſtminſter abbey, where a ſplendid monument was erected to his memory. He married the daughter of ——— Dent, a citizen of London, by whom he had three ſons and two daughters, none of whom ſurvived him. He will ever be remembered by poſterity as one of the greateſt heroes of our moſt heroic age.—The work above mentioned is intitled, "The Commentaries of Sir Francis Vere, being diverſe pieces of ſervice wherein he had command; written by himſelf by way of commentary." Cambridge, 1657, folio. It is elegantly printed, and adorned with prints of Sir Francis, Sir Horace Vere, Sir John Ogle, maps, and plans of battles, &c.

VERGE (*Virgata*), in law, ſignifies the compaſs of the king's court, which bounds the juriſdiction of the lord ſteward of the houſehold; and which is thought to have been 12 miles round.

The term *verge* is alſo uſed for a ſtick or rod, whereby one is admitted tenant to a copyhold eſtate, by holding it in his hand, and ſwearing fealty to the lord of the manor.

VERGERS, certain officers of the courts of king's bench and common pleas, whoſe buſineſs it is to carry white wands before the judges. There are alſo vergers of cathedrals, who carry a rod tipped with ſilver before the biſhop, dean, &c.

VERGIL (Polydore). See VIRGIL.

VERJUICE, a liquor obtained from grapes or apples, unfit for wine or cyder; or from ſweet ones, whilſt yet acid and unripe. Its chief uſe is in ſauces, ragouts, &c. though it is alſo an ingredient in ſome medicinal compoſitions, and is uſed by the wax-chandlers to purify their wax.

VERMES, the ſixth claſs of animals in the Linnæan ſyſtem, comprehending five orders. See NATURAL HISTORY, and Zoology.

VERMICELLI, or VERMICHELLY, a compoſition of flour, cheeſe, yolks of eggs, ſugar, and ſaffron, reduced to a paſte, and formed into long ſlender pieces like worms, by forcing it with a piſton through a number of little holes. It was firſt brought from Italy, where it is in great vogue: it is chiefly uſed in ſoups and pottages, to provoke venery, &c.

VERMICULAR, an epithet given to any thing that bears a relation or reſemblance to worms.

VERMIFORMIS, in anatomy, a term applied to various parts in the human body, bearing ſome reſemblance to worms.

VERMILION, a very bright and beautiful red colour, compoſed of quickſilver and ſulphur, in great eſteem among the ancients under the name of *minium*; but what goes by the name of minium amongſt us, is a preparation of lead, known alſo by the name of *red-lead*. See CHEMISTRY, nº 1404.

VERMIN, a collective name, including all kinds of little animals and inſects, which are hurtful or troubleſome to mankind, beaſts, or fruits, &c. as worms, lice, fleas, caterpillars, ants, flies, &c.

VERNACULAR, a word applied to ſomething that is peculiar to any one country.

VERNAL, ſomething belonging to the ſpring-ſeaſon.

VERNIER Scale, a ſcale excellently adapted for the graduation of mathematical inſtruments, thus called from its inventor Peter Vernier, a perſon of diſtinction in the Franche Comté. See Nonius.

Vernier's method is derived from the following principle. If two equal right lines, or circular arcs, A, B, are ſo divided, that the number of equal diviſions in B is one leſs than the number of equal diviſions of A, then will the exceſs of one diviſion of B above one diviſion of A be compounded of the ratios of one of A to A, and of one of B to B.

For let A contain 11 parts, then one of A to A is as 1 to 11, or $\frac{1}{11}$. Let B contain 10 parts, then one of B to B is as 1 to 10, or $\frac{1}{10}$. Now $\frac{1}{10} - \frac{1}{11} = \frac{11 - 10}{10 \times 11} = \frac{1}{10 \times 11} = \frac{1}{10} \times \frac{1}{11}$.

Or if B contains n parts, and A contains $n + 1$ parts; then $\frac{1}{n}$ is one part of B, and $\frac{1}{n+1}$ is one part of A. And $\frac{1}{n} - \frac{1}{n+1} = \frac{\overline{n+1} - n}{n \times \overline{n+1}} = \frac{1}{n} \times \frac{1}{n+1}$.

The moſt commodious diviſions, and their aliquot parts, into which the degrees on the circular limb of an inſtrument may be ſuppoſed to be divided, depend on the radius of that inſtrument.

Let R be the radius of a circle in inches; and a degree to be divided into n parts, each being $\frac{1}{p}$th part of an inch.

Now the circumference of a circle, in parts of its diameter 2 R inches, is $3{,}1415926 \times 2$ R inches.

Then $360^{\circ} : 3{,}1415926 \times 2\,\mathrm{R} :: 1^{\circ} : \frac{3{,}1415926}{360} \times 2\,\mathrm{R}$ inches.

Or, $0{,}01745329 \times \mathrm{R}$ is the length of one degree in inches.

Or, $0{,}01745329 \times \mathrm{R} \times p$ is the length of 1°, in pth parts of an inch.

But as every degree contains n times ſuch parts, therefore $n = 0{,}01745329 \times \mathrm{R} \times p$.

The moſt commodious perceptible diviſion is $\frac{1}{8}$ or $\frac{1}{10}$ of an inch.

Example. Suppoſe an inſtrument of 30 inches radius, into how many convenient parts may each degree be divided? how many of theſe parts are to go to the breadth of the vernier, and to what parts of a degree may an obſervation be made by that inſtrument?

Now $0{,}01745 \times \mathrm{R} = 0{,}5236$ inches, the length of each degree: and if p be ſuppoſed about $\frac{1}{8}$ of an inch for one diviſion; then $0{,}5236 \times p = 4{,}188$ ſhows the number of ſuch parts in a degree. But as this number muſt be an integer, let it be 4, each being 15′: and let the breadth of the vernier contain 31 of thoſe parts, or $7\frac{3}{4}^{\circ}$, and be divided into 30 parts.

Here $n = \frac{1}{4}$; $m = \frac{1}{30}$; then $\frac{1}{4} \times \frac{1}{30} = \frac{1}{120}$ of a degree, or 30′, which is the leaſt part of a degree that inſtrument can ſhow.

If $n = \frac{1}{5}$, and $m = \frac{1}{36}$; then $\frac{1}{5} \times \frac{1}{36} = \frac{60}{5 \times 36}$ of a minute, or 20″.

The following table, taken as examples in the inſtruments commonly made from 3 inches to 8 feet radius, ſhows the diviſions of the limb to neareſt tenths of inches, ſo as to be an aliquot of 60's, and what parts of a degree may be eſtimated by the vernier, it being divided into ſuch equal parts, and containing ſuch degrees as their columns ſhow.

Rad. inches.	Parts in a deg.	Parts in vernier.	Breadth of vernier.	Parts obſerved.
3	1	15	$15\frac{1}{4}$	4′ 0″
6	1	20	$20\frac{1}{4}$	3 0
9	2	20	$10\frac{1}{4}$	1 30
12	2	24	$12\frac{3}{4}$	1 15
15	3	20	$6\frac{3}{4}$	1 0
18	3	30	$10\frac{1}{4}$	0 40
21	4	30	$7\frac{1}{4}$	0 30
24	4	36	$9\frac{3}{4}$	0 25
30	5	30	$7\frac{1}{2}$	0 20
36	6	30	$5\frac{1}{4}$	0 20
42	8	30	$3\frac{7}{8}$	0 15
48	9	40	$4\frac{5}{9}$	0 10
60	10	36	$3\frac{7}{10}$	0 10
72	12	30	$2\frac{7}{12}$	0 10
84	15	40	$2\frac{2}{3}$	0 6
96	15	60	4	0 4

By altering the number of diviſions, either in the degrees or in the vernier, or in both, an angle can be obſerved to a different degree of accuracy. Thus to a radius of 30 inches, if a degree be divided into 12 parts, each being five minutes, and the breadth of the vernier be 21 ſuch parts, or $1\frac{3}{4}^{\circ}$, and divided into 20 parts, then $\frac{1}{12} \times \frac{1}{20} = \frac{1^{\circ}}{240} = 15''$: or taking the breadth of the vernier $2\frac{7}{12}^{\circ}$, and divided into 30 parts; then $\frac{1}{12} \times \frac{1}{30} = \frac{1^{\circ}}{360}$, or 10″: Or $\frac{1}{12} \times \frac{1}{50} = \frac{1^{\circ}}{600} = 6''$; where the breadth of the vernier is $4\frac{1}{4}^{\circ}$.

VERONA, a city of Italy, capital of the Veroneſe, in the territory of Venice, ſituated near the mountains, on the river Adige, in E. Long. 11. 24. N. Lat. 45. 26. It is ſeven miles in compaſs; and has been ſo fortified by the Venetians, that it is now looked upon as impregnable. It contains 57,400 inhabitants.

VERONESE, a territory of Italy, in the republic of Venice, bounded on the north by the Trentino, on the eaſt by the Vicentino and Paduano, on the ſouth by the Mantuano, and on the weſt by the Breſciano. It is about 35 miles in length, and 27 in breadth; and is one of the moſt fertile countries in Italy, abounding in corn, wine, fruits, and cattle.

Veroneſe. See Cagliari.

VERONICA, in botany: A genus of plants of the claſs of *diandria*, and order of *monogynia*; and in the natural ſyſtem arranged under the 40th order, *Perſonatæ*. There are 40 ſpecies; 15 are natives of Britain, only two of which have been applied to any uſe. 1. The *officinalis*, common male ſpeedwell, or fluellin; a native of Britain, growing on heaths and barren grounds. The bloſſoms are blue, the leaves elliptical, ſerrated, and hairy. The leaves have a ſmall degree of aſtringency, and are ſomewhat bitter. An infuſion of them is recommended by Hoffman as a ſubſtitute for tea; but is more aſtringent and leſs grateful. The herb was formerly eſteemed in medicine for various diſorders, but is now almoſt totally diſuſed. Cows, ſheep, goats, and horſes, eat it; ſwine refuſe it. 2. The *beccabunga*, or common brook-lime, the flowers of which are blue, in looſe lateral ſpikes; leaves ſeſſile, oval, oppoſite, thick, notched.

This plant was formerly conſidered as of much uſe in ſeveral diſeaſes, and was applied externally to wounds and ulcers; but if it have any peculiar efficacy, it is to be derived from its antiſcorbutic virtue. As a mild refrigerant juice it is preferred where an acrimonious ſtate of the fluids prevails, indicated by prurient eruptions upon the ſkin, or in what has been called the *hot ſcurvy*. We muſt, however, acknowledge, that we ſhould expect equal benefit from the ſame quantity of any other bland freſh vegetable matter taken into the ſyſtem. To derive much advantage from it, the juice ought to be uſed in large quantities, or the freſh plant eaten as food.

VERSAILLES, a town of France, in the late province of the Iſle of France, 10 miles weſt-ſouth-weſt of Paris. It contains 60,000 inhabitants, and ſince the Revolution has been created a biſhop's ſee. In the reign of Louis the XIII. it was only a ſmall village. This prince built here a hunting-hut in 1630, which Baſſompierre calls "the paltry chateau of Verſailles." Although the ſituation was low and very unfavourable, Louis XIV. built a magnificent palace here, which was the uſual reſidence of the kings of France till the 6th of October 1789, when the late unfortunate Louis XVI. and his family were removed from it to the Thuilleries. The buildings and the gardens are adorned with a vaſt number of ſtatues, done by the greateſt maſters, and the water-works are all worthy of admiration. The great gallery is thought to be as curious a piece of workmanſhip of that kind as any in the world: nor is the chapel leſs to be admired for its fine architecture and ornaments. The gardens with the park are five miles in circumference, and ſurrounded by walls. There are three fine avenues to Verſailles; one of which is the common road to Paris, the other comes from Seaux, and the third from St Cloud. E. Long. 2. 12. N. Lat. 48. 48.

VERSE, in poetry, a line conſiſting of a number of long and ſhort ſyllables, which run with an agreeable cadence.

Verse is alſo uſed for a part of a chapter, ſection, &c.

VERSIFICATION, the art or manner of making verſe; alſo the tune and cadence of verſe. See Poetry, Part III.

VERSION, a tranſlation of ſome book or writing out of one language into another. See Translation.

VERT, in heraldry, the term for a green colour. It is called *vert* in the blazon of the coats of all under the degree of nobles: but in coats of nobility it is called *emerald*; and in thoſe of kings *venus*. In engraving it is expreſſed by diagonals, or lines drawn athwart from right to left, from the dexter chief corner to the ſiniſter baſe.

VERTEBRÆ, in anatomy. See there n° 30.

VERTEX, in anatomy, denotes the crown of the head. Hence vertex is alſo uſed figuratively for the top of other things; thus we ſay, the vertex of a cone, pyramid, &c.

Vertex, is alſo uſed in aſtronomy for the point of the heaven directly over our heads, properly called the *zenith*.

VERTICILLATÆ, the name of a claſs in Ray's and Boerhaave's Methods, conſiſting of herbaceous vegetables, having four naked ſeeds, and the flowers placed in whorls round the ſtalk. The term is ſynonymous to the *labiati*, or lip-flowers of Tournefort; and is exemplified in mint, thyme, and ſavory. Verticillatæ is alſo the name of the 42d order in Linnæus's Fragments of a Natural Method, conſiſting of plants which anſwer the above deſcription.

VERTICILLUS, a mode of flowering, in which the flowers are produced in rings at each joint of the ſtem, with very ſhort foot-ſtalks. The term is exemplified in mint, hore-hound, and the other plants of the natural order deſcribed above.

VERTICITY, is that property of the loadſtone whereby it turns or directs itſelf to one particular point.

VERTIGO, in medicine, ſee there, n° 82.

VERTUMNUS, in mythology, a god who preſided over gardens and orchards, honoured among the Etruſcans, from whom the worſhip of this deity was tranſmitted to the Romans.

Ovid has deſcribed the various forms aſſumed by this deity, in order to obtain the love of Pomona. Some have ſuppoſed that Vertumnus, whoſe name they derive *a vertendo*, becauſe he had power to change his form at pleaſure, marked the year and its variations; and thus they ſay he pleaſed Pomona, by bringing the fruits to maturity. Accordingly, Ovid ſays, that he aſſumed the form of a labourer, reaper, vine-dreſſer, an old woman, to repreſent the four ſeaſons, ſpring, ſummer, autumn, and winter. Vertumnus had a temple near the market place at Rome, being repreſented as one of the tutelary deities of the merchants. The commentators on Ovid ſay, that he was an ancient king of Hetruria, who, by his diligent and ſucceſsful cultivation of fruits and gardens, obtained the honour of being ranked among the gods.

VERUMONTANUM, in anatomy, a ſmall eminence near the paſſages where the ſemen is diſcharged into the urethra.

VERVAIN, in botany. See Verbena.

VERTOT d'Auboef (Rene Aubert de), a celebrated hiſtorian, was deſcended from a noble and ancient family in Normandy, and born in 1655. At 16 years of age he became a Franciſcan friar; afterwards he entered into the order of the Premonſtratenſes, in which he had ſeveral benefices; and at length was a ſecular eccleſiaſtic. He became ſecretary to the dutcheſs of Orleans, member of the academy of Inſcriptions, and hiſtoriographer of Malta. He died at Paris in 1735. His principal works are, 1. The Hiſtory of the Revolutions of Sweden. 2. The Revolutions of Portugal. 3. The Revolutions of the Romans. 4. The Hiſtory of Malta. Theſe works are written in elegant French, and tranſlated into moſt of the languages of Europe.

VERULAM. See Bacon.

VESALIUS (Andreas), a celebrated phyſician and anatomiſt, was born at Bruſſels about the year 1512. He ſtudied phyſic at Paris under James Sylvius; but applied himſelf chiefly to anatomy, which was then very little known, diſſections being eſteemed unlawful and impious: and it appears from his work *De humani corporis fabrica*, that he perfected himſelf in this uſeful knowledge very early. About the year 1537, the republic of Venice made him profeſſor in the univerſity of Padua, where he taught anatomy for ſeven years; Charles V. called him to be his phyſician, as he was alſo to Philip II. king of Spain. Veſalius was now at the height of his glory, when all of a ſudden he formed the deſign of taking a journey to Paleſtine; concerning which journey we are told the following ſtory. A young Spaniſh nobleman he attended, being believed to be dead, Veſalius obtained leave to open him to explore the true cauſe of his illneſs; but when he opened the breaſt, he perceived ſymptoms of life, and ſaw the heart beat. The parents, not ſatisfied with proſecuting him for murder, accuſed him of impiety to the inquiſition, in hopes that tribunal would puniſh him with greater rigour: but the king interpoſing, ſaved him on condition of his making a pilgrimage to the Holy Land. He was ſhipwrecked on his return, and thrown upon the iſland of Zante, where he periſhed, in 1564. He was the author of ſeveral works, the principal of which is *De humani corporis fabrica.*

VESICATORIUM, a Bliſter; an application of an acrid nature made to any part of the body, in order to draw a flux of humours to that part, and thus elevate the ſcarf-ſkin into a bliſter.

VESPA, the waſp; a genus of inſects belonging to the order of hymenoptera. The mouth conſiſts of two jaws without any proboſcis; the ſuperior wings are plaited; the eyes are lunar; and there is a ſharp ſting in the tail. There are 159 ſpecies; only three of which are natives of Britain, the *crabro*, the *vulgaris*, and the *coarctata*.

1. *Crabro*, the hornet. It has tawny antennæ; the ſegments of the abdomen are black on the anterior part and yellow on the poſterior, with two black ſpots on each. Its length is an inch; it builds in hollow trees. Its cakes or combs are compoſed of a ſubſtance like coarſe paper, or ruſty parchment. It is very voracious, devouring other inſects, and even bees.

2. *Vulgaris*, the common waſp. The male has ſeven yellow ſegments of the abdomen, with a black triangle on each: the head is yellow, and the antennæ long. The upper lip of the female is yellow, the antennæ ſhort; there are ſix ſegments of the abdomen with two lateral black ſpots on each. M. Reaumur and Dr Derham agree in diſtinguiſhing three ſorts of waſps; *viz.* the queens or females, the males, and the common labouring waſps, called *mules*, which, according to Reaumur, are neither males nor females, and conſequently barren. The queens, of which there is a great number, are much longer in the body, and larger than any other waſp: they have a large heavy belly, correſponding in ſize to the prodigious quantity of eggs with which they are charged. The males are leſs than the queens, but longer and larger than the common waſps, which are the ſmalleſt of the ſpecies: they have no ſtings with which both the queens and common waſps are furniſhed. There are in one neſt two or three hundred males, and as many females: but their number depends on the ſize of the neſt; and Dr Derham obſerved, that the males were bred, or at leaſt moſtly reſided, in the two cells or partings, between the combs, next the uppermoſt cell. The antennæ or horns of the male waſps are longer and larger than thoſe of either of the other ſorts: but the chief difference, ſays Dr Derham, conſiſts in their parts of generation, which are altogether different from thoſe of other waſps.

The mules are the labourers belonging to a neſt, and are employed in procuring materials for the neſts and in conſtructing them, and alſo in furniſhing the other waſps and the young, with proviſions.

At the beginning of winter, the waſps deſtroy all the eggs, and all the young ones without exception: all the mules and males, which have been employed in this work, being unfurniſhed with proviſions, periſh: and none ſurvive except ſome few females, which, according to Reaumur, were fecundated in October, and raiſe a new colony in the beginning of ſpring.

In ſpring a new commonwealth is founded by a ſingle female impregnated during the autumn, and that has weathered out the ſeverity of the winter. It digs a hole in a dry ſoil, contrives itſelf a ſinuous inlet, or elſe it takes up with the dwelling place of a mole, where it haſtily builds a few cells and depoſits its eggs. Within the ſpace of 20 days, they have gone through the different ſtates of larvæ, chryſalids, and turned to waſps. Nature all-wiſe provides for every thing. The mule-waſps are the only ones that labour at laying the foundation of the republic. The firſt eggs that are hatched prove to be neuter-waſps. No ſooner are they come into exiſtence, but they fall to work, enlarge the hole, and go about upon wood, lattice-work, and window ſaſhes, in ſearch of materials for building. With their teeth they cut, hack, and tear off ſmall fibres of wood, which they moiſten with a liquor they diſgorge, and then convey them to the work-ſhop. Other labourers are in waiting for them, who with thoſe materials ſet about the conſtruction of the waſp-neſt, which is commonly round, and made of materials reſembling fine paper. The common covering of it, which is formed of ſeveral leaves or layers, with intermediate ſpaces, is pierced by two holes at a diſtance from one another, one of which is uſed for the entrance of the waſps, and the other only for their exit. The ſpace within this covering is cut by a number of horizontal planes, with intervals between them of the ſize of about half an inch; they are ſuſpended from one another by ligaments, and attached to the covering by their edges: they all have hexagonal cells in their lower ſurface.

The eggs of the waſp are of an oblong form, and reſemble thoſe of a common fly, but they are larger; they are always faſtened to the angles of a cell, never to the ſides of it. They are uſually placed ſingle; it is very rare to find two in one cell; and, if they are laid ſo, it ſeems that only one ſucceeds; for there is never found more than one worm in a cell.

The heads of all the nymphs are turned towards the centre of the comb, and their tails go obliquely downward toward the baſe of the cell. They are continually ſeen opening their mouths, and moving their forcipes, ſeeming ever hungry, and impatiently waiting for food from their parents. The cells are left open till the nymph is at its full growth; then the waſps cover it over with a thin lid, under which the worm undergoes its transformation; and as ſoon as it is arrived at the waſp-ſtate, it eats its way through this thin cover, and comes to work with the reſt. The elder brothers, or firſt-hatched inſects, take amazing care of thoſe born after them, by proportioning their food to the delicacy of their ſtomach. Firſt, it conſiſts of the juice of fruits and meats; afterwards it is the carcaſes of inſects. The caterers provide for the labourers. Each one takes his own portion; there is no diſpute, no fighting. The republic grows daily more numerous, living in profound peace. Every individual as ſoon as he has acquired ſufficient ſtrength, flies away to the fields. They then become a gang of banditti; they pillage our wall-trees, break into our fruit before its maturity, dart with the fierceneſs of hawks upon our bees, cut their throats to poſſeſs themſelves of their honey, plunder and lay waſte their commonwealth, riot on the fruits of their labour, and oblige them to remove. During the period of plenty, the waſps bring all the booty to the neſt, and ſhare it among them. There is nothing then goes forward but feaſting, rioting, and good fellowſhip; but concord cannot be laſting among robbers. Towards the month of October proviſions begin to run ſhort: The neuters and males tear from their cradles the eggs, the larvæ, the chryſalids, and the new-born inſects, without ſhowing mercy to any. They next fight againſt one another. Froſts and rains throw the citizens into a ſtate of languor, and they almoſt all periſh, luckily for us and our bees, ſome few females alone excepted, which in the enſuing ſpring become founders of new republics.

3. *Coarctata*, the ſmall waſp; has black antennæ, yellowiſh at the baſe; the head is black with a yellow ſpot between the antennæ, and another at the baſe of the upper lip. Each ſegment of the abdomen is bordered with yellow. It is about half an inch long. The hiſtory, as well as the manners of this ſpecies, are the ſame as thoſe of the common waſp; but their buildings are on a different conſtruction. Their neſt is faſtened to the branch of a tree with a kind of band; and is in bigneſs from the ſize of an orange down to that of an egg. Wood reduced to paper is the material part of it; which if it were of a ruddy colour, might be taken for a large opening roſe. It is covered over with a varniſh impenetrable by water. One of thoſe neſts was neither mollified nor impaired by that element.

VESPASIAN, the 10th emperor of Rome; remarkable for his clemency and other virtues. See Rome, n° 332—339.

VESPERS, in the church of Rome, denote the afternoon ſervice; anſwering in ſome meaſure to the evening prayers of the church of England.

VESPERTILIO, the Bat; a genus of quadrupeds, belonging to the order of *primates*. All the teeth are erect, pointed, near each other; and the firſt four are equal. The fore-feet have the toes connected by a membrane expanded into a kind of wings by which the creature is enabled to fly. There are 28 ſpecies, of which 4 are natives of Britain. The moſt remarkable are.

1. The *vampyrus*, vampire, or Ternate bat, with large canine teeth; four cutting teeth above, the ſame below; ſharp black noſe; large naked ears; the tongue is pointed, terminated by ſharp aculeated papillæ; talons very crooked, ſtrong, and compreſſed ſidewiſe; no tail: the membrane divided behind quite to the rump: head of a dark ferruginous colour; on the neck, ſhoulder, and under-ſide, of a much lighter and brighter red; on the back the hair ſhorter, duſky, and ſmooth: the membranes of the wings duſky. They vary in colour; ſome being entirely of a reddiſh brown, others duſky.

Theſe monſters inhabit Guinea, Madagaſcar, and all the iſlands from thence to the remoteſt in the Indian Ocean. They fly in flocks, and perfectly obſcure the air with their numbers; they begin their flight from one neighbouring iſland to another immediately on ſun-ſet, and return in clouds from the time it is light till ſun riſe. They live on fruits; and are ſo fond of the juice of the palm tree, that they will intoxicate themſelves with it till they drop on the ground. It is moſt likely, from the ſize of their teeth, they are carnivorous. Mr Edwards relates, that they will dip into the ſea for fiſh. They ſwarm like bees; hanging by one another from the trees in great cluſters. The Indians eat them, and declare the fleſh to be very good: they grow exceſſively fat at certain times of the year. The French who live in the Iſle de Bourbon boil them in their bouillon, to give it a reliſh. The negroes have them in abhorrence. Many are of an enormous ſize: Beckman meaſured one, whoſe extent from tip to tip of the wings was five feet four inches; and Dampier another, which extended farther than he could reach with out-ſtretched arms. Their bodies are from the ſize of a pullet to that of a dove: their cry is dreadful, their ſmell rank, their bite, reſiſtance, and fierceneſs great, when taken.

The ancients had ſome knowledge of theſe animals. Herodotus mentions certain winged wild beaſts like bats, that moleſted the Arabs who collected the caſſia, to ſuch a degree, that they were obliged to cover their faces, all but their eyes, with ſkins. It is very probable, as M. de Buffon remarks, it was from ſuch relations that poets formed their fictions of Harpies.

Linnæus gives this ſpecies the title of *vampyre;* conjecturing it to be the kind which draws blood from people in their ſleep. M. de Buffon denies it; aſcribing that faculty only to a ſpecies found in South America. But there is reaſon to imagine that this thirſt after blood is not confined to the bats of one continent nor to one ſpecies: for Bontius and Nieuhoff inform us, that the bats of Java ſeldom fail attacking perſons who lie with their feet uncovered, whenever they can get acceſs; and Gumilla, after mentioning a greater and leſs ſpecies found on the banks of the Oronoque, declares them to be equally greedy after human blood. Perſons thus attacked have been known to be near paſſing from a ſound ſleep into eternity. The bat is ſo dexterous a bleeder, as to inſinuate its aculeated tongue into a vein without being perceived, and then ſuck the blood till it is ſatiated; all the while fanning with its wings, and agitating the air in that hot climate in ſo pleaſing a manner, as to fling the ſufferer into a ſtill ſounder ſleep. It is therefore very unſafe to reſt either in the open air, or to leave open any entrance to theſe dangerous animals: but they do not confine themſelves to human blood; for M. Condamine ſays, that in certain parts of America they have deſtroyed all the great cattle introduced there by the miſſionaries. See Plate DX. fig. 3.

2. The *ſpectrum*, or ſpectre, with a long noſe; large teeth; long, broad, and upright ears; at the end of the noſe a long conic erect membrane, bending at the end, and flexible; hair on the body cinereous, and pretty long; wings full of ramified fibres: the membrane extends from hind leg to hind leg; no tail; but from the rump extend three tendons, terminating at the edge of the membrane. By Seba's figure the extent of the wings is two feet two inches; from the end of the noſe to the rump, ſeven inches and an half.

Inhabits South America; lives in the palm-trees; grows very fat; called *vampyre* by M. de Buffon, who ſuppoſes it to be the ſpecies that ſucks human blood: but neither Piſo, nor any other writer who mentions the fact, gives the leaſt deſcription of the kind.

3. The *Peruvian* bat hath a head like a pug-dog; large ſtraight pointed ears; two canine teeth, and two ſmall cutting teeth between each, in each jaw: the tail is incloſed in the membrane which joins to each hind-leg, and is alſo ſupported by two long cartilaginous ligaments involved in the membrane: colour of the fur, iron grey: body equal to that of a middle ſized rat: extent of the wings two feet five inches.

4. The *noctule* hath the noſe ſlightly bilobated; ears ſmall and rounded; on the chin a minute verruca; hair reddiſh aſh-colour: length of the rump two inches eight-tenths; tail one inch ſeven-tenths; extent of wings 13 inches. Inhabits Great Britain and France; flies high in ſearch of food, not ſkimming near the ground. A gentleman informed Mr Pennant of the following fact relating to thoſe animals, which he was witneſs to: That he ſaw taken, under the eaves of Queen's College, Cambridge, in one night, 185; the ſecond night, 63; the third night, 2; and that each that was meaſured had 15 inches extent of wings.

5. The *murinus*, common bat; has a tail: the lips and noſe are ſimple; and the ears are ſmaller than the head.

It inhabits Europe, and is found in Britain. This animal flies only during the night, living chiefly on moths: when it lights on the ground it is unable to riſe again till it has crawled to ſome height: it remains torpid during winter,

ter, revives in the beginning of the ſpring, and comes abroad in the duſk of the evening. This ſpecies is two inches and a half long when full grown, and about nine inches in extent; the fur is of a mouſe-colour, tinged with reddiſh; it generally ſkims near the ground, with an uneven jerking flight; and often ſeeking for gnats and other aquatic inſects, flies cloſe by the ſurface of water. It breeds in the ſummer ſeaſon, and is preyed on by owls.

Bats are very voracious, if proper food is to be had; and though moths and other inſects be their natural and common food, yet if fleſh, whether raw or roaſted, freſh or corrupted, comes in their way, they devour it with greedineſs. In this country they appear abroad early in ſpring, flying about only in the evenings; but are ſometimes rouſed from their torpidity by a warm day or two during winter, and will then venture out in queſt of food, but recommence their ſtate of hybernation whenever the cold returns; They retire at the end of ſummer into caves, ruined houſes, or the roofs and eaves of houſes, where they remain ſuſpended by the hind legs, and enveloped in their wings, generally in large numbers. Bats may be caught by means of the flower cups of bur-dock, whitened and thrown up in the way of their flight; they are attracted by the whiteneſs, and the hooks of the bur, ſticking to their membranous wings, make them fall to the ground.

VESSEL, a general name given to the different ſorts of ſhips which are navigated on the ocean, or in canals and rivers. It is, however, more particularly applied to thoſe of the ſmaller kind, furniſhed with one or two maſts. See Ship.

VESTA, in pagan worſhip, the ſame with Cybele. See Cybele.

Vesta the *Younger*, in pagan worſhip, the goddeſs of Fire, was the daughter of Saturn and Cybele, and the ſiſter of Ceres. She was ſo much in love with chaſtity, that on Jupiter's aſcending the throne and offering to grant whatever ſhe aſked, ſhe only deſired the preſervation of her virginity, which ſhe obtained.—Veſta was not repreſented in her temple by any image.

VESTALIA, in Roman antiquity, a feſtival celebrated in honour of the goddeſs Veſta, on the 5th of the ides of June; that is, on the ninth of the month.

VESTALS, among the ancient Romans, were prieſteſſes of the goddeſs Veſta, and had the perpetual fire committed to their charge: they were at firſt only four in number, but afterwards increaſed to ſix; and it does not appear that their number ever exceeded ſix, among whom was one ſuperior to the reſt, and called *veſtalis maxima*.

The veſtals were choſen from ſix to ten years of age, and obliged to ſtrict continency for 30 years; the firſt 10 of which were employed in learning the ceremonies of religion, the next 10 in the performance of them, and the 10 laſt in teaching them to the younger veſtals.

The habit of the veſtals conſiſted of an head-dreſs, called *infula*, which ſat cloſe to the head, and from whence hung certain laces called *vitta*; a kind of ſurplice made of white linen, and over it a purple mantle with a long train to it.

VESTIBLE, in architecture, a kind of entrance into a large building; being an open place before the hall, or at the bottom of the ſtaircaſe.

VESTRY, a place adjoining to a church, where the veſtments of the miniſter are kept; and alſo a meeting at ſuch place, conſiſting of the miniſter, church-wardens, and chief men of moſt pariſhes, who make a pariſh veſtry or meeting. By cuſtom there are ſelect veſtries, being a certain number of perſons choſen to have the government of the pariſh, make rates, and take the accounts of church-wardens, &c.

VESUVIUS, a celebrated volcano of Italy, ſix miles eaſt from the city of Naples. This mountain has two tops; one of which only goes by the name of *Veſuvius*, the other being now called *Somma*; but Sir William Hamilton is of opinion, that the latter is what the ancients called *Veſuvius*.

1 General deſcription of the mountain.

The perpendicular height of Veſuvius is only 3700 feet, though the aſcent from the foot to the top is three Italian miles. One ſide of the mountain is well cultivated and fertile, producing great plenty of vines; but the ſouth and weſt ſides are entirely covered with cinders and aſhes; while a ſulphureous ſmoke conſtantly iſſues from the top, ſometimes attended with the moſt violent exploſions of ſtones, the emiſſion of great ſtreams of lava, and all the other attendants of a moſt formidable volcano. The firſt of theſe eruptions recorded in hiſtory took place in the year 79; at which time the two cities of Pompeii and Herculaneum were entirely buried under the ſtones and aſhes thrown out. Incredible miſchief was alſo done to the neighbouring country, and numbers of people loſt their lives, among whom was Pliny the Elder.

2 Account of the firſt eruption recorded in hiſtory.

It is the opinion of the beſt judges, however, that this eruption was by no means the firſt that had ever happened. The very ſtreets of thoſe cities which were at that time overwhelmed are ſaid to be partly paved with lava. Since that time 30 different eruptions have been recorded, ſome of which have been extremely violent. In the year 1538, a mountain, three miles in circumference and a quarter of a mile in perpendicular height, was thrown up in the courſe of one night. In the year 1766, Sir William Hamilton, ambaſſador to his Sicilian Majeſty, began to obſerve the phenomena of this mountain; and ſince that time the public has been favoured with much more exact and authentic accounts of the various changes which have taken place in Veſuvius than what were to be had before.

3 Of the eruption in 1767.

The firſt great eruption taken notice of by this gentleman was that of 1767, which, though very violent, was mild in compariſon with that of 1538.

4 Nine eruptions from 1767 to 1779.

From this time (1767) Veſuvius never ceaſed for ten years to ſend forth ſmoke, nor were there many months in which it did not throw out ſtones, ſcoriæ, and cinders; which, increaſing to a certain degree, were uſually followed by lava; ſo that from the year 1767 to 1779 there were nine eruptions, ſome of them very conſiderable. In the month of Auguſt that year, however, an eruption took place, which, for its extraordinary and terrible appearance, may be reckoned among the moſt remarkable of any recorded concerning this or any other volcano.

5 Account of the great eruption in 1779.

During the whole month of July the mountain continued in a ſtate of fermentation. Subterraneous exploſions and rumbling noiſes were heard; quantities of ſmoke were thrown up with great violence, ſometimes with red-hot ſtones, ſcoriæ, and aſhes; and towards the end of the month theſe ſymptoms increaſed to ſuch a degree as to exhibit, in the night time, the moſt beautiful fire-works that can be imagined.

On Thurſday 5th Auguſt the volcano appeared moſt violently agitated; a white and ſulphureous ſmoke iſſued continually and impetuouſly from its crater, one puff ſeeming to impel another; ſo that a maſs of them was ſoon accumulated, to appearance, four times the height and ſize of the volcano itſelf. Theſe clouds of ſmoke were exceedingly white, ſo that the whole reſembled an immenſe accumulation of bales of the whiteſt cotton. In the midſt of this very white ſmoke, vaſt quantities of ſtones, ſcoriæ, and aſhes, were thrown up to the height of 2000 feet; and a quantity of liquid lava, ſeemingly very heavy, was lifted up juſt high enough to clear the rim of the crater, and take its way down the ſides of the mountain. This lava, having run violently for ſome hours, ſuddenly ceaſed, juſt before it had reached the cultivated parts of the mountain, near four miles from the ſpot whence it iſſued. The heat, all this day, was intolerable at the towns of Somma and Ottaiano; and was ſenſibly felt at Palma and Lauri, which are much farther off. Reddiſh aſhes fell ſo thick on the two former, that the air was darkened, ſo that objects could not be diſtinguiſhed at the diſtance of ten feet. Long filaments of a vitrified matter, like ſpun glaſs, were mixed, and fell with theſe aſhes; ſeveral birds in cages were ſuffocated, and the leaves of the trees in the neighbourhood of Somma were covered with white and very corroſive ſalt.

6
Extraordinary effuſion of fire by the approach of ſtormy clouds

About 12 at night, on the *7th*, the fermentation of the mountain ſeemed greatly to increaſe. Our author was watching the motions of the volcano from the mole at Naples, which has a full view of it. Several glorious pictureſque effects had been obſerved from the reflection of the deep red fire within the crater of Veſuvius, and which mounted high amongſt thoſe huge clouds on the top of it: when a ſummer ſtorm, called in that country a *tropea*, came on ſuddenly, and blended its heavy watery clouds with the ſulphureous and mineral ones, which were already like ſo many other mountains piled up on the top of the volcano. At this moment a fountain of fire was ſhot up to an incredible height, caſting ſo bright a light, that the ſmalleſt objects were clearly diſtinguiſhable at any place within ſix miles or more of Veſuvius. The black ſtormy clouds, paſſing ſwiftly over, and at times covering the whole or a part of the bright column of fire, at other times clearing away and giving a full view of it, with the various tints produced by its reverberated light on the white clouds above in contraſt with the pale flaſhes of forked lightning that attended the tropea, formed ſuch a ſcene as no power of art can expreſs. One of his Sicilian majeſty's gamekeepers, who was out in the fields near Ottaiano whilſt this ſtorm was at its height, was ſurpriſed to find the drops of rain ſcald his face and hands; a phenomenon probably occaſioned by the clouds having acquired a great degree of heat in paſſing through the above mentioned column of fire.

7
Immenſe fountain of lava thrown up by Veſuvius.

On the *8th* the mountain was quiet till towards ſix o'clock in the evening, when a great ſmoke began to gather over its crater; and about an hour after a rumbling ſubterraneous noiſe was heard in the neighbourhood of the volcano; the uſual throws of red-hot ſtones and ſcoriæ began and increaſed every inſtant. The crater, viewed through a teleſcope, ſeemed much enlarged by the violence of laſt night's exploſions, and the little mountain on the top was entirely gone. About nine o'clock a moſt violent report was heard at Portici and its neighbourhood, which ſhook the houſes to ſuch a degree as made the inhabitants run out into the ſtreets. Many windows were broken, and walls cracked by the concuſſion of the air on this occaſion, though the noiſe was but faintly heard at Naples. In an inſtant a fountain of liquid tranſparent fire began to riſe, and gradually increaſing, arrived at laſt at the amazing height of ten thouſand feet and upwards. Puffs of ſmoke, as black as can poſſibly be imagined, ſucceeded one another haſtily, and accompanied the red-hot, tranſparent, and liquid lava, interrupting its ſplendid brightneſs here and there by patches of the darkeſt hue. Within theſe puffs of ſmoke at the very moment of emiſſion, a bright but pale electrical fire was obſerved playing briſkly about in zig-zag lines. The wind was ſouth-weſt, and, though gentle, was ſufficient to carry theſe puffs of ſmoke out of the column of fire; and a collection of them by degrees formed a black and extenſive curtain behind it; in other parts of the ſky it was perfectly clear, and the ſtars bright. The fiery fountain, of ſuch immenſe magnitude, on the dark ground juſt mentioned, made the fineſt contraſt imaginable; and the blaze of it reflected from the ſurface of the ſea, which was at that time perfectly ſmooth, added greatly to this ſublime view.

The lava, mixed with ſtones and ſcoria, having riſen to the amazing height already mentioned, was party directed by the wind towards Ottaiano, and partly falling, ſtill red-hot and liquid, upon the top of Veſuvius, covered its whole cone, part of that of the ſummit of Somma, and the valley between them. The falling matter, being nearly as inflamed and vivid as that which was continually iſſuing freſh from the crater, formed with it one complete body of fire, which could not be leſs than two miles and a half in breadth, and of the extraordinary height above mentioned, caſt a heat to the diſtance of at leaſt ſix miles round. The bruſhwood on the mountain of Somma was ſoon in a blaze, and the flame of it being of a different colour from the deep red of the matter thrown out by the volcano, and from the ſilvery blue of the electrical fire, ſtill added to the contraſt of this moſt extraordinary ſcene.

The black cloud, increaſing greatly, once bent towards Naples, and threatened the city with ſpeedy deſtruction; for it was charged with electrical fire, which kept conſtantly darting about in bright zig-zag lines. This fire, however, rarely quitted the cloud, but uſually returned to the great column of fire whence it proceeded; though once or twice it was ſeen to fall on the top of Somma, and ſet fire to ſome dry graſs and buſhes. Fortunately the wind carried back the cloud juſt as it reached the city, and had begun to occaſion great alarm. The column of fire, however, ſtill continued, and diffuſed ſuch a ſtrong light, that the moſt minute objects could be diſcerned at the diſtance of ten miles or more from the mountain. Mr Morris informed our author, that at Sorrento, which is twelve miles diſtant from Veſuvius, he read the title-page of a book by that volcanic light.

8
Diſtreſs of the inhabitants of Ottaiano.

All this time the miſerable inhabitants of Ottaiano were involved in the utmoſt diſtreſs and danger by the ſhowers of ſtones which fell upon them, and which, had the eruption continued for a longer time, would moſt certainly have reduced their town to the ſame ſituation with Herculaneum and Pompeii. The mountain of Somma, at the foot of which the town of Ottaiano is ſituated, hides Veſuvius from the view of its inhabitants; ſo that till the eruption became conſiderable it was not viſible to them. On Sunday night, when the noiſe increaſed, and the fire began to appear above the mountain of Somma, many of the inhabitants flew to the churches, and others were preparing to quit the town, when a ſudden and violent report was heard; ſoon after which they found themſelves involved in a thick cloud of ſmoke and aſhes: a horrid claſhing noiſe was heard in the air, and preſently fell a vaſt ſhower of ſtones and large pieces of ſcoriæ, ſome of which were of the diameter of ſeven or eight feet, which muſt have weighed more than a hundred pounds before they were broken, as ſome of the fragments which Sir William Hamilton found in the ſtreets ſtill weighed upwards of 60 pounds. When theſe large vitrified maſſes either ſtruck againſt one another in the air, or fell on the ground, they broke in many pieces, and covered a large ſpace of ground with vivid ſparks of fire, which communicated their heat to every thing that was combuſtible. Theſe maſſes were formed of the liquid lava; the exterior parts of which were become black and porous by cooling in their fall through ſuch a vaſt ſpace; whilſt the interior parts, leſs expoſed, retained an extreme heat, and were perfectly red.

In an inſtant the town and country about it was on fire in many parts, for there were ſeveral ſtraw huts in the vineyards, which had been erected for the watchmen of the grapes; all of which were burnt. A great magazine of wood in the heart of the town was all in a blaze; and had there been much wind, the flames muſt have ſpread univerſally, and all the inhabitants would have been burnt in their houſes; for it was impoſſible for them to ſtir out. Some, who attempted it with pillows, tables, chairs, the tops of wine caſks, &c. on their heads, were either knocked down or ſoon driven back to their cloſe quarters under arches and in the cellars of their houſes. Many were wounded, but only two perſons died of their wounds.

To add to the horror of the ſcene, inceſſant volcanic lightning was whiſking about the black cloud that ſurrounded them, and the ſulphureous ſmell and heat would ſcarcely allow them to draw their breath. In this dreadful ſituation they remained about 25 minutes, when the volcanic ſtorm ceaſed all at once, and Veſuvius remained ſullen and ſilent.

9 Vaſt quantity of electric matter in the air.

Some time after the eruption had ceaſed, the air continued greatly impregnated with electrical matter. The duke of Cottofiano told our author, that having, about half an hour after the great eruption had ceaſed, held a Leyden bottle, armed with a pointed wire, out at his window at Naples, it ſoon became conſiderably charged. But whilſt the eruption was in force, its appearance was too alarming to allow one to think of ſuch experiments.—He was informed alſo by the prince of Monte Mileto, that his ſon, the duke of Popoli, who was at Monte Mileto the 8th of Auguſt, had been alarmed by the ſhower of cinders that fell there; ſome of which he had ſent to Naples weighing two ounces; and that ſtones of an ounce weight had fallen upon an eſtate of his ten miles farther off. Monte Mileto is about 30 miles from the volcano. The Abbé Cagliani alſo related, that his ſiſter, a nun in a convent at Manfredonia, had written to inquire after him, imagining that Naples muſt have been deſtroyed, when they, at ſo great a diſtance, had been alarmed by a ſhower of aſhes which fell on the city at eleven o'clock at night, ſo much as to open all the churches, and go to prayers. As the great eruption happened at nine o'clock, theſe aſhes muſt have travelled an hundred miles in the ſpace of two hours.

10 Damage done by the irruption at Ottaiano.

Nothing could be more diſmal than the appearance of Ottaiano after this eruption. The houſes were unroofed, half buried under the black ſcoriæ and aſhes; all the windows towards the mountain were broken, and ſome of the houſes themſelves burnt; the ſtreets choked up with aſhes; in ſome narrow places not leſs than four feet thick: and a few of the inhabitants who had juſt returned, were employed in clearing them away, and piling them up in hillocks, to get at their ruined houſes. The palace of the prince of Ottaiano is ſituated on an eminence above the town, and nearer the mountain. The ſteps leading up to it were deeply covered with volcanic matter: the roof was totally deſtroyed, and the windows broken, but the houſe itſelf, being ſtrongly built, had not ſuffered much.

11 Vaſt fragments of lava thrown out.

An incredible number of fragments of lava were thrown out during the eruption, ſome of which were of immenſe magnitude. The largeſt meaſured by Sir William Hamilton was 108 feet in circumference and 17 in height. This was thrown at leaſt a quarter of a mile clear of the mouth of the volcano. Another, 66 feet in circumference and 19 in height, being nearly of a ſpherical figure, was thrown out at the ſame time, and lay near the former. This laſt had the marks of being rounded, nay almoſt poliſhed, by continual rolling in torrents or on the ſea ſhore. Our author conjectures that it might be a ſpherical volcanic ſalt, ſuch as that of 45 feet in circumference mentioned by M. de St Fond, in his Treatiſe of Extinguiſhed Volcanoes. A third of 16 feet in height and 92 in circumference was thrown much farther, and lay in the valley between Veſuvius and the Hermitage. It appeared alſo, from the large fragments that ſurrounded this maſs, that it had been much larger while in the air.

Veſuvius continued to emit ſmoke for a conſiderable time after this great eruption, ſo that our author was apprehenſive that another would ſoon enſue; but from that time nothing comparable to the above has taken place. From the time of this great eruption to the year 1786 our author kept an exact diary of the operations of Veſuvius, with drawings, ſhowing, by the quantity of ſmoke, the degree of fermentation within the volcano. The operations of the ſubterraneous fire, however, appear to be very capricious and uncertain. One day there will be the appearance of a violent fermentation, and the next every thing will be calmed; but whenever there has been a conſiderable ejection of ſcoriæ and cinders, it has been a conſtant obſervation, that the lava ſoon made its appearance, either by boiling over the crater, or forcing its way through the crevices in the conical part of the mountain.

12 Eruption in 1784.

An eruption took place in the month of November 1784, and continued for ſome time, but without being accompanied with any extraordinary circumſtance.

13 State of Veſuvius to the preſent time.

Since that time there have been no remarkable eruptions of this volcano, at leaſt none that have been properly authenticated; though, indeed, Sir William Hamilton obſerves, that the inhabitants of Naples in general pay ſo little attention to the operations of this volcano, that many of its eruptions paſs unnoticed by at leaſt two-thirds of them.

VETCH, in botany. See VICIA.

VETERAN, among the ancient Romans, an appellation given to a *ſoldier* grown old in the ſervice, or who had made a certain number of campaigns.

VETERINARY ART. See FARRIERY.

VEXILLUM, in botany; the upper petal of a pea-bloom, or butterfly-ſhaped flower, which is generally larger than any of the others.

VIALES, in mythology, a name given among the Romans to the gods who had the care and guard of the roads and highways.

VIATICUM, in Roman antiquity, an appellation given in common to all officers of any of the magiſtrates; as *lictors*, *accenſi*, *ſcribes*, *criers*.

VIBEX, is ſometimes uſed, by phyſicians, for a black and blue ſpot in the ſkin occaſioned by an afflux or extravaſation of blood.

VIBRATION, in mechanics, a regular, reciprocal motion of a body, as a pendulum.

VIBURNUM, in botany; a genus of plants of the claſs *pentandria*, order *trigynia*, and in the natural ſyſtem arranged under the 43d order, *dumoſæ*. The calyx is quinquepartite and above; the corolla divided into five laciniæ; the fruit a monoſpermous berry. There are 19 ſpecies; two of which the *lantana* and *opulus*, are natives of Britain. 1. The *lantana*, common viburnum, wayfaring, or pliant mealy tree, riſes with a woody ſtem, branching twenty feet high, having very pliant ſhoots covered with a lightiſh brown bark; large heart-ſhaped, veined, ſerrated leaves, white and hoary underneath; and the branches terminated by umbels of white flowers, ſucceeded by bunches of red berries, &c. 2. The *opulus*, or gelder roſe; conſiſting of two varieties, one with flat flowers, the other globular. The former grows eighteen or twenty feet high, branching oppoſite, of an irregular growth, and covered with a whitiſh bark; large lobated or three-lobed leaves on glanduloſe foot-ſtalks, and large flat umbels of white flowers at the ends of the branches, ſucceeded by red berries. The latter grows fifteen or eighteen feet high, branching like the other, garniſhed with large lobated or three-lobed leaves, on glandular footſtalks; and large globular umbels of white flowers at the ends of the branches, in great abundance. This tree when in bloom exhibits a ſingularly fine appearance: the flowers, though ſmall, are collected numerouſly into large globular umbels round like a ball; hence it is ſometimes called *ſnow-ball-tree*. 3. The *tinus*, common lauruſtinus, or evergreen viburnum; grows eight or ten feet high or more, branching numerouſly from the bottom upwards, aſſuming a cloſe buſhy growth, with the branches ſomewhat hairy and glandulous; very cloſely garniſhed with oval, wholly entire leaves, of a ſtrong green colour, placed in pairs oppoſite; and whitiſh and red flowers, collected numerouſly in large umbellate cluſters all over the plant, at the ſides and ends of the branches, from January until March or April, exhibiting a moſt beautiful appearance. There are a great many varieties. All the different ſpecies of viburnum, both deciduous and evergreen kinds, being of the tree kind, are woody and durable in root, ſtem, and branches. They may all be propagated by layers; and are of ſuch hardy temperature, as to grow freely in the open ground all the year, in ſhrubberies, and other hardy plantations.

VICAR, a perſon appointed as deputy to another, to perform his functions in his abſence, and under his authority.

Vicar, in the canon-law, denotes a prieſt of a pariſh, the predial tithes whereof are impropriated or appropriated; that is, belong either to a chapter, religious houſe, &c. or to a layman who receives them, and only allows the vicar the ſmall tithes, or a convenient ſalary. See the article *Parson and Vicar*.

VICE, in ethics, is ordinarily defined an elective habit, denoting either an exceſs or defect from the juſt medium wherein virtue is placed.

Vice, in ſmithery and other arts converſant in metals, a machine or inſtrument ſerving to hold faſt any thing they are at work upon, whether it is to be beat, filed, or rivetted.

Vice is alſo uſed in the compoſition of divers words to denote the relation of ſomething that comes inſtead or in the place of another; as vice-admiral, vice-chancellor, &c. are officers who take place in the abſence of admirals, &c.

VICEROY, a governor of a kingdom, who commands in the name and inſtead of a king, with full and ſovereign authority.

VICIA, in botany: A genus of plants of the claſs *diadelphia*, and order of *decandria*; and in the natural ſyſtem arranged under the 32d order, *Papilionaceæ*. The ſtigma is bearded tranſverſely on the lower ſide. There are 20 ſpecies, 7 of which are natives of Britain. The moſt important of theſe are, 1. The *ſativa*, common vetch, or tare. The ſtalks are round, weak, branched, about two feet long. Pinnæ five or ſeven pair, a little hairy, notched at the end. Stipulæ dentated. Flowers light and dark purple, on ſhort pedicles, generally two together; pods erect; ſeeds black. It is known to be an excellent fodder for horſes. 2. The *cracca*, tufted vetch. It has a ſtem branched, three or four feet long. Leaves pinnated; pinnæ generally ten or twelve pair, lance-ſhaped, downy. Stipulæ entire. Flowers purple, numerous, pendulous, in imbricated ſpikes. It is alſo reckoned an excellent fodder for cattle. 3. The *faba*, or common garden bean. It is a native of Egypt. It is too well known to require deſcription.

VICISSITUDE, the regular ſucceſſion of one thing after another; as the viciſſitude of day and night, of the ſeaſons, &c.

VICTIM, denotes a ſacrifice offered to ſome deity, of a living creature, as a man or beaſt, which is ſlain to appeaſe his wrath, or to obtain ſome favour.

VICTOR (Sextus Aurelius), a Roman hiſtorian, who flouriſhed under the emperors Conſtantius and Julian; as we learn from many paſſages in his own writings, and alſo from Ammianus Marcellinus. This hiſtorian relates, that Conſtantius made him conſul, and honoured him with a brazen ſtatue, on account of his excellent qualifications; although, as he owns of himſelf, he was born in an obſcure village, and of poor and illiterate parents. It is commonly believed that he was an African: it is certain, that he dwells much upon the praiſes of that country, which he calls the glory of the earth; *decus terrarum*. Two books of his are extant in the hiſtorical way: one *De viris illuſtribus urbis Romæ*; the other *De Cæſaribus*; to which is prefixed *Libellus de origine gentis Romanæ*. The whole makes an abridged hiſtory of Rome, from its foundation down to the reign of Julian incluſive.

VICTORY, the overthrow or defeat of an enemy in war or combat.

Victory, in pagan worſhip, is repreſented by Heſiod as the daughter of Styx and Pallas; and Varro calls her the *daughter of Heaven and Earth*. The Romans erected a temple to her, where they prayed to the gods to give ſucceſs to their arms. They painted her in the form of a woman, clad in cloth of gold. In ſome medals, ſhe is repreſented with wings flying through the air, holding a laurel crown in one hand and a palm in the other; but in other medals, ſhe is ſeen ſtanding upon a globe, with the ſame crown and branch of palm.

VIDA (Marcus Hieronymus), biſhop of Alva, in Mountſerrat, and one of the moſt excellent Latin poets that have appeared ſince the Auguſtan age, was born at Cremona in 1470. Having diſtinguiſhed himſelf by his learning and taſte for literature, he was made biſhop of Alva in 1552. After continuing two years with pope Clement VII. at Rome, he went to reſide upon his ſee; where, for 30 years, he performed all the offices of a good biſhop and a good man; and though he was mild, gentle, and full of goodneſs, he was ſo far from wanting ſpirit, that when the city of Alva was beſieged by the French, he uſed all poſſible means to prevent its being given up, by ſtrenuouſly exhorting the people, and, when proviſions were ſcarce, by ſupplying them at his own expence. His poetics, and poem on the ſilk-worm, paſs for his maſterpiece; his poem on the game of cheſs is alſo greatly admired. He alſo wrote hymns, eclogues, and a poem entitled *Chriſtiados* in ſix books; all which are in Latin, and have gained him a great reputation. His works in proſe conſiſt of dialogues, ſynodical conſtitutions, letters, and other pieces. He died in 1566, ſoon after his being made biſhop of Cremona.

VIENNA, the capital of the circle of Auſtria, in Germany, and of the whole German empire, is the place where the emperor reſides. The city itſelf is not of very great extent; nor can it be enlarged, it being limited by a very ſtrong fortification; but it is very populous. The ſtreets, in general, are narrow, and the houſes built high. Some of the public buildings are magnificent; but they appear externally to no great advantage, on account of the narrowneſs of the ſtreets. The chief of them are the imperial palace, the library, and the muſeum; the palaces of the princes Lichtenſtein, Eugene, &c. Vienna was twice ineffectually beſieged by the Turks; namely, in 1589 and 1683. At the latter period, the ſiege was raiſed by John Sobieſki, king of Poland, who totally defeated the Turkiſh army before the walls of this place. There is no great danger that Vienna will ever again be ſubjected to the inconveniences of a ſiege. Yet, in caſe this ſhould happen, a meaſure has been taken, which will prevent the neceſſity of deſtroying the ſuburbs; namely, no houſes without the walls are allowed to be built nearer to the glacis than 600 yards; ſo that there is a circular field of that breadth all round the town, which, excluſive of the advantage above-mentioned, has a very beautiful and ſalutary effect. Theſe magnificent ſuburbs, and the town together, are ſaid to contain above 300,000 inhabitants; yet the former are not near ſo populous, in proportion to their ſize, as the town; becauſe many houſes in the ſuburbs have extenſive gardens belonging to them, and many families, who live during the winter within the fortifications, ſpend the ſummer in the ſuburbs. The cathedral is built of free-ſtone, is 114 yards long, and 48 broad, and the ſteeple is 447 feet high. Inſtead of a weather-cock there was a Turkiſh creſcent, in memory of the ſiege in 1589; but, after the ſecond ſiege in 1683, they changed it for a golden croſs, which three months after was thrown down by a ſtorm. At preſent there is a black ſpread eagle, over which is a gilded croſs. Joining to this church is the archbiſhop's palace, the front of which is very fine. The univerſity had ſeveral thouſand ſtudents, who, when this city was beſieged, mounted guard, as they did alſo in 1741. Beſide this, there is the academy of Lower Auſtria; and the archducal library is much frequented by foreigners, as it contains above 100, 000 printed books, and 10,000 manuſcripts. The academy of painting is remarkable for the fine pictures it produces. The archducal treaſury, and a cabinet of curioſities of the houſe of Auſtria, are great rarities. The inhabitants, in general, live in a ſplendid manner; and people of diſtinction have all ſorts of wines at their tables, which they are very free with to foreigners. There is a ſort of harbour on the Danube, where there are magazines of naval ſtores and ſhips have been fitted out to ſerve on that river againſt the Turks. Vienna is an archbiſhop's ſee. It is ſeated at the place where the river Vienna, or Wien, falls into the Danube, 30 miles weſt of Preſburgh, 350 north-north-eaſt of Rome, 520 ſouth-eaſt by ſouth of Amſterdam, 565 eaſt of Paris, and 680 eaſt-ſouth-eaſt of London. E. Long. 16. 28. N. Lat. 48. 13.

VIGIL, in church-hiſtory, is the eve or next day before any ſolemn feaſt; becauſe then Chriſtians were wont to watch, faſt, and pray, in their churches.

Vigils of Plants, a term under which botaniſts comprehend the preciſe time of the day in which the flowers of different plants open, expand, and ſhut.

As all plants do not flower in the ſame ſeaſon, or month; in like manner, thoſe which flower the ſame day, in the ſame place, do not open and ſhut preciſely at the ſame hour. Some open in the morning, as the lip flowers, and compound flowers with flat ſpreading petals; others at noon, as the mallows; and a third ſet in the evening, or after ſunſet, as ſome geraniums and opuntias: the hour of ſhutting is equally undetermined. Of thoſe which open in the morning, ſome ſhut ſoon after, while others remain expanded till night.

The hours of opening, like the time of flowering, ſeem to vary, according to the ſpecies of the plant, the temperature of the climate, and that of the ſeaſon. Flowers, whoſe extreme delicacy would be hurt by the ſtrong impreſſions of an ardent ſun, do not open till night; thoſe which require a moderate degree of heat to elevate their juices; in other words, whoſe juices do not riſe but in the morning or evening, do not expand till then; whilſt thoſe which need a more lively heat for the ſame purpoſe, expand at noon, when the ſun is in his meridian ſtrength. Hence it is, that the heat of the air being greater betwixt the tropics than elſewhere, plants which are tranſported from thoſe climates into the cold or temperate climates of Europe, expand their flowers much later than in their native ſoil. Thus, a flower which opens in ſummer at ſix o'clock in the morning at Senegal, will not open at the ſame ſeaſon in France and England till eight or nine, nor in Sweden till ten.

Linnæus diſtinguiſhes by the general name of *ſolar (flores ſolares)* all thoſe flowers which obſerve a determinate time in opening and ſhutting. Theſe flowers are again divided, from certain circumſtances, into three ſpecies, or kinds:

Equinoctial flowers *(flores æquinoctiales)* are ſuch as open and ſhut at all ſeaſons, at a certain fixed or determinate hour.

Tropical flowers *(flores tropici)* are ſuch whoſe hour of opening is not fixed at all ſeaſons, but accelerated or retarded according as the length of the day is increaſed or diminiſhed.

Meteorous flowers *(flores meteorici)* are ſuch whoſe hour of expanſion depends upon the dry or humid ſtate of the air, and the greater or leſs preſſure of the atmoſphere. Of this kind is the Siberian ſow-thiſtle, which ſhuts at night if the enſuing day is to be clear and ſerene, and opens if it is to be cloudy and rainy. In like manner the African marigold, which in dry ſerene weather opens at ſix or ſeven in the morning, and ſhuts at four o'clock in the afternoon, is a ſure indication that rain will fall during the courſe of the day, when it continues ſhut after ſeven.

VIGO, a ſea-port town of Spain, in Galicia, with an old caſtle and a fort. It is ſeated in a fertile country by the ſea-ſide. It was rendered famous by a ſea-fight between the confederate fleet commanded by Sir George Rook, and a ſquadron of French men of war, while the duke of Ormond with a body of land-forces drove the Spaniards from the caſtles which defended the harbour. Admiral Hopſon having with infinite danger broke through the boom made acroſs the mouth of the harbour, the Engliſh took four galleons and five large men of war, and the Dutch five galleons and one man of war. Four galleons, with 14 men of war, were deſtroyed, with abundance of plate and other rich effects. W. Long. 8. 21. N. Lat. 42. 3.

VILLA Franca, the name of ſeveral towns; one in Piedmont, three miles eaſt of Nice; another of Catalonia, 18 miles weſt of Barcelona; a third, the capital of St Michael, one of the Azores; and a fourth, a town of Eſtremadura in Spain, 57 miles ſouth-eaſt of Salamanca.

VILLAGE, an aſſemblage of houſes inhabited chiefly by peaſants and farmers, and having no market, whereby it is diſtinguiſhed from a town. The word is French, formed of *vil*, or *vilis*, "low, mean, contemptible:" or rather, from the Latin *villa*, a country-houſe or farm.

VILLAIN, or Villein, in our ancient cuſtoms, denotes a man of ſervile or baſe condition, *viz.* a bond-man or ſervant.

VILLARS (Lewis Hector, duke de), marſhal of France, grandee of Spain, &c. and a very brave general, was the ſon of Peter marquis de Villars, of a noble and ancient family. He was at firſt aid de-camp to marſhal de Belleſons, his couſin; and diſtinguiſhed himſelf in ſeveral ſieges and battles till the year 1702, when having obtained the victory at Fredlinghem from the prince of Baden, he was made marſhal of France. The marſhal de Villars took the fort of Kell the year following, and gained a battle at Hochſtet in concert with the elector of Bavaria. In 1707 he forced the lines of Stolhoffen, and raiſed large contributions from the enemy: but in 1709, he, in conjunction with marſhal Bouflers, was entirely defeated by the duke of Marlborough, at the battle of Malplaquet, when marſhal Villars was wounded at the beginning of the action. In 1712 he gained much glory by forcing the intrenchments at Denain on the Scheld; which was followed by the taking of Marchiennes, Douay, Bouchain, Landau, Friburg, &c. and by the peace concluded at Raſtat between the emperor and

France in 1714. The marſhal de Villars, who had been plenipotentiary at the treaty of Raſtat, was made preſident of the council of war in 1715, then counſellor of the regency, and miniſter of ſtate. In 1733, he was nominated to command in Italy under the king of Sardinia, and the French king declared him marſhal-general of his camps and armies; a title which had not been granted to any one ſince the marſhal Turenne, who appears to have been the firſt who was ever honoured with it. The marſhal de Villars made himſelf maſter of Piſighitona, Milan, Novara, and Tortona. But having opened the following campaign, he fell ſick, and died at Turin, in 1734, aged 82. The Memoirs of M. de Villars have been publiſhed in Holland, the firſt volume of which was written by himſelf.

VILLENAGE, in law. The folk-land or eſtates held in villenage, was a ſpecies of tenure neither ſtrictly feodal, Norman, nor Saxon; but mixed and compounded of them all; and which alſo, on account of the heriots that uſually attend it, may ſeem to have ſomewhat Daniſh in its compoſition. Under the Saxon Government there were, as Sir William Temple ſpeaks, a ſort of people in a condition of downright ſervitude, uſed and employed in the moſt ſervile works, and belonging, both they, their children, and effects, to the lord of the ſoil, like the reſt of the cattle or ſtock upon it. Theſe ſeem to have been thoſe who held what was called the *folkland*, from which they were removeable at the lord's pleaſure. On the arrival of the Normans here, it ſeems not improbable, that they, who were ſtrangers to any other than a feodal ſtate, might give ſome ſparks of enfranchiſement to ſuch wretched perſons as fell to their ſhare, by admitting them, as well as others, to the oath of fealty; which conferred a right of protection, and raiſed the tenant to a kind of eſtate ſuperior to downright ſlavery, but inferior to every other condition. This they called *villenage*, and the tenants *villeins*.

Theſe villeins, belonging principally to lords of manors, were either villeins *regardant*, that is, annexed to the manor or land; or elſe they were *in groſs*, or at large, that is, annexed to the perſon of the lord, and transferable by deed from one owner to another. They could not leave their lord without his permiſſion; but, if they ran away, or were purloined from him, might be claimed and recovered by action, like beaſts or other chattels. They held indeed ſmall portions of land by way of ſuſtaining themſelves and families: but it was at the mere will of the lord, who might diſpoſſeſs them whenever he pleaſed; and it was upon villein ſervices, that is, to carry out dung, to hedge and ditch the lord's demeſnes, and any other the meaneſt offices: and their ſervices were not only baſe, but uncertain both as to their time and quantity.

A villein could acquire no property either in lands or goods: if he purchaſed either, the lord might ſeize them to his own uſe; unleſs he contrived to diſpoſe of them again before the lord had ſeized them, for the lord had then loſt his opportunity.

In many places alſo a fine was payable to the lord, if the villein preſumed to marry his daughter to any one without leave from the lord: and, by the common law, the lord might alſo bring an action againſt the huſband for damages in thus purloining his property. For the children of villeins were alſo in the ſame ſtate of bondage with their parents; whence they were called in Latin *nativi*, which gave riſe to the female appellation of a villein, who was called a *neife*. In caſe of a marriage between a freeman and a neife, or a villein and a freewoman, the iſſue followed the condition of the father, being free if he was free, and villein if he was villein; contrary to the maxim of the civil law, that *partus ſequitur ventrem*. But no baſtard could be born a villein, becauſe by another maxim of our law he is *nullius filius*; and as he can *gain* nothing by inheritance, it were hard that he ſhould *loſe* his natural freedom by it. The law, however, protected the perſons of villeins againſt atrocious injuries of the lord: for he might not kill or maim his villein; though he might beat him with impunity.

Villeins might be enfranchiſed by manumiſſion. In proceſs of time they gained conſiderable ground on their lords; and in particular ſtrengthened the tenure of their eſtates to that degree, that they came to have in them an intereſt in many places full as good, in others better than their lords. For the good-nature and benevolence of many lords of manors having, time out of mind, permitted their villeins and their children to enjoy their poſſeſſions without interruption, in a regular courſe of deſcent, the common law, of which cuſtom is the life, now gave them title to preſcribe againſt their lords; and, on performance of the ſame ſervices, to hold their lands, in ſpite of any determination of the lord's will. For though in general they are ſtill ſaid to hold their eſtates at the will of the lord, yet it is ſuch a will as is agreeable to the cuſtom of the manor: which cuſtoms are preſerved and evidenced by the rolls of the ſeveral courts-baron in which they are entered, or kept on foot by the conſtant immemorial uſage of the ſeveral manors in which the lands lie. And as ſuch tenants had nothing to ſhow for their eſtates but theſe cuſtoms, and admiſſions in purſuance of them, entered on thoſe rolls, or the copies of ſuch entries witneſſed by the ſteward, they now began to be called *tenants by copy of court-roll*, and their tenure itſelf a *copyhold*.

Privileged VILLENAGE, a ſpecies of tenure otherwiſe called *vellein-ſocage*. See TENURE.

Ancient demeſne conſiſts of thoſe lands or manors which, though now perhaps granted out to private ſubjects, were actually in the hands of the crown in the time of Edward the Confeſſor, or William the Conqueror; and ſo appear to have been by the great ſurvey in the exchequer, called *doomſday-book*. The tenants of theſe lands, under the crown, were not all of the ſame order or degree. Some of them, as Britton teſtifies, continued for a long time pure and abſolute villeins, dependent on the will of the lord, and common copyholders in only a few points. Others were in a great meaſure enfranchiſed by the royal favour; being only bound in reſpect of their lands to perform ſome of the better ſort of villein-ſervices: but thoſe determinate and certain; as, to plough the king's land for ſo many days, to ſupply his court with ſuch a quantity of proviſions, and the like; all of which are now changed into pecuniary rents: and in conſideration hereof they had many immunities and privileges granted to them; as, to try the right of their property in a peculiar court of their own, called a *court of ancient demeſne*, by a peculiar proceſs denominated a writ of right cloſe: not to pay toll or taxes; not to contribute to the expences of knights of the ſhire; not to be put on juries, and the like.

Theſe tenants therefore, though their tenure be abſolutely copyhold, yet have an intereſt equivalent to a freehold: for though their ſervices were of a baſe and villenous original, yet the tenants were eſteemed in all other reſpects to be highly privileged villeins; and eſpecially for that their ſervices were fixed and determinate, and that they could not be compelled (like pure villeins) to relinquiſh thoſe tenements at the lord's will, or to hold them againſt their own: *et ideo* (ſays Bracton) *dicuntur liberi*.

Lands holding by this tenure are therefore a ſpecies of copyhold, and as ſuch preſerved and exempted from the operation of the ſtatute of Charles II. Yet they differ from common copyholds, principally in the privileges before mentioned;

tioned: as alſo they differ from freeholders by one eſpecial mark and tincture of villenage, noted by Bracton, and remaining to this day; *viz.* that they cannot be conveyed from man to man by the general common-law conveyances of feoffment, and the reſt; but muſt paſs by ſurrender to the lord or his ſteward, in the manner of common copyholds: yet with this difference, that, in the ſurrenders of theſe lands in ancient demeſne, it is not uſed to ſay, "to hold at the will of their lord," in their copies; but only, "to hold according to the cuſtom of the manor."

VILLI, among botaniſts, a kind of down-like ſhort hair, with which ſome trees abound.

VILLIERS (George duke of Buckingham), an ingenious and witty nobleman, whoſe mingled character rendered him at once the ornament and diſgrace, the envy and ridicule, of the court he lived in, was ſon to that famous ſtateſman and favourite of king Charles I. who loſt his life by the hands of lieutenant Felton. He was born in 1627, the year before the fatal cataſtrophe of his father's death. The early parts of his education he received from various domeſtic tutors, after which he was ſent to the univerſity of Cambridge. Having here completed a courſe of ſtudies, he, with his brother lord Francis, went abroad under the care of one Mr Ayleſbury. Upon his return, which was not till after the breaking out of the civil wars, the king being at Oxford, his grace repaired thither, was preſented to his majeſty, and entered of Chriſt-church college. Upon the decline of the king's cauſe, he attended prince Charles into Scotland, and was with him at the battle of Worceſter in 1661; after which, making his eſcape beyond ſea, he again joined him, and was ſoon after, as a reward for this attachment, made knight of the garter.

Deſirous, however, of retrieving his affairs, he came privately to England; and in 1657 married Mary, the daughter and ſole heireſs of Thomas lord Fairfax, through whoſe intereſt he recovered the greateſt part of the eſtate he had loſt, and the aſſurance of ſucceeding to an accumulation of wealth in the right of his wife.

We do not find, however, that this ſtep loſt him the royal favour; for after the reſtoration, at which time he is ſaid to have poſſeſſed an eſtate of L. 20,000 *per annum*, he was made one of the lords of the bed-chamber, called to the privy-council, and appointed lord-lieutenant of Yorkſhire and maſter of the horſe. All theſe high poſts, however, he loſt again in the year 1666. For having been refuſed the poſt of preſident of the north, he became diſaffected to the king; and it was diſcovered that he had carried on a ſecret correſpondence by letters and other tranſactions with one Dr Heydon, tending to raiſe mutinies among his majeſty's forces, particularly in the navy, to ſtir up ſedition among the people, and even to engage perſons in a conſpiracy for the ſeizing the tower of London. Matters were ripe for execution; and an inſurrection, at the head of which the duke was openly to have appeared, was on the very eve of breaking out, when it was diſcovered by means of ſome agents whom Heydon had employed to carry letters to the duke. The detection of this affair ſo exaſperated the king, who knew Buckingham to be capable of the blackeſt deſigns, that he immediately ordered him to be ſeized; but the duke finding means, after having defended his houſe for ſome time by force, to make his eſcape, his majeſty ſtruck him out of all his commiſſions, and iſſued a proclamation requiring his ſurrender by a certain day.

This ſtorm, however, did not long hang over his head; for, on his making a humble ſubmiſſion, king Charles, who was far from being of an implacable temper, took him again into favour, and the very next year reſtored him both to the privy-council and bed-chamber. But the duke's diſpoſition for intrigue and machination could not long lie idle; for having conceived a reſentment againſt the duke of Ormond for having acted with ſome ſeverity againſt him in regard to the laſt-mentioned affair, he, in 1670, was ſuppoſed to be concerned in an attempt made on that nobleman's life by the ſame Blood who afterwards endeavoured to ſteal the crown. Their deſign was to have conveyed the duke to Tyburn, and there to have hanged him; and ſo far did they proceed towards the putting it in execution, that Blood and his ſon had actually forced the duke out of his coach in St James's Street, and carried him away beyond Devonſhire houſe, Piccadilly, before he was reſcued from them.

It does not appear, however, that this tranſaction hurt the duke's intereſt at court; for in 1671 he was inſtalled chancellor of the univerſity of Cambridge, and ſent ambaſſador to France. Here he was very nobly entertained by Louis XIV. and preſented by that monarch at his departure with a ſword and belt ſet with jewels, to the value of 40,000 piſtoles; and the next year he was employed in the ſecond embaſſy to that king at Utrecht. However, in June 1674, he reſigned the chancellorſhip of Cambridge, and about the ſame time became a zealous partizan and favourer of the Nonconformiſts. On the 16th of February 1676, his grace, with the earls of Saliſbury and Shafteſbury and lord Warton, were committed to the tower by order of the houſe of lords, for a contempt in refuſing to retract the purport of a ſpeech which the duke had made concerning a diſſolution of the parliament. This confinement did not laſt long; yet we find no material tranſaction of this nobleman's life recorded after it, till the time of his death, which happened in 1687. Wood tells us that he died at his houſe in Yorkſhire: but Mr Pope, who muſt certainly have had very good information, and it is to be imagined would not have dared to advance an injurious falſehood of a perſon of his rank, has, in his epiſtle to lord Bathurſt, given us a moſt affecting account of the death of this ill-ſtarred nobleman, whom, after having been maſter of near L. 50,000 *per annum*, he deſcribes as reduced to the deepeſt diſtreſs by his vice and extravagance, and breathing his laſt moments in a mean apartment at an inn.

As to his perſonal character, it is impoſſible to ſay any thing in its vindication; for though his ſevereſt enemies acknowledge him to have poſſeſſed great vivacity and a quickneſs of parts peculiarly adapted to the purpoſes of ridicule, yet his warmeſt advocates have never attributed to him a ſingle virtue. His generoſity was profuſeneſs, his wit malevolence, the gratification of his paſſions his ſole aim thro' life, his very talents caprice, and even his gallantry the mere love of pleaſure. But it is impoſſible to draw his character with equal beauty, or with more juſtice, than in that given of him by Dryden, in his Abſalom and Achitophel, under the name of *Zimri*, to which the reader is referred.

As a writer, however, he ſtands in a quite different point of view. There we ſee the wit, and forget the libertine.—His poems, which indeed are not very numerous, are capital in their kind; but what will immortalize his memory while language ſhall be underſtood, or true wit reliſhed, is his celebrated comedy of The Rehearſal.

VILLOSE, or VILLOUS, ſomething abounding with villi or fibres like ſhort hair; ſuch is one of the coats of the ſtomach.

VINCA, in botany: A genus of plants of the claſs *pentandria*, and order of *monogynia*; and in the natural ſyſtem arranged under the 30th order, *Contortæ*. The corolla is twiſted; there are two erect follicles; the ſeeds are naked. There are five ſpecies; only two of which are natives of Britain:

St Vincent.

Britain: 1. The *major*, great periwinckle. It has a woody, erect ſtem; leaves broader and ſharper pointed; pedicles of the flowers ſtraight, and calyx as long as the tube: otherwiſe like the former. 2. The *minor*, ſmall periwinckle, has a woody, creeping, ſlender, crooked ſtem; leaves long, oval, entire, pointed, oppoſite, gloſſy. Flowers ſingle, on long curved pedicles from the alæ of the leaves, which are large and blue.

ST VINCENT, one of the windward Caribbee iſlands, which received its name from being diſcovered on the 22d of January, the feaſt of that Saint. It is inhabited by a race of people, of whom Dr Robertſon gives this account: "There is a great diſtinction in character between the Caribbees and the inhabitants of the larger iſlands. The former appear manifeſtly to be a ſeparate race. Their language is totally different from that of their neighbours in the large iſlands. They themſelves have a tradition that their anceſtors came originally from ſome part of the continent, and having conquered and exterminated the ancient inhabitants, took poſſeſſion of their lands and of their women. Hence they call themſelves Banaree, which ſignifies a man come from beyond ſea. Accordingly, the Caribbees ſtill uſe two diſtinct languages, one peculiar to the men, and the other to the women. The language of the men has nothing common with that ſpoken in the large iſlands. The dialect of the women conſiderably reſembles it. This ſtrongly confirms the tradition which I have mentioned. The Caribbees themſelves imagine that they were a colony from the Galibis, a powerful nation of Guiana in South America. But as their fierce manners approach nearer to thoſe of the people in the northern continent, than to thoſe of the natives of South America, and as their language has likewiſe ſome affinity to that ſpoken in Florida, their origin ſhould be deduced rather from the former than from the latter. In their wars, they ſtill preſerve their ancient practice of deſtroying all the males, and preſerving the women either for ſervitude or for breeding."

It remained a long time after it was diſcovered inhabited by theſe people, and by another race improperly ſtyled *Black Caribs*, who are in reality negroes deſcended, as is generally believed, from ſome who eſcaped out of a Guinea ſhip wrecked upon the coaſt, and gradually augmented by ſuch as from time to time fled thither from Barbadoes. Theſe nations were often at war; but when their quarrels were compoſed, they had a ſtrength ſufficient to prevent ſtrangers from ſettling by force. The French, about half a century ago, at the requeſt of the Caribs, made a deſcent from Martinico, and attacked the negroes, but were repulſed with loſs; and found it their intereſt to conciliate a friendſhip with both nations by means of preſents, and furniſhing them with arms and ammunition.

St Vincent was long a neutral iſland; but, at the peace of 1763, the French agreed that the right to it ſhould be veſted in the Engliſh; who, in the ſequel, at the inſtance of ſome rapacious planters, engaged in an unjuſt war againſt the Caribbees, who inhabited the windward ſide of the iſland, and who were obliged to conſent to a peace, by which they ceded a very large tract of valuable land to the crown. The conſequence of this was, that in the next war, in 1779, they greatly contributed to the reduction of this iſland by the French, who, however, reſtored it by the peace of 1783. Since that time it has continued in the poſſeſſion of Great Britain. During the preſent war, the Caribs revolted; and, aſſiſted by the French, ſpread deſolation over the whole iſland. By the exertions of the governor, however, and the Britiſh forces in the Weſt Indies, the revolt is in a great meaſure quelled, though it will be long before things are reſtored to their former ſtate.

St Vincent is in length about 24 miles, and about 18 in breadth; in circumference between 60 and 70. The climate is very warm; at leaſt in the judgment of the Europeans. The country is in general hilly, in ſome places mountainous; but interſperſed with a variety of pleaſant valleys, and ſome luxuriant plains, the ſoil being everywhere very fertile, and the high grounds are at leaſt in general eaſy of aſcent. Few iſlands of its extent are ſo well watered: for ſeveral rivers run down from the mountains, and ſmaller ſtreams from almoſt every hill; there are likewiſe ſeveral fine ſprings at a little diſtance from the ſea. The inhabitants raiſe all kinds of ground proviſions in plenty, and with little trouble. The rivers ſupply them with a variety of fiſh; and the ſame may be ſaid of the ſea that waſhes their coaſts. They have abundance of excellent fruits, and very fine timber fit for almoſt every uſe; and with which they formerly ſupplied their neighbours.

In 1770 its exports were, cotton, 284 bags, at 10l. *per* bag, 2840l. Coffee, 4818 hundred-weight one quarter ſix pound, at 3l. 5s. *per* hundred-weight, 15,659l. 9s. 8¼d. Cacao, 1000 hogſheads and one barrel, at 25l. *per* hogſhead, and 12l. *per* barrel, 25,012l. Rum, 346 hogſheads, at 10l. *per* hogſhead, 3460l. Sugar, 2866 hogſheads, at 17l. 10s. *per* hogſhead, 50,155l. In all to Great Britain, 97,126l. 9s. 1¼d. To North America, 13,375l. Total 110,501l. 9s. 8¾d. W. Long. 61°. N. Lat. 13°.

Vinci.

VINCI (Leonardo da), an illuſtrious Italian painter, deſcended from a noble Tuſcan family, was born in the caſtle of Vinci near Florence in 1445. He was placed under Andrea Verochia, a celebrated painter in that city; but ſoon ſurpaſſed him and all his predeceſſors ſo much, as to be reputed the maſter of the third or golden age of modern painting. But his ſtudies were far from terminating here; no man's genius was more univerſal: he applied himſelf to arts, to literature, and to the accompliſhments of the body; and he excelled in every thing which he attempted. Lewis Sforza duke of Milan prevailed on him to be director of the academy for architecture he had juſt eſtabliſhed; where Leonardo ſoon baniſhed all the Gothic faſhions, and reduced every thing to the happy ſimplicity of the Greek and Roman ſtyle. By the duke's order he conſtructed the famous aqueduct that ſupplies the city of Milan with water: this canal goes by the name of *Morteſana*, being above 200 miles in length, and conducts the water of the river Adda quite to the walls of the city. In 1479, he was deſired to conſtruct ſome new device for the entertainment of Louis XII. of France, who was then to make his entrance into Milan. Leonardo accordingly made a very curious automaton in the form of a lion, which marched out to meet the king, reared up on its hinder legs before him, and opening its breaſt, diſplayed an eſcutcheon with fleur de lys quartered on it. The diſorders of Lombardy, with the misfortunes of his patrons the Sforzi, obliging Leonardo to quit Milan, he retired to Florence, where he flouriſhed under the Medici: here he raiſed the envy of Michael Angelo, who was his contemporary; and Raphael, from the ſtudy of his works, acquired his beſt manner of deſigning. At length on the invitation of Francis I. he removed to France when about 70 years of age; where the journey and change of climate threw him into his laſt ſickneſs: he languiſhed for ſome months at Fontainbleau, where the king came frequently to ſee him; and one day riſing up in his bed to acknowledge the honour done him, he fainted, and Francis ſupporting him, Leonardo died in his arms. His death happened in 1520. Some of his paintings are to be ſeen in England and other countries, but the greateſt part of them are in Florence and France. He compoſed a great number of diſcourſes on curious ſubjects; but none of them have been publiſhed but his treatiſe on the Art of Painting. —For his anatomical knowledge, ſee Anatomy (hiſtory of), p. 669.

VINCULUM, in algebra, a character in form of a line, or ſtroke drawn over a factor, diviſor, or dividend, when compounded of ſeveral letters or quantities to connect them, and ſhows that they are to be multiplied or divided, &c. together by the other term.

Thus $d \times \overline{a + b - c}$ ſhows that d is to be multiplied into $a + b - c$.

VINE, in botany. See Vitis.

VINEGAR, Acetum, an agreeable acid and penetrating liquor, prepared from wine, cyder, beer, and other liquors; of conſiderable uſe, both as a medicine and a ſauce. The word is French, *vinaigre*: formed from *vin*, "wine;" and *aigre*, "ſour." See Acetum, and Chemistry-*Index*.

Lavoiſier's Chemiſtry.

Wine and other vinous liquors are changed into vinegar by the acetous fermentation. The acetous fermentation is nothing more than the acidification or oxygenation of wine, produced in the open air by means of the abſorption of oxygen. Vinegar is compoſed of hydrogen and carbon, united together in proportions not yet aſcertained, and changed into the acid ſtate by oxygen. As vinegar is an acid, we might conclude from analogy, that it contains oxygen; but this is put beyond doubt by direct experiments. In the firſt place, we cannot change wine into vinegar without the contact of air containing oxygen: ſecondly, this proceſs is accompanied by a diminution of the air in which it is carried on from the abſorption of its oxygen; and thirdly, wine may be changed into vinegar by any other means of oxydation. Independent of the proofs which theſe facts furniſh of the acetous acid being produced by the oxygenation of wine, an experiment made by Mr. Chaptal, profeſſor of chemiſtry at Montpelier, gives a diſtinct view of what takes place in this proceſs. He impregnated ſome water with about its own bulk of carbonic acid gas, procured from beer vats in fermentation; and placed this water in a cellar, in veſſels communicating with the air, and in a ſhort time the whole was converted into acetous acid. This carbonic acid gas, procured from beer vats in fermentation, is not perfectly pure, but contains a great quantity of alcohol in ſolution; wherefore water impregnated with it contains all the materials neceſſary for forming the acetous acid. The alcohol furniſhes hydrogen and one portion of carbon; the carbonic acid furniſhes oxygen and the reſt of carbon; and the air of the atmoſphere furniſhes the reſt of the oxygen neceſſary for changing the mixture into acetous acid. From this obſervation it follows, that nothing but hydrogen is wanting to convert carbonic acid into acetous acid; or, more generally, that by means of hydrogen; and according to the degree of oxydation, carbonic acid may be changed into all the vegetable acids: and, on the contrary, that, by depriving any of the vegetable acids of their hydrogen, they may be converted into carbonic acid.

Chaptal's Chemiſtry.

The proceſs indicated by Boerhaave for making vinegar is ſtill the moſt frequently uſed. It conſiſts in fixing two caſks in a warm room or place. Two falſe bottoms of baſket-work are fixed at a certain diſtance from the bottom, upon which the refuſe of grapes and vine twigs are placed. One of theſe tuns is filled with wine, and the other only half filled. The fermentation begins in this laſt; and, when it is in full action, it is checked by filling the caſk up with wine out of the other. The fermentation then takes place in the laſt mentioned caſk, that remained half filled; and this is checked in the ſame manner by pouring back the ſame quantity of liquid out of the other: and in this way the proceſs is continued till the vinegar is made, which is uſually in about 15 days. When the fermentation developes itſelf, the liquor becomes heated and turbid; a great number of filaments are ſeen in it; it emits a lively ſmell; and much air is abſorbed, according to the obſervation of the Abbé Rozier. A large quantity of lees is formed, which ſubſides when the vinegar becomes clear. This lees is very analogous to the fibrous matter.

Vinegar is purified by diſtillation. The firſt portions which paſs over are weak; but ſoon afterwards the acetous acid riſes, and is ſtronger the later it comes over in the diſtillation. This fluid is called *diſtilled vinegar;* and is thus cleared of its colouring principle, and the lees, which are always more or leſs abundant. Vinegar may likewiſe be concentrated by expoſing it to the froſt. The ſuperabundant water freezes, and leaves the acid more condenſed.

Method of making Cyder Vinegar.—The cyder (the meaneſt of which will ſerve the purpoſe) is firſt to be drawn off fine into another veſſel, and a quantity of the muſt of apples to be added: the whole is ſet in the ſun, if there be conveniency for it; and at a week or nine days end it may be drawn off.

Method of making Beer Vinegar.—Take a middling ſort of beer, indifferently well hopped; into which, when it has worked well and grown fine, put ſome rape, or huſks of grapes, uſually brought home for that purpoſe; maſh them together in a tub; then letting the rape ſettle, draw off the liquid part, put it into a caſk, and ſet it in the ſun as hot as may be; the bung being only covered with a tile or ſlateſtone: and in about 30 or 40 days it will become a good vinegar, and may paſs in uſe as well as that made of wine, if it be refined, and kept from turning muſty.

Or thus:—To every gallon of ſpring-water add three pounds of Malaga raiſins; which put into an earthen jar, and place them where they may have the hotteſt ſun from May till Michaelmas; then preſſing all well, tun the liquor up in a very ſtrong iron-hooped veſſel, to prevent its burſting, it will appear very thick and muddy when newly preſſed; but will refine in the veſſel, and be as clear as wine. Thus let it remain untouched for three months before it is drawn off, and it will prove excellent vinegar.

To make Wine Vinegar.—Any ſort of vinous liquor being mixed with its own fæces, flowers, or ferment, and its tartar firſt reduced to powder; or elſe with the acid and auſtere ſtalks of the vegetable from whence the wine was obtained, which hold a large proportion of tartar; and the whole being kept frequently ſtirring in a veſſel which has formerly held vinegar, or ſet in a warm place full of the ſteams of the ſame, will begin to ferment anew, conceive heat, grow ſour by degrees, and ſoon after turn into vinegar.

The remote ſubjects of acetous fermentation are the ſame with thoſe of vinous; but the immediate ſubjects of it, are all kinds of vegetable juices, after they have once undergone that fermentation which reduces them to wine: for it is abſolutely impoſſible to make vinegar of muſt, the crude juice of grapes, and other ripe fruits, without the previous aſſiſtance of vinous fermentation.

The proper ferments for this operation, whereby vinegar is prepared, are, 1. The fæces of all acid wines. 2. The lees of vinegar. 3. Pulverized tartar, eſpecially that of Rheniſh wine, or the cream or chryſtals thereof. 4. Vinegar, itſelf. 5. A wooden veſſel well drenched with vinegar, or one that has long been employed to contain it. 6. Wine that has often been mixed with its own fæces. 7. The twigs of vines, and the ſtalks of grapes, currants, cherries, or other vegetables of an acid auſtere taſte. 8. Baker's leven, after it is turned acid. 9. All manner of ferments, compounded of thoſe already mentioned.

Vinegar *Concentrated.* See Chemistry, n° 881.

Vinegar *(Salt of).* See Chemistry, n° 882.

Eels in Vinegar. See Animalcule, n° 9.

VINEYARD, a plantation of vines. The beſt ſituation of a vineyard is on the declivity of a hill facing the ſouth.

VIO (Thomas de). See Cajetan.

VIOL, a muſical inſtrument of the ſame form with the violin, and, like that, ſtruck with a bow.

VIOLA, in botany: A genus of plants of the claſs *ſyngeneſia*, order *monogynia*; in the natural ſyſtem arranged under the 29th order, *Campanaceæ*. The calyx is pentaphyllous; the corolla five petaled, irregular, with a nectarium behind, horn-ſhaped; the capſule is above the germen, three-valved, monolocular. There are 28 ſpecies; ſix of which are natives of Britain. The moſt important of theſe are, 1. The *paluſtris*, march violet. The leaves are ſmooth, reniform, two or three on each footſtalk: flowers pale blue, ſmall, inodorous. An infuſion of the flowers is an excellent teſt of the preſence of acids and alkalis. 2. The *odorata*, purple ſweet violet, has leaves heart-ſhaped, notched: flowers deep purple, ſingle; creeping ſcions. The flowers of this plant taken in the quantity of a dram or two are ſaid to be gently purgative or laxative, and, according to Bergius and ſome others, they poſſeſs an anodyne and pectoral quality. 3. *Tricolor*, panſies, heart's eaſe, or three faces under a hood. The ſtems are diffuſe, procumbent, triangular; the leaves oblong, cut at the edges; ſtipulæ dentated: the flowers purple, yellow, and light blue; inodorous.

This elegant little plant merits culture in every garden, for the beauty and great variety of its three-coloured flowers; and it will ſucceed anywhere in the open borders, or other compartments, diſpoſed in patches towards the front; either by ſowing the ſeed at once to remain, or by putting in young plants previouſly raiſed in a ſeed-bed: they will begin flowering early in ſummer, and will continue ſhooting and flowering in ſucceſſion till winter; and even during part of that ſeaſon in mild weather.

The common violet is propagated by parting the roots, ſometimes by ſeed.

VIOLATION, the act of violating, that is, forcing a woman, committing a rape upon her.—This term is alſo uſed in a moral ſenſe, for a breach or infringement of a law, ordinance, or the like.

VIOLET, in botany. See Viola.

Violet-Crab, in zoology. See Cancer.

VIOLIN, or Fiddle, a muſical inſtrument mounted with four ſtrings or guts, and ſtruck or played with a bow. The ſtyle and ſound of the violin is the gayeſt and moſt ſprightly of all other inſtruments; and hence it is of all others the fitteſt for dancing. Yet there are ways of touching it, which render it grave, ſoft, languiſhing, and fit for church or chamber muſic.—It generally makes the treble or higheſt parts in concerts. Its harmony is from fifth to fifth. Its play is compoſed of baſs, counter-tenor, tenor, and treble; to which may be added, a fifth part: each part has four fifths, which riſe to a greater ſeventeenth.

VIOLONCELLO, of the Italians, is properly our fifth violin; which is a little baſs violin half the ſize of the common baſs violin, and the ſtrings bigger and longer in proportion: conſequently its ſound is an octave lower than our baſs violin; which has a noble effect in concerts.

VIPER, in zoology. See Coluber, Poison, and Serpent; in which laſt article every thing concerning the poiſon of the *viper*, for which we referred from Poison, is already diſcuſſed.

VIRAGO, a woman of extraordinary ſtature and courage; and who, with the female ſex, has the mien and air of a man, and performs the actions and exerciſes of men.

VIRGIL, or Publius Virgilius Maro, the moſt excellent of all the Latin poets, was the ſon of a potter of Andes, near Mantua, where he was born, 70 years B. C. He ſtudied firſt at Mantua; then at Cremona, Milan, and Naples; whence going to Rome, he acquired the eſteem of the greateſt wits and moſt illuſtrious perſons of his time; and among others of the emperor Auguſtus, Mæcenas, and Pollio. He was well ſkilled not only in polite literature and poetry, but alſo in philoſophy, the mathematics, geography, medicine, and natural hiſtory. Though one of the greateſt geniuſes of his age, and the admiration of the Romans, he always preſerved a ſingular modeſty, and lived chaſte at a time when the manners of the people were extremely corrupt. He carried Latin poetry to ſuch an high perfection, that he was juſtly eſteemed the prince of Latin poets. He firſt turned himſelf to paſtoral; and being captivated with the beauty and ſweetneſs of Theocritus, was ambitious to introduce this new ſpecies of poetry among the Romans. His firſt performance in this way is ſuppoſed to have been written U. C. 709, the year before the death of Julius Cæſar, when the poet was in his 25th year: it is intitled *Alexis*. Poſſibly *Palæmon* was his ſecond: it is a cloſe imitation of the fourth and fifth Idylls of Theocritus. Mr Wharton places *Silenus* next; which is ſaid to have been publicly recited on the ſtage by Cytheris, a celebrated comedian. Virgil's fifth eclogue is compoſed in alluſion to the death and deification of Cæſar. The battle of Philippi in 712 having put an end to the Roman liberty, the veteran ſoldiers began to murmur for their pay; and Auguſtus, to reward them, diſtributed among them the lands of Mantua and Cremona. Virgil was involved in this common calamity; and applied to Varus and Pollio, who warmly recommended him to Auguſtus, and procured for him his patrimony again. Full of gratitude to Auguſtus, he compoſed the *Tityrus*, in which he introduces two ſhepherds: one of them complaining of the diſtraction of the times, and of the havock the ſoldiers made among the Mantuan farmers; the other rejoicing for the recovery of his eſtate, and promiſing to honour as a god the perſon who reſtored it to him. But our poet's joy was not of long continuance; for we are told, that when he returned to take poſſeſſion of his farm, he was violently aſſaulted by the intruder, and would certainly have been killed by him if he had not eſcaped by ſwimming haſtily over the Mincio. Upon this unexpected diſappointment, he returned to Rome to renew his petition; and during his journey ſeems to have compoſed his ninth eclogue. The celebrated eclogue, intitled *Pollio*, was compoſed U. C. 714, upon the following occaſion: The conſul Pollio on the part of Antony, and Mæcenas on the part of Cæſar, had made up the differences between them; by agreeing, that Octavia, half-ſiſter to Cæſar, ſhould be given in marriage to Antony. This agreement cauſed an univerſal joy; and Virgil, in his eclogue, teſtified his. Octavia was with child by her late huſband Marcellus at the time of this marriage; and whereas the Sibylline oracles had foretold, that a child was to be born about this time, who ſhould rule the world, and eſtabliſh perpetual peace, the poet ingeniouſly ſuppoſes the child in Octavia's womb to be the glorious infant, under whoſe reign mankind was to be happy, the golden age to return from heaven, and fraud and violence to be no more. In this celebrated poem, the author, with great delicacy at the ſame time, pays his court to both the chiefs, to his patron Pollio, to Octavia, and to the unborn infant. In 715, Pollio was ſent againſt the Parthini, a people of Illyricum; and during this expedition, Virgil addreſſed to him a beautiful eclogue, called *Pharmaceutria*. His tenth and laſt eclogue was addreſſed to Gallus.

In his 34th year, he retired to Naples, and laid the plan of this Georgics; which he undertook at the intreaties of Mæcenas to whom he dedicated them. This wiſe and

Virgil.

able miniſter reſolved, if poſſible, to revive the decayed ſpirit of huſbandry; to introduce a taſte for agriculture, even among the great; and could not think of a better method to effect this, than to recommend it by the inſinuating charms of poetry. Virgil fully anſwered the expectations of his patron by his Georgics. They are divided into four books. Corn and ploughing are the ſubject of the firſt, vines of the ſecond, cattle of the third, and bees of the fourth.

He is ſuppoſed to have been in his 45th year when he began to write the Æneid; the deſign of which was to reconcile the Romans to the government of Auguſtus. Auguſtus was eager to peruſe this poem before it was finiſhed; and intreated him by letters to communicate it. Macrobius has preſerved to us part of one of Virgil's anſwers to the emperor, in which the poet excuſes himſelf: who, however, at length complied, and read himſelf the ſixth book to the emperor: when Octavia, who had juſt loſt her ſon Marcellus, the darling of Rome, and adopted ſon of Auguſtus, made one of the audience. Virgil had artfully inſerted that beautiful lamentation for the death of young Marcellus, beginning with—*O nate, ingentem luctum ne quære tuorum*—but ſuppreſſed his name till he came to the line—*Tu Marcellus eris:* upon hearing which, Octavia could bear no more, but fainted away; overcome with ſurpriſe and ſorrow. When ſhe recovered, ſhe made the poet a preſent of ten ſeſterces for every line, which amounted in the whole to above 2000l.

The Æneid being brought to a concluſion, but not to the perfection our author intended to give it, he reſolved to travel into Greece, to correct and poliſh it at leiſure. It was probably on this occaſion that Horace addreſſed that affectionate ode to him, *Sic te Divæ potens Cypri, &c.* Auguſtus returning victorious from the eaſt, met with Virgil at Athens, who thought himſelf obliged to attend the emperor to Italy: but the poet was ſuddenly ſeized with a fatal diſtemper, which being increaſed by the agitation of the veſſel, put an end to his life as ſoon as he landed at Brunduſium, in his 52d year. He had ordered in his will, that the Æneid ſhould be burnt as an unfiniſhed poem; but Auguſtus forbade it, and had it delivered to Varius and Tucca, with the ſtricteſt charge to make no additions, but only to publiſh it correctly. He died with ſuch ſteadineſs and tranquillity, as to be able to dictate his own epitaph in the following words:

Mantua me genuit: Calabri rapuere, tenet nunc
Parthenope: cecini Paſcua, Rura, Duces.

His bones were carried to Naples, according to his earneſt requeſt; and a monument was erected at a ſmall diſtance from the city.

Virgil was of a ſwarthy complexion, tall, of a ſickly conſtitution, and afflicted with frequent head-achs and ſpitting of blood. He was ſo very baſhful, that he often ran into the ſhops to prevent being gazed at in the ſtreets; yet was ſo honoured by the Roman people, that once coming into the theatre, the whole audience roſe up out of reſpect to him. He was of a thoughtful and melancholy temper; he ſpoke little, and loved retirement and contemplation. His fortune was affluent; he had a fine houſe and well furniſhed library near Mæcenas's gardens, on the Eſquiline mount at Rome, and alſo a delightful villa in Sicily. He was ſo benevolent and inoffenſive, that moſt of his contemporary poets, though they envied each other, agreed in loving and eſteeming him. He reviſed his verſes with prodigious ſeverity; and uſed to compare himſelf to a ſhe bear, which licked her cubs into ſhape.

The beſt edition of Virgil's works are thoſe of Moſvicius, with the notes of Servius, printed at Lewarden in 1717, 2 vols 4to: and that of Burman, at Amſterdam, 1746, in 4 vols 4to. There are ſeveral Engliſh tranſlations, which are well known.

Virgil, Virginia.

Virgil (Polydore), an Engliſh hiſtorian, born at Urbino in Italy, was ſent in the beginning of the 16th century, by pope Alexander VI. as ſub-collector of the Papal tax, called *Peter-pence*, in this kingdom. He had not been long in England before he obtained preferment in the church; for in 1503 he was preſented to the rectory of Church-Langton in the archdeaconry of Leiceſter. In 1507 he was collated to the prebend of Scamleſby in the church of Lincoln; and in the ſame year was made archdeacon of Wells, and prebendary of Hereford. In 1513, he reſigned his prebend of Lincoln, and was collated to that of Oxgate in St Paul's London. We are told, that on his preferment to the archdeaconry of Wells, he reſigned the office of ſub-collector to the pope, and determined to ſpend the remainder of his life in England, the Hiſtory of which kingdom he began in the year 1505, at the command of Henry VII. That work coſt him 12 years labour. In 1526, he finiſhed his treatiſe on Prodigies. Polydore continued in England during the whole reign of Henry VIII. and part of that of Edward VI. whence it is concluded that he was a moderate Papiſt. In 1550, being now an old man, he requeſted leave to reviſit his native country. He was accordingly diſmiſſed with a preſent of 300 crowns, together with the privilege of holding his preferments to the end of his life. He died at Urbino in the year 1555. As an hiſtorian, he is accuſed by ſome as a malignant ſlanderer of the Engliſh nation; yet Jovius remarks, that the French and Scotch accuſe him of having flattered that nation too much; (See his *Elog.* cap. 135. p. 179). Beſides the above, he wrote, 1. *De rerum inventoribus;* of which an Engliſh tranſlation was publiſhed by Langley in 1663. It was alſo tranſlated into French and Spaniſh. 2. *De prodigiis et ſortibus*. 3. *Epiſcoporum Angliæ catalogus*. Manuſcript. 4. *De vita perfecta*, Baſil. 1546, 1553, 8vo. 5. *Epiſtolæ eruditæ*; and ſome other works.

VIRGINIA, one of the United States of North America, is bounded on the eaſt by the Atlantic Ocean, on the north by Pennſylvania and Maryland, on the weſt by Kentucky, on the ſouth by North Carolina.

Theſe boundaries include an area ſomewhat triangular of about 70,000 miles. The country between the great Kanhaway and the Cumberland river formerly part of this ſtate, containing about 50,000 ſquare miles has been lately erected into the new ſtate of Kentucky.

The principal rivers in Virginia are, Roanoke, James river, which receives the Rivanna, Appamattox, Chickahominy, Nanſemond, and Elizabeth rivers; York river, which is formed by the junction of Pamunky and Mattapony rivers; Rappahannok, and Patomak.

The mountains are not ſolitary and ſcattered confuſedly over the face of the country; they commence at about 150 miles from the ſea-coaſt, and are diſpoſed in ridges one behind another, running nearly parallel with the coaſt, though rather approaching it as they advance north-eaſtwardly. To the ſouth-weſt, as the tract of country between the ſea coaſt and the Miſſiſſippi becomes narrower, the mountains converge into a ſingle ridge, which, as it approaches the Gulph of Mexico, ſubſides into plain country, and gives riſe to ſome of the waters of that Gulph.

Jefferſon's Virginia.

From the great extent of Virginia, it may be expected that the climate is not the ſame in all its parts. It is remarkable that, proceeding on the ſame parallel of latitude weſtwardly, the climate becomes colder in like manner as when you proceed northwardly. This continues to be the caſe till you attain the ſummit of the Allegany, which is the higheſt land between the ocean and the Miſſiſſippi.

From thence, deſcending in the ſame latitude to the Miſſiſſippi, the change reverſes; and, if we may believe travellers, it becomes warmer there than it is in the ſame latitude on the ſea-ſide. Their teſtimony is ſtrengthened by the vegetables and animals which ſubſiſt and multiply there naturally, and do not on the ſea-coaſt. Thus catalpas grow ſpontaneouſly on the Miſſiſſippi as far as the latitude of 37, and reeds as far as 38, degrees. Perroquets even winter on the Sioto in the 39th degree of latitude. In the ſummer of 1779, when the thermometer was at 90 degrees at Monticello, and 96 degrees at Williamſburg, it was 110 degrees at Kaſkaſkia. Perhaps the mountain, which overhangs this village on the north ſide, may by its reflection have contributed ſomewhat to produce this heat.

The number of free inhabitants in this ſtate in 1790 was 454,983, ſlaves 292,627. The number of free inhabitants were to the number of ſlaves nearly as 54 to 29.

The college of William and Mary is the only public ſeminary of learning in Virginia. It was founded in the time of king William and queen Mary, who granted to it 20,000 acres of land, and a penny a pound duty on certain tobaccoes exported from Virginia and Maryland. The aſſembly alſo gave it by temporary law a duty on liquors imported, and ſkins and furs exported. From theſe reſources it received upwards of 3000l. *communibus annis*. The buildings are of brick, ſufficient for an indifferent accommodation of perhaps 100 ſtudents. By its charter it was to be under the government of 20 viſitors, who were to be its legiſlators; and to have a preſident and ſix profeſſorſhips, which at preſent ſtand thus:—A profeſſorſhip for Law and Police; Anatomy and Medicine; Natural Philoſophy and Mathematics; Moral Philoſophy, the Law of Nature and Nations, the Fine Arts; Modern Languages. For the Brafferton. The college edifice is a large, irregular pile, which, however, ſerves the purpoſe for the preſent. In 1787, there were about 30 young gentlemen members of this college, a large proportion of which were law ſtudents. There are a number of flouriſhing academies in Virginia; one in Prince Edward county, one at Alexandria, one at Norfolk, one at Hanover, and others in other places.

The preſent denominations of Chriſtians in Virginia are Preſbyterians, who are the moſt numerous, and inhabit the weſtern parts of the ſtate; Epiſcopalians, who are the moſt ancient ſettlers, and occupy the eaſtern and firſt ſettled parts of the ſtate. Intermingled with theſe are great numbers of Baptiſts and Methodiſts. The bulk of theſe laſt mentioned religious ſects are of the poorer ſort of people, and many of them are very ignorant (as is indeed the caſe with the other denominations), but they are generally a virtuous well-meaning ſet of people.

Virginia has produced ſome of the moſt diſtinguiſhed men that have been active in effecting the two late important revolutions in America, whoſe political and military character will rank among the firſt in the page of hiſtory. The great body of the people do not concern themſelves with politics; ſo that their government, though nominally republican, is in fact oligarchical or ariſtocratical. The Virginians who are rich, are in general ſenſible, polite, and hoſpitable and of an independent ſpirit. The poor are ignorant and abject; all are of an inquiſitive turn, and in many other reſpects very much reſemble the people in the eaſtern ſtates. There is a much greater diſparity between the rich and the poor in Virginia than in any of the northern ſtates. A ſpirit for literary inquiries, if not altogether confined to a few, is, among the body of the people, evidently ſubordinate to a ſpirit of gaming and barbarous ſports. At almoſt every tavern or ordinary on the public road there is a billiard table, a backgammon table, cards, and other implements for various games. To theſe public houſes the gambling gentry in the neighbourhood reſort to kill time which hangs heavily upon them; and at this buſineſs they are extremely expert, having been accuſtomed to it from their earlieſt youth. The paſſion for cock-fighting, a diverſion not only inhumanly barbarous, but infinitely beneath the dignity of a man of ſenſe, is ſo predominant, that they even advertiſe their matches in the public newſpapers.

The executive powers are lodged in the hands of a governor choſen annually, and incapable of acting more than three years in ſeven. He is aſſiſted by a council of eight members. The judiciary powers are divided among ſeveral courts. Legiſlation is exerciſed by two houſes of aſſembly, the one called the *Houſe of Delegates*, compoſed of two members from each county, choſen annually by the citizens poſſeſſing an eſtate for life in 100 acres of uninhabited land, or 25 acres with a houſe on it, or in a houſe or lot in ſome town. The other called the *Senate*, conſiſting of 24 members, choſen quadrennially by the ſame electors, who for this purpoſe are diſtributed into 24 diſtricts. The concurrence of both houſes is neceſſary to the paſſage of a law. They have the appointment of the governor and council, the judges of the ſuperior courts, auditors, attorney-general, treaſurer, regiſter of the land office, and delegates to Congreſs.

Before the preſent war, there was exported from this ſtate, *communibus annis*, nearly as follows:

Articles.	Quantity.
Tobacco.	55,000 hhds. of 1000lb
Wheat,	800,000 buſhels
Indian Corn,	600,000 buſhels
Shipping,	
Maſts, planks, ſkantling, ſhingles, ſtaves,	
Tar, pitch, turpentine,	30,000 barrels
Peltry, viz. ſkins of deer, beavers, otters, muſk-rats, racoons, foxes,	180 hhds. of 600 lb.
Pork,	4,000 barrels
Flax ſeed, hemp, cotton,	
Pit coal, pig iron,	
Peaſe,	5,000 buſhels
Beef,	1,000 barrels
Sturgeon, white ſhad, herring,	
Brandy from peaches and apples, whiſky,	
Horſes,	
The amount of the above articles is 850,000l. Virginia money, or 607,142 guineas.	

The whole country before it was planted was one continued foreſt interſperſed with marſhes, which in the Weſt Indies they call *ſwamps*. No country now produces greater quantities of excellent tobacco; and the ſoil is generally ſo ſandy and ſhallow, that after they have cleared a freſh piece of ground out of the woods, it will not bear tobacco after two or three years unleſs cow-penned and well dunged. The foreſts yield oaks, poplars, pines, cedars, cypreſſes, ſweet myrtles, cheſnuts, hickery, live oak, walnut, dog-wood, alder, hazel, chinkapins, locuſt-trees, ſaſſafras, elm, aſh, beech, with a great variety of ſweet gums and incenſe, which diſtil from ſeveral trees; pitch, tar, roſin, turpentine, plank-timber, maſts, and yards. Virginia yields alſo rice, hemp, Indian corn, plenty of paſture, with coal, quarries of ſtone, and lead and iron ore.

VIRGO, in aſtronomy, one of the ſigns or conſtellations of the zodiac.

VIRGULA Divinitoria, divining rod. See Mine, Vol. XII. p. 41.

VIRTUAL, or Potential; ſomething that has a power or virtue of acting or doing. The term is chiefly underſtood of ſomething that acts by a ſecret inviſible cauſe, in oppoſition to actual and ſenſible.

VIRTUE, a term uſed in various ſignifications. In the general it denotes power, or the perfection of any thing, whether natural or ſupernatural, animate or inanimate, eſſential or acceſſory. But, in its more proper or reſtrained ſenſe, virtue ſignifies a habit, which improves and perfects the poſſeſſor and his actions. See MORAL PHILOSOPHY, n° 84.

VIRTUOSO, an Italian term lately introduced into the Engliſh, ſignifying a man of curioſity and learning, or one who loves and promotes the arts and ſciences. But among us the term ſeems to be appropriated to thoſe who apply themſelves to ſome curious and quaint rather than immediately uſeful art or ſtudy; as antiquaries, collectors of rarities of any kind, microſcopical obſervers, &c.

VIRULENT, a term applied to any thing that yields a virus; that is, a contagious or malignant pus.

VISCERA, in anatomy, a term ſignifying the ſame with entrails; including the heart, liver, lungs, ſpleen, inteſtines, and other inward parts of the body.

VISCIDITY, or VISCOSITY, the quality of ſomething that is viſcid or viſcous; that is, glutinous and ſticky like bird-lime, which the Latins call by the name of *viſcus*.

VISCOUNT (*Vice Comes*), was anciently an officer under an earl, to whom, during his attendance at court, he acted as deputy to look after the affairs of the country. But the name was afterwards made uſe of as an arbitrary title of honour, without any ſhadow of office pertaining to it, by Henry VI; when, in the 18th year of his reign, he created John Beaumont a peer by the name of *viſcount Beaumont*; which was the firſt inſtance of the kind.

A viſcount is created by patent as an earl is; his title is *Right Honourable*; his mantle is two doublings and a half of plain fur; and his coronet has only a row of pearls cloſe to the circle.

VISCUM, in botany; a genus of plants of the claſs *diœcia*, order *tetrandria*, and in the natural ſyſtem arranged under the 48th order, *aggregatæ*. The male calyx is quadripartite; the antheræ adhere to the calyx: the female calyx conſiſts of four leaves; there is no ſtyle; the ſtigma is obtuſe. There is no corolla; the fruit is a berry with one ſeed. There are 9 ſpecies; only one of which is a native of Britain, viz. the *album*, or common miſſeltoe. It is a ſhrub growing on the bark of ſeveral trees: the leaves are conjugate and elliptical, the ſtem forked; the flowers whitiſh in the alæ of the leaves. This plant was reckoned ſacred among the druids.

VISHNOU, that perſon in the triad of the Bramins who is conſidered as the *preſerver* of the univerſe. *Brahma* is the creator and *Siva* the deſtroyer; and theſe two, with Viſhnou, united in ſome inexplicable manner, conſtitute *Brahme*, or the ſupreme numen of the Hindoos. See POLYTHEISM, n° 36.

VISIBLE, ſomething that is an object of ſight or viſion; or ſomething whereby the eye is affected ſo as to produce this ſenſation.

VISIER, an officer or dignitary in the Ottoman empire, wherof there are two kinds; one called by the Turks *Viſier-azem*, that is, "grand viſier," is the prime miniſter of ſtate in the whole empire. He commands the army in chief, and preſides in the divan or great council. Next to him are ſix other ſubordinate viſiers, called *viſiers of the bench*; who officiate as his counſellors or aſſeſſors in the divan.

VISION, in optics, the act of ſeeing or perceiving external objects by means of the organ of ſight, the eye. See ANATOMY, n° 142, and METAPHYSICS, n° 49—54.

VISTULA, or WEISEL, a large river of Poland, which taking its riſe in the mountains ſouth of Sileſia, viſits Cracow, Warſaw, &c. and continuing its courſe northward, falls into the Baltic ſea below Dantzic.

VISUAL, in general, ſomething belonging to viſion.

VITAL, in phyſiology, an appellation given to whatever miniſters principally to the conſtituting or maintaining life in the bodies of animals: thus the heart, lungs, and brain, are called *vital parts*; and the operations of theſe parts by which the life of animals is maintained are called *vital functions*.

VITALIANO (Donati), an eminent naturaliſt, was born in Padua the 8th of September 1717. He ſhowed from his childhood the greateſt inclination for botany and natural hiſtory; and, at the age of twelve years, knew all the medicinal plants, and had made a collection of natural productions. When ſome years older, he profited by the friendſhip of the celebrated Pontedero, and was generouſly furniſhed with books and information by the living profeſſor Valliſneri junior. His beſt maſters were, however, his own mountain and maritime peregrinations; which he began in Dalmatia in 1743, and continued for five years. He was choſen for adjutant to the marquis Poleni, public profeſſor of experimental phyſic, and cultivated under ſo great a maſter all the parts of phyſico-mathematics. With him he made a journey to Rome, and there became an intimate friend of Leprotti the papal phyſician, to whom he afterwards dedicated his *Saggio della ſtoria naturale dell' Adriatico*; a work of great merit, which count Ginanni of Ravenna endeavoured to depreciate, though with little ſucceſs. The eſſay of Donati was publiſhed in 1750, and was afterwards tranſlated into French. The fame which our author acquired induced his Sardinian majeſty to appoint him profeſſor of botany and natural hiſtory at Turin. He went there very willingly; made many excurſions among the mountains of Savoy and Genoa, and would have been happy could he always have converſed with the mountaineers, who generally are harmleſs people. The king his maſter ſent him out of the way of his enemies, whoſe envy and hatred his merit alone had raiſed; he commanded him to ſet out on a voyage to Egypt, and from thence to viſit Syria, Paleſtine, Arabia, and the Eaſt Indies, to make obſervations and to collect the rareſt productions of nature. In 1759 he was in Alexandria, ſaw Egypt as far as the great cataract of the Nile, and a great part of Paleſtine, Arabia, and Chaldea; and in all thoſe travels was expoſed to ſuffer the cruel conſequences of a bad choice which he had made of his companions. While he ſtaid at Baſſora, waiting for orders from court, he fell ill of a putrid fever, and died in a few days. The news of his death came to Turin about the end of October 1763. He left in manuſcript two volumes in folio.

VITELLUS, the yolk of an egg. See EGG.

VITIS, in botany: A genus of the claſs *pentandria*, order *monogynia*; and in the natural ſyſtem arranged under the 46th order, *pectoraceæ*. The petals cohere at the top, and are withered; the fruit is a berry with five ſeeds. There are 11 ſpecies; the moſt important of which is the *vinifera* or common vine, which has naked, lobed, ſinuated leaves.

There are a great many varieties; but a recital of their names would be tireſome without being uſeful. All the ſorts are propagated either from layers or cuttings, the former of which is greatly practiſed in England, but the latter is much preferable.

In chooſing the cuttings, you ſhould always take ſuch ſhoots of the laſt year's growth as are ſtrong and well ripened; theſe ſhould be cut from the old vine, juſt below the place where they were produced, taking a knot, or piece of the two-years wood to each, which ſhould be pruned ſmooth; then you ſhould cut off the upper part of the ſhoots, ſo as to leave the cutting about ſixteen inches long. When the piece or knot of old wood is cut at both ends, near the young ſhoot, the cutting will reſemble a little mallet; from whence Columella gives the title of *malleolus* to the vine-cuttings. In making the cuttings after this manner, there can be but one taken from each ſhoot; whereas moſt perſons cut them into lengths of about a foot, and plant them all; which is very wrong, for various reaſons too tedious to mention.

When the cuttings are thus prepared, if they are not then planted, they ſhould be placed with their lower part in the ground in a dry ſoil, laying ſome litter upon their upper parts to prevent them from drying: in this ſituation they may remain till the beginning of April (which is the beſt time for planting them); when you ſhould take them out, and waſh them from the filth they have contracted; and if you find them very dry, you ſhould let them ſtand with their lower parts in the water ſix or eight hours, which will diſtend their veſſels, and diſpoſe them for taking root. If the ground be ſtrong and inclined to wet, you ſhould open a trench where the cuttings are to be planted, which ſhould be filled with lime rubbiſh, the better to drain off the moiſture: then raiſe the borders with freſh light earth about two feet thick, ſo that it may be at leaſt a foot above the level of the ground: then you ſhould open the holes at about ſix feet diſtance from each other, putting one good ſtrong cutting into each hole, which ſhould be laid a little ſloping, that their tops may incline to the wall; but it muſt be put in ſo deep, as that the uppermoſt eye may be level with the ſurface of the ground; for when any part of the cutting is left above ground, moſt of the buds attempt to ſhoot, ſo that the ſtrength of the cuttings is divided to nouriſh ſo many ſhoots, which muſt conſequently be weaker than if only one of them grew; whereas, by burying the whole cutting in the ground, the ſap is all employed on one ſingle ſhoot, which conſequently will be much ſtronger; beſides, the ſun and air are apt to dry that part of the cutting which remains above ground, and ſo often prevents their buds from ſhooting.

Having placed the cutting into the ground, fill up the hole gently, preſſing down the earth with your foot cloſe about it, and raiſe a little hill juſt upon the top of the cutting, to cover the upper eye quite over, which will prevent it from drying. Nothing more is neceſſary but to keep the ground clear from weeds until the cuttings begin to ſhoot: at which time you ſhould look over them carefully, to rub off any ſmall ſhoots, if ſuch are produced, faſtening the firſt main ſhoot to the wall, which ſhould be conſtantly trained up, as it is extended in length, to prevent its breaking or hanging down. You muſt continue to look over theſe once in about three weeks during the ſummer ſeaſon, conſtantly rubbing off all lateral ſhoots which are produced; and be ſure to keep the ground clear from weeds, which, if ſuffered to grow, will exhauſt the goodneſs of the ſoil and ſtarve the cuttings. The Michaelmas following, if your cuttings have produced ſtrong ſhoots, you ſhould prune them down to two eyes. In the ſpring, after the cold weather is paſt, you muſt gently dig up the borders to looſe the earth; but you muſt be very careful in doing this, not to injure the roots of your vines: you ſhould alſo raiſe the earth up to the ſtems of the plants, ſo as to cover the old wood, but not ſo deep as to cover either of the eyes of the laſt year's wood. After this they will require no farther care until they begin to ſhoot: when you ſhould rub off all weak dangling ſhoots, leaving no more than the two produced from the two eyes of the laſt year's wood, which ſhould be faſtened to the wall. From this time till the vines have done ſhooting, you ſhould look them over once in three weeks or a month, to rub off all lateral ſhoots as they are produced, and to faſten the main ſhoots to the wall as they are extended in length; about the middle or latter end of July, it will be proper to nip off the tops of theſe two ſhoots which will ſtrengthen the lower eyes. During the ſummer ſeaſon you muſt conſtantly keep the ground clear from weeds: nor ſhould you permit any ſort of plants to grow near the vines, which would not only rob them of nouriſhment, but ſhade the lower parts of the ſhoots, and thereby prevent their ripening; which will not only cauſe their wood to be ſpongy and luxuriant, but render it leſs fruitful.

As ſoon as the leaves begin to drop in autumn, you ſhould prune theſe young vines again, leaving three buds to each of the ſhoots, provided they are ſtrong: otherwiſe it is better to ſhorten them down to two eyes if they are good; for it is a very wrong practice to leave much wood upon young vines, or to leave their ſhoots too long, which greatly weakens the roots: then you ſhould faſten them to the wall, ſpreading them out horizontal each way, that there may be room to train the new ſhoots the following ſummer, and in the ſpring the borders muſt be digged as before.

The uſes of the fruit of the vine for making wine, &c. are well known. The vine was introduced by the Romans into Britain, and appears formerly to have been very common. From the name of vineyard yet adhering to the ruinous ſites of our caſtles and monaſteries, there ſeem to have been few in the country but what had a vineyard belonging to them. The county of Glouceſter is particularly commended by Malmſbury in the twelfth century, as excelling all the reſt of the kingdom in the number and goodneſs of its vineyards. In the earlier periods of our hiſtory, the iſle of Ely was expreſsly denominated the *Iſle of Vines* by the Normans. Vineyards are frequently noticed in the deſcriptive accounts of doomſday; and thoſe of England are even mentioned by Bede as early as the commencement of the eighth century.

Doomſday exhibits to us a particular proof that wine was made in England during the period preceding the conqueſt. And after the conqueſt the biſhop of Ely appears to have received at leaſt three or four tuns of wine annually, as tythes, from the produce of the vineyards in his dioceſe; and to have made frequent reſervations in his leaſes of a certain quantity of wine for rent. A plot of land in London, which now forms Eaſt-Smithfield and ſome adjoining ſtreets, was withheld from the religious houſe within Aldgate by four ſucceſſive conſtables of the Tower, in the reigns of Rufus, Henry, and Stephen, and made by them into a vineyard to their great emolument and profit. In the old accounts of rectorial and vicarial revenues, and in the old regiſters of eccleſiaſtical ſuits concerning them, the tithe of wine is an article that frequently occurs in Kent, Surry, and other counties. And the wines of Glouceſterſhire, within a century after the conqueſt, were little inferior to the French in ſweetneſs. The beautiful region of Gaul, which had not a ſingle vine in the days of Cæſar, had numbers ſo early as the time of Strabo. The ſouth of it was particularly ſtocked with them; and they had even extended themſelves into the interior parts of the country: But the grapes of the latter did not ripen kindly. France was famous for its vineyards in the reign of Veſpaſian, and even exported its wines into Italy. The whole province of Narbonne was then covered with vines: and the wine-merchants of the country were remarkable for all the knaviſh dexterity of our modern brewers, tinging it with ſmoke, colouring it (as was ſuſpected) with herbs and noxious dyes, and even adulterating the taſte and appearance with aloes. And, as our firſt vines would be tranſplanted from Gaul, ſo were in all probability thoſe of the Allobroges in Franche Compte. Theſe were peculiarly fitted for cold countries. They ripened even in the froſts of the advancing winter. And they were of the ſame colour, and ſeem to have been of the ſame ſpecies, as the black Muſcadines of the preſent day, which have lately been tried in the iſland, I think, and found to be fitteſt for the climate. Theſe were pretty certainly brought into Britain a little after vines had been carried over all the kingdoms of Gaul, and about the middle of the third century; when the numerous plantations had gradually ſpread over the face of the latter, and muſt naturally have continued their progreſs into the former.

The Romans, even nearly to the days of Lucullus, were very ſeldom able to regale themſelves with wine. Very little was then raiſed in the compaſs of Italy. And the foreign wines were ſo dear, that they were rarely produced at an entertainment; and when they were, each gueſt was indulged only with a ſingle draught. But in the ſeventh century of Rome, as their conqueſts augmented the degree of their wealth, and enlarged the ſphere of their luxury, wines became the object of particular attention. Many vaults were conſtructed, and good ſtocks of liquor depoſited in them. And this naturally gave encouragement to the wines of the country. The Falernian roſe immediately into great repute; and a variety of others, that of Florence among the reſt, ſucceeded it about the cloſe of the century. And the more weſterly parts of the European continent were at once ſubjected to the arms, and enriched with the vines, of Italy.

But the ſcarcity of the native, and dearneſs of the foreign, wines in that country, ſeveral ages before the conqueſt of Lancaſhire, had called out the ſpirit of invention, and occaſioned the making of fictitious wines. Theſe were ſtill continued by the Romans, and naturally taught to the Britons. And they were made of almoſt all the products of the orchard and garden, the pear, the apple, mulberry, ſervis, and roſe. Two of them, therefore, were thoſe agreeable liquors which we ſtill denominate *cyder* and *perry*. The latter would be called *pyrum* by the Romans, and is therefore called *perry* or *pear-water* by us. And the former aſſumed among the Romans the appellation of *ſicera*, which was colloquially pronounced by them *ſidera*, as the ſame pronunciation of it among the preſent Italians ſhows; and retains therefore the denomination of *cyder* among ourſelves.

VITREOUS HUMOUR OF THE EYE. See ANATOMY, nº 142.

VITRIFICATION, in chemiſtry, the converſion of a body into glaſs by means of fire. See GLASS.

VITRIOL, a compound ſalt, formed by the union of iron, copper, or zinc with the ſulphuric acid. It is of three colours, white, blue, and green, according to the metal. See CHEMISTRY-*Index*.

VITRIOLATED, among chemiſts, ſomething impregnated, or ſuppoſed to be ſo, with vitriol or its acid.

VITRIOLIC ACID. See *SULPHURIC Acid* and CHEMISTRY-*Index*.

VITRUVIUS POLLIO (Marcus), a very celebrated Roman architect, was, according to the common opinion, born at Verona, and lived in the reign of Auguſtus, to whom he dedicated his excellent treatiſe on architecture, divided into ten books. William Philander's edition of this celebrated work is eſteemed. Claudius Perrault has given an excellent tranſlation of it in French, with learned notes. There are alſo ſeveral Engliſh tranſlations of Vitruvius.

VITUS's DANCE. See MEDICINE, nº 284.

VIVERRA, THE WEASEL; a genus of quadrupeds belonging to the order of feræ. They have ſix fore-teeth, the intermediate ones being ſhorter, and more than three grinders, and the claws are exſerted. There are 27 ſpecies, the principal of which are,

1. The ichneumon, with the tail tapering to a point, and the toes diſtant from each other; inhabits Egypt, Barbary, India and its iſlands. It is there a moſt uſeful animal, being an inveterate enemy to the ſerpents and other noxious reptiles which infeſt the torrid zone: it attacks without dread that moſt fatal of ſerpents the Naja, or Cobra de Capello; and ſhould it receive a wound in the combat, inſtantly retires, and is ſaid to obtain an antidote from a certain herb (according to Sparmann the *ophiorhiza*); after which it returns to the attack, and ſeldom fails of victory: it is a great deſtroyer of the eggs of crocodiles, which it digs out of the ſand; and even kills multitudes of the young of thoſe terrible reptiles: it was not therefore without reaſon that the ancient Egyptians ranked the ichneumon among their deities. This animal is at preſent domeſticated and kept in houſes in India and in Egypt, for it is more uſeful than a cat in deſtroying rats and mice; and grows very tame. It is very active; ſprings with great agility on its prey; will glide along the ground like a ſerpent, and ſeem as if without feet. It ſits up like a ſquirrel, and eats with its fore-feet, catching any thing that is flung to it. It is a great enemy to poultry, and will ſeign itſelf dead till they come within reach: loves fiſh; draws its prey, after ſucking the blood, to its hole. Its excrements are very fetid; when it ſleeps, it brings its head and tail under its belly, appearing like a round ball, with two legs ſticking out. Rumphius obſerves how ſkilfully it ſeizes the ſerpents by the throat, ſo as to avoid receiving an injury; and Lucan beautifully deſcribes the ſame addreſs of this animal in conquering the Egyptian aſp.

2. The vulpecula, or ſtifling weaſel, has a ſhort ſlender noſe; ſhort ears and legs; black body, full of hair; the tail long, of a black and white colour; length from noſe to tail about 18 inches. It inhabits Mexico, and perhaps other parts of America. This and ſome other ſpecies are remarkable for the peſtiferous, ſuffocating, and moſt fetid vapour they emit from behind, when attacked, purſued, or frightened: it is their only means of defence. Some turn their tail to their enemy, and keep them at a diſtance by a frequent crepitus; and others ejaculate their urine, tainted with the horrid effluvia, to the diſtance of 18 feet. The purſuers are ſtopped with the terrible ſtench. Should any of this liquor fall into the eyes, it almoſt occaſions blindneſs: if on the clothes, the ſmell will remain for ſeveral days, in ſpite of all waſhing; they muſt even be buried in freſh ſoil, in order to be ſweetened. Dogs that are not true bred, run back as ſoon as they perceive the ſmell: thoſe that have been uſed to it, will kill the animal; but are often obliged to relieve themſelves by thruſting their noſes into the ground. There is no bearing the company of a dog that has killed one for ſeveral days. Profeſſor Kalm was one night in great danger of being ſuffocated by one that was purſued into a houſe where he ſlept; and it affected the cattle ſo, that they bellowed through pain. Another, which was killed by a maid-ſervant in a cellar, ſo affected her with its ſtench, that ſhe lay ill for ſeveral days; all the proviſions that were in the place were ſo tainted, that the owner was obliged to throw them away. Notwithſtanding this, the fleſh is reckoned good meat, and not unlike that of a pig; but it muſt be ſkinned as ſoon as killed, and the bladder taken carefully out. It breeds in hollow trees, or holes under ground, or in clefts of rocks; climbs trees with great agility; kills poultry; eats eggs, and deſtroys young birds.

3. The zibetha, or civet-cat, has ſhort rounded ears; the back and ſides cinereous, tinged with yellow, marked with large duſky ſpots diſpoſed in rows; the hair coarſe; that on the top of the body longeſt, ſtanding up like a mane;

the tail ſometimes wholly black; ſometimes ſpotted near the baſe; length, from noſe to tail, about two feet three inches; the tail 14 inches; the body pretty thick. It inhabits India, the Philippine Iſles, Guinea, Ethiopia, and Madagaſcar. The famous drug muſk, or civet, which is produced from an aperture between the privities and the anus, in both ſexes, is ſecreted from certain glands. The perſons who keep them procure the muſk by ſcraping the inſide of this bag twice a-week with an iron ſpatula, and get about a dram each time: but it is ſeldom ſold pure, being generally mixed with ſuet or oil, to make it more weighty. The males yield the moſt, eſpecially when they are previouſly irritated. They are fed, when young, with pap made of millet, with a little fleſh or fiſh; when old, with raw fleſh. In a wild ſtate, they prey on fowl. Theſe animals ſeem not to be known to the ancients: it is probable the drug was brought without their knowing its origin; for it is certain the fine gentlemen in Rome uſed perfumes.

VIVES, in farriery. See there, § xiv.

VIVIPAROUS, in natural hiſtory, an epithet applied to ſuch animals as bring forth their young alive and perfect; in contradiſtinction to thoſe that lay eggs, which are called *oviparous* animals.

UKRAINE, a large country of Europe, lying on the borders of Turkey in Europe, Poland, Ruſſia, and Little Tartary. Its name properly ſignifies a *frontier*. By a treaty between Ruſſia and Poland in 1693, the latter remained in poſſeſſion of all that part of the Ukraine lying on the weſt ſide of the river Dnieper, which is but indifferently cultivated; while the country on the eaſt ſide, inhabited by the Coſſacs, is in much better condition. The Ruſſian part is compriſed in the government of Kiof; and the empreſs of Ruſſia having obtained the Poliſh palatinate of Kiof, by the treaty of partition in 1793, the whole of the Ukraine, on both ſides of the Dnieper, belongs now to that ambitious and formidable power. The principal town is Kiof.

ULCER, in ſurgery. See Chap. IV. Sect. 1.

ULCER, in farriery. See FARRIERY, Sect. 28.

ULEX, in botany: A genus of plants of the claſs of *diadelphia*, and order of *decandria*; and in the natural ſyſtem arranged under the 32d order, *Papilionaceæ*. The calyx conſiſts of two leaves quinquedentate: pod almoſt covered by the calyx. There are two ſpecies; one of which, the *Europæus*, the furze, gorſe, or whin, is a native of Britain; it is too well known to need deſcription. Its uſes, however, are many; as a fuel where wood and coals are ſcarce; and as hedge-wood upon light barren land: its uſe as horſe provender too ſeems to be fully proved though not yet eſtabliſhed. See AGRICULTURE, n° 47. and FENCE.

ULIETEA, one of the Society Iſlands. This iſland is about 21 leagues in circuit. Its productions are plantains, cocoa nuts, yams, hogs, and fowl; the two latter of which are ſcarce. The ſoil on the top of one of the hills was found to be a kind of ſtone marle; on the ſides were found ſome ſcattered flints, and a few ſmall pieces of a cavernous or ſpongy ſtone lava, of a whitiſh colour, which ſeemed to contain ſome remains of iron, ſo that it may poſſibly be here lodged in the mountains in a great quantity. Nothing was ſeen on this iſland to diſtinguiſh either its inhabitants, or their manners, from the other neighbouring iſlands. The firſt Europeans who landed on this ſhore were Mr (now Sir Joſeph) Banks and Dr Solander; they were received by the natives in the moſt courteous manner, reports concerning them having been their harbingers from Otaheite. Every body ſeemed to fear and reſpect them, placing in them at the ſame time the utmoſt confidence: behaving, as if conſcious that their viſitors poſſeſſed the power of doing them miſchief without a diſpoſition to make uſe of it.

ULIGINOUS, in agriculture, an appellation given to a moiſt, mooriſh, and fenny ſoil.

ULLAGE, in gauging, is ſo much of a caſk or other veſſel as it wants of being full.

ULM, a free and imperial city of Germany, in the circle of Swabia, ſeated on the river Iller. It is a pretty large place, defended by fortifications; and the inhabitants are Proteſtants. Here the archives of the circle are depoſited, and it carries on a very great trade. The elector of Bavaria became maſter of it, in 1702, by a ſtratagem; but, in 1704, the French being vanquiſhed at the battle of Hochſtet, the Bavarians ſurrendered it by capitulation. The Roman Catholics have but two churches, all the reſt belonging to the Proteſtants. E. Long. 10. 12. N. Lat. 48. 25.

ULMUS, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *digynia*; and in the natural ſyſtem arranged under the 53d order, *Scabridæ*. The calyx is quinquefid; there is no corolla. The fruit is a dry, compreſſed, membranaceous berry. There are three ſpecies, one of which is a native of Britain. The *campeſtris*, common elm. The leaves are rough, oval, pointed, doubly ſerrated, unequal at the baſe. Bark of the trunk cracked and wrinkled. Fruit membranous. The *montana*, or wych elm, is generally reckoned a variety of this ſpecies.

All the ſorts of elm may be either propagated by layers or ſuckers taken from the roots of the old trees, the latter of which is generally practiſed by the nurſery-gardeners: but as theſe are often cut up with indifferent roots, they often miſcarry, and render the ſucceſs doubtful; whereas thoſe which are propagated by layers are in no hazard, and always make better roots, and come on faſter than the other, and do not ſend out ſuckers from their roots in ſuch plenty, for which reaſon this method ſhould be more univerſally practiſed.

The elm delights in a ſtiff ſtrong ſoil. It is obſervable, however, that here it grows comparatively ſlow. In light land, eſpecially if it be rich, its growth is very rapid; but its wood is light, porous, and of little value, compared with that which grows upon ſtrong land; which is of a cloſer ſtronger texture, and, at the heart, will have the colour, and almoſt the heavineſs and the hardneſs, of iron: On ſuch ſoils the elm becomes profitable, and is one of the trees which ought in preference to all others to engage the planter's attention.

ULSTER, the moſt northerly province of Ireland. In Latin it is called *Ultonia*, in Iriſh *Cui Guilly*; and gives the title of *earl* to the dukes of York of the royal family. It is bounded by the Atlantic Ocean on the weſt, St George's Channel and the Iriſh Sea on the eaſt, the Deucaledonian Ocean on the north, and on the ſouth and ſouth-weſt the provinces of Leinſter and Connaught. Its greateſt length is near 120 miles, its breadth about 100; and its circumference, including the windings and turnings, 460; containing 9 counties, 58 market-towns and boroughs, 1 archbiſhopric, 6 biſhoprics, and 214 pariſhes. Ulſter abounds in lakes and rivers, which ſupply it with variety of fine fiſh, eſpecially ſalmon, beſides what it has from the ſea, with which a great part of it is bounded. The ſouthern parts of it are rich, fertile, well cultivated, and incloſed; but the greater part of the northern is open and mountainous.— The towns of this province are in general the neateſt and beſt built of any in Ireland, as well as the farm houſes; which in moſt parts of the kingdom are conſtructed of no better materials than clay and ſtraw. The inhabitants of Ulſter are alſo more like the Engliſh in their manners and dialect than thoſe of the other three provinces: for as it includes within itſelf the whole, or by far the greater part, of the linen manufactory, the beſt branch of trade in the kingdom, they have conſequently the greateſt intercourſe with England. An Engliſhman, in ſome parts of it, indeed, will imagine himſelf, from the ſimilarity of their language and manners, in his own country. This province had anciently petty kings of its own. It was firſt ſubjected to the Engliſh in the reign of Henry II. by John Courcy, the firſt who bore the title of *earl of Ulſter*; but it afterwards threw off the yoke, and was never entirely reduced till the reign of James I. when great numbers of Scots by his encouragement went and ſettled in it. Of theſe, moſt of the preſent inhabitants are the deſcendants. This province was the firſt and principal ſcene of the bloody maſſacre in 1641.

ULTERIOR, in geography, is applied to ſome part of a country or province, which, with regard to the reſt of that country, is ſituated on the farther ſide of the river, mountain, or other boundary, which ſeparates the two countries.

ULTRAMARINE, a beautiful blue colour uſed by the painters, prepared from the lapis lazuli by calcination.

ULTRAMONTANE, ſomething beyond the mountains. The term is principally applied in relation to France and Italy, which are ſeparated by the Alps.

ULVA, in botany; a genus of plants of the claſs of *cryptogamia*, and order of *algæ*. The fructification is incloſed in a diaphanous membrane. There are 17 ſpecies; 12 of which are Britiſh plants.

They are all ſeſſile, and without roots, and grow in ditches and on ſtones along the ſea-coaſt. None of them are applied to any particular uſe different from the reſt of the algæ, except perhaps the *umbilicalis*, which in England is pickled with ſalt and preſerved in jars, and afterwards ſtewed and eaten with oil and lemon-juice. This ſpecies, called in Engliſh the *navel laver*, is flat, orbicular, ſeſſile, and coreaceous.

ULUG BEIG, a Perſian prince and learned aſtronomer, was deſcended from the famous Tamerlane, and reigned at Samarcand about 40 years; after which he was murdered by his own ſon in 1449. His catalogue of the fixed ſtars, rectified for the year 1434, was publiſhed at Oxford by Mr Hyde, in 1665, with learned notes. Mr Hudſon printed in the Engliſh Geography, Ulug Beig's Tables of the Longitude and Latitude of Places; and Mr Greaves publiſhed, in Latin, his Aſtronomical Epochas, at London, in 1650. See ASTRONOMY-*Index*.

ULYSSES, king of Ithaca, the ſon of Laertes, and father of Telemachus, and one of thoſe heroes who contributed moſt to the taking of Troy. After the deſtruction of that city, he wandered for 10 years; and at laſt returned to Ithaca, where, with the aſſiſtance of Telemachus, he killed Antinous and other princes who intended to marry his wiſe Penelope and ſeize his dominions. He at length reſigned the government of the kingdom to his ſon Telemachus; and was killed by Telegonus, his ſon by Circe, who did not know him. This hero is the ſubject of the Odyſſey.

UMBELLA, an UMBEL, in botany: A ſpecies of receptacle; or rather a mode of flowering, in which a number of ſlender footſtalks proceed from the ſame centre, and riſe to an equal height, ſo as to form an even and generally round ſurface at top. See BOTANY.

UMBELLATÆ, the name of a claſs in Ray's and Tournefort's methods, conſiſting of plants whoſe flowers grow in umbels, with five petals that are often unequal, and two naked ſeeds that are joined at top and ſeparated below.

The ſame plants conſtitute the 45th order of Linnæus's Fragment's of a Natural Method. See BOTANY.

UMBELLIFEROUS PLANTS, are ſuch as have their tops branched and ſpread out like an umbrella.

UMBER, or UMBRE, in natural hiſtory, a foſſil brown or blackiſh ſubſtance, uſed in painting; ſo called from *Ombria*, the ancient name of the duchy of Spoleto in Italy, whence it was firſt obtained; diluted with water, it ſerves to make a dark brown colour, uſually called with us an *hair colour*.

Dr Hill and Mr da Coſta conſider it as an earth of the ochre kind. It is found in Egypt, Italy, Spain, and Germany; in Cyprus alſo it is found in large quantities; but what we have brought into England is principally from different parts of the Turkiſh dominions. But it might be found in conſiderable plenty alſo in England and Ireland, if properly looked after, ſeveral large maſſes of it having been thrown up in digging on Mendip hills in Somerſetſhire, and in the county of Wexford in Ireland: it is alſo ſometimes found in the veins of lead-ore both in Derbyſhire and Flintſhire.

UMBILICAL, among anatomiſts, ſomething relating to the umbilicus or navel.

UMBRELLA, a moveable canopy, made of ſilk or other cloth ſpread out upon ribs of whale-bone, and ſupperſed by a ſtaff, to protect a perſon from rain, or the ſcorching beams of the ſun.

UMPIRE, a third perſon choſen to decide a controverſy left to arbitration.

UNCIA, in general, a Latin term, denoting the twelfth part of any thing; particularly the twelfth part of a pound, called in Engliſh an *ounce*; or the twelfth part of a foot, called an *inch*.

UNCTION, the act of anointing or rubbing with oil or other fatty matter.

UNCTION, in matters of religion, is uſed for the character conferred on ſacred things by anointing them with oil. Unctions were very frequent among the Hebrews. They anointed both their kings and high-prieſts at the ceremony of their inauguration. They alſo anointed the ſacred veſſels of the tabernacle and temple, to ſanctify and conſecrate them to the ſervice of God. The unction of kings is ſuppoſed to be a ceremony introduced very late among the Chriſtian princes. It is ſaid that none of the emperors were ever anointed before Juſtinian or Juſtin. The emperors of Germany took the practice from thoſe of the eaſtern empire: king Pepin of France was the firſt who received the unction. In the ancient Chriſtian church, unction always accompanied the ceremonies of baptiſm and confirmation. Extreme unction, or the anointing perſons in the article of death, was alſo practiſed by the ancient Chriſtians, in compliance with the precept of St James, chap. v. 14th and 15th verſes; and this extreme unction the Romiſh church has advanced to the dignity of a ſacrament. It is adminiſtered to none but ſuch as are affected with ſome mortal diſeaſe, or in a decrepit age. It is refuſed to impenitent perſons, as alſo to criminals. The parts to be anointed are the eyes, the ears, the noſtrils, the mouth, the hands, the feet, and the reins. The laity are anointed in the palms of the hands, but prieſts on the back of it; becauſe the palms of their hands have been already conſecrated by ordination.

The oil with which the ſick perſon is anointed repreſents the grace of God, which is poured down into the ſoul, and the prayer uſed at the time of anointing expreſſes the remiſſion of ſins thereby granted to the ſick perſon; for the prayer is this: "By this holy unction, and his own moſt pious mercy, may the Almighty God forgive thee whatever ſins thou haſt committed *by the ſight*," when the eyes are anointed; *by the hearing*, when the ears are anointed; and ſo of the other ſenſes*.

UNDECAGON, is a regular polygon of 11 ſides.

* The Sincere Chriſtian inſtructed from the Written Word.

UNDECEMVIR, a magiſtrate among the ancient Athenians, who had 10 other colleagues or aſſociates joined with him in the ſame commiſſion. The functions of the undecemviri at Athens were much the ſame as thoſe of the late *prevots de marechauſſe* in France. They took care of the apprehending of criminals; ſecured them in the hands of juſtice; and when they were condemned, took them again into cuſtody, that the ſentence might be executed on them. They were choſen by the tribes, each tribe naming its own; and as the number of the tribes after Calliſthenes was but 10, which made 10 members, a ſcribe or notary was added, which made the number 11.

UNDERSTANDING. See METAPHYSICS and LOGIC.

UNDERWALD, a canton of Swiſſerland, and the ſixth in rank. It is bounded on the north by the canton of Lucern and by the Lake of the Four Cantons, on the eaſt by the high mountains which ſeparate it from the canton of Bern, and on the weſt by the canton of Bern. The religion of this canton is the Roman Catholic.

UNDERWOOD, is coppice, or any wood that is not accounted timber.

UNDULATION, in phyſics, a kind of tremulous motion or vibration obſervable in a liquid, whereby it alternately riſes and falls like the waves of the ſea.

UNGUENT, in medicine and ſurgery, a topical remedy or compoſition, chiefly uſed in the dreſſing of wounds or bliſters. See PHARMACY, nº 635.

UNICORN, an animal famous among the ancients, and thought to be the ſame with the rhinoceros. See RHINOCEROS.

Sparmann informs us, that the figure of the unicorn deſcribed by the ancients has been found delineated by the Sneſe Hottentots on the plain ſurface of a rock in Caffraria; and therefore conjectures, that ſuch an animal either does exiſt at preſent in the internal parts of Africa, or at leaſt once did ſo. Father Lobo affirms that he has ſeen it.

UNICORN-Fiſh. See MONODON.

UNIFORM, denotes a thing to be ſimilar, or conſiſtent either with another thing, or with itſelf, in reſpect of figure, ſtructure, proportion, or the like; in which ſenſe it ſtands oppoſed to difform.

UNIFORMITY, regularity, a ſimilitude or reſemblance between the parts of a whole. Such is that we meet with in figures of many ſides, and angles reſpectively equal, and anſwerable to each other. A late ingenious author makes beauty to conſiſt in uniformity, joined or combined with variety. Where the uniformity is equal in two objects, the beauty, he contends, is as the variety; and where the variety is equal, the beauty is as the uniformity.

UNIFORMITY, is particularly uſed for one and the ſame form of public prayers, and adminiſtration of ſacraments, and other rites, &c. of the church of England, preſcribed by the famous ſtat. 1 Eliz. and 13 and 14 Car. II. cap. 4. called the *Act of Uniformity*. See LITURGY.

UNION, a junction,, coalition, or aſſemblage of two or more different things in one.

UNION, or *The Union*, by way of eminence, is more particularly uſed to expreſs the act by which the two ſeparate kingdoms of England and Scotland were incorporated into one, under the title of *The kingdom of Great Britain*. This union, in vain attempted by king James I. was at length effected in the year 1707, 6 Annæ, when 25 articles were agreed to by the parliament of both nations; the purport of the moſt conſiderable being as follows:

1. That on the firſt of May 1707, and for ever after, the kingdoms of England and Scotland ſhall be united into one kingdom, by the name of *Great Britain*.

2. The ſucceſſion to the monarchy of Great Britain ſhall be the ſame as was before ſettled with regard to that of England.

3. The united kingdom ſhall be repreſented by one parliament.

4. There ſhall be a communication of all rights and privileges between the ſubjects of both kingdoms, except where it is otherwiſe agreed.

9. When England raiſes 2,000,000l. by a land tax, Scotland ſhall raiſe 48,000l.

16, 17. The ſtandards of the coin, of weights, and of meaſures, ſhall be reduced to thoſe of England throughout the united kingdoms.

18. The laws relating to trade, cuſtoms, and the exciſe, ſhall be the ſame in Scotland as in England. But all the other laws of Scotland ſhall remain in force; but alterable by the parliament of Great Britain. Yet with this caution, that laws relating to public policy are alterable at the diſcretion of the parliament; laws relating to private right are not to be altered but for the evident utility of the people of Scotland.

22. Sixteen peers are to be choſen to repreſent the peerage of Scotland in parliament, and 45 members to ſit in the houſe of commons.

23. The 16 peers of Scotland ſhall have all privileges of parliament; and all peers of Scotland ſhall be peers of Great Britain, and rank next after thoſe of the ſame degree at the time of the union, and ſhall have all privileges of peers, except ſitting in the houſe of lords, and voting on the trial of a peer.

Theſe are the principal of the 25 articles of union, which are ratified and confirmed by ſtatute 5 Ann. c. 8. in which ſtatute there are alſo two acts of parliament recited; the one of Scotland, whereby the church of Scotland, and alſo the four univerſities of that kingdom, are eſtabliſhed for ever, and all ſucceeding ſovereigns are to take an oath inviolably to maintain the ſame; the other of England, 5 Annæ, c. 6. whereby the acts of uniformity of 13 Eliz. and 13 Car. II. (except as the ſame had been altered by parliament at that time), and all other acts then in force for the preſervation of the church of England, are declared perpetual; and it is ſtipulated, that every ſubſequent king and queen ſhall take an oath inviolably to maintain the ſame within England, Ireland, Wales, and the town of Berwick upon Tweed. And it is enacted, that theſe two acts "ſhall for ever be obſerved as fundamental and eſſential conditions of the union."

Upon theſe articles and act of union, it is to be obſerved, 1. That the two kingdoms are ſo inſeparably united, that nothing can ever diſunite them; except the mutual conſent of both, or the ſucceſsful reſiſtance of either, upon apprehending an infringement of thoſe points which, when they were ſeparate and independent nations, it was mutually ſtipulated ſhould be "fundamental and eſſential conditions of the union." 2. That whatever elſe may be deemed "fundamental and eſſential conditions," the preſervation of the two churches, of England and Scotland, in the ſame ſtate that they were in at the time of the union, and the maintenance of the acts of uniformity which eſtabliſhed the liturgy, are expreſsly declared ſo to be. 3. That therefore any alteration in the conſtitution of either of theſe churches, or in the liturgy of the church of England (unleſs with the conſent of the reſpective churches, collectively or repreſentatively given), would be an infringement of theſe "fundamental and eſſential conditions," and greatly endanger the union. 4. That the municipal laws of Scotland are ordained to be ſtill obſerved in that part of the iſland, unleſs altered by parliament; and as the parliament has not yet thought proper, except in a few inſtances, to alter them, they ſtill, with regard to the particulars unaltered, continue in full force.

UNISON, in muſic. See INTERVAL.

UNIT, or UNITY, in arithmetic, the number one; or one ſingle individual part of diſcrete quantity.

UNITARIANS, in eccleſiaſtical hiſtory, a name given to thoſe who confine the glory and attribute of divinity to the One only great and ſupreme God, and Father of our Lord Jeſus Chriſt

UNITED BRETHREN, or *UNITAS Fratrum*, in eccleſiaſtical hiſtory, a church of which many of our readers will think that an account ſufficiently full has been given under the word HERRNHUT. With that account, however, ſome of the brethren have expreſſed themſelves diſſatisfied, in terms which might, without impropriety, be called ſtrong; and the preſent Editor of this work, being convinced by his own experience how difficult it is to extract pure and unſophiſticated truth from the perplexed writings of angry polemics, reſolved, when he entered upon his laborious taſk, to permit every ſect of Chriſtians to plead its own cauſe, upon the ſingle condition of not loading its opponents with opprobrious epithets. He hopes therefore that the public will forgive him for inſerting the following account of the riſe, progreſs, worſhip, and diſcipline, of the church of the *United Brethren*, extracted from a manuſcript ſent to him by one of their clergy. He has faithfully abridged the narrative of his author; but does not conſider himſelf as under any obligation either to maintain its truth, or to convict it of falſehood.

According to this writer, the church of the United Brethren took its riſe in Moravia during the 14th century; though in the ſentence immediately following this aſſertion, he ſays, that it derived its origin from the Greek church in the 9th century, when, by the inſtrumentality of Methodius and Cyrillus, two Greek monks, the kings of Bulgaria and Moravia being converted to the faith, were, together with their ſubjects, united in communion with the Greek church. Methodius was their firſt biſhop; and for their uſe Cyrillus tranſlated the Scriptures into the Sclavonian language.

The antipathy of the Greek and Roman churches is well known; and by much the greater part of the brethren were in proceſs of time compelled, after many ſtruggles, to ſubmit to the ſee of Rome. A few, however, adhering to the rites of their mother church, united themſelves in 1176 to the Waldenſes, and ſent miſſionaries into many countries. In 1457 they were called *fratres legis Chriſti*, or brethren of the law of Chriſt, becauſe about that period they had thrown off all reverence for human compilations of the faith, profeſſing ſimply to follow the doctrines and precepts contained in the word of God.

There being at this time no biſhops in the Bohemian church who had not ſubmitted to the papal juriſdiction, three prieſts of the ſociety of United Brethren were, about the year 1467, conſecrated by Stephen biſhop of the Waldenſes in Auſtria (ſee WALDENSES); and theſe prelates, on their return to their own country, conſecrated ten co-biſhops, or conſeniors, from among the reſt of the preſbyters. In 1523, the United Brethren commenced a friendly correſpondence, firſt with Luther, and afterwards with Calvin and other leaders among the Reformers. A perſecution, which was brought upon them on this account, and ſome religious diſputes which took place among themſelves, threatened for a while the ſociety with ruin; but the diſputes were in 1570 put an end to by a ſynod, which decreed that differences about non-eſſentials ſhould not deſtroy their union; and the perſecution ceaſed in 1575, when the United Brethren obtained an edict for the public exerciſe of their religion. This toleration was renewed in 1609, and liberty granted them to erect new churches. But a civil war which in 1612 broke out in Bohemia, and a violent perſecution which followed it in 1621, occaſioned the diſperſion of their miniſters, and brought great diſtreſs upon the Brethren in general. Some of them fled to England, others to Saxony and Brandenburg, whilſt many, overcome by the ſeverity of the perſecution, conformed to the rites of the church of Rome. One colony of theſe, who retained in purity their original principles and practice, was, in 1722, conducted by a brother named *Chriſtian David*, from Fulneck in Moravia to Upper Luſatia, where they put themſelves under the protection of NICHOLAS LEWIS COUNT OF ZINZENDORF, and built a village on his eſtate, at the foot of a hill called *Hutberg*, or "Watch Hill" (ſee HERRNHUT). The count, who ſoon after their arrival removed from Dreſden to his eſtate in the country, ſhowed every mark of kindneſs to the poor emigrants; but being a zealous member of the church eſtabliſhed by law, he endeavoured for ſome time to prevail upon them to unite themſelves with it, by adopting the Lutheran faith and diſcipline. This they declined; and the count, on a more minute inquiry into their ancient hiſtory and diſtinguiſhing tenets, not only deſiſted from his firſt purpoſe, but became himſelf a convert to the faith and diſcipline of the United Brethren.

The ſynod, which in 1570 put an end to the diſputes which then tore the church of the Brethren into factions, had conſidered as non-eſſentials the diſtinguiſhing tenets of their own ſociety, of the Lutherans, and of the Calviniſts. In conſequence of this, many of the Reformers of both theſe ſects had followed the Brethren to Herrnhut, and been received by them into communion; but not being endued with the peaceable ſpirit of the church which they had joined, they ſtarted diſputes among themſelves, which threatened the deſtruction of the whole eſtabliſhment. By the indefatigable exertions of Count Zinzendorf theſe diſputes were allayed; and ſtatutes being in 1727 drawn up and agreed to for the regulation both of the internal and of the external concerns of the congregation, brotherly love and union was again eſtabliſhed; and no ſchiſm whatever, in points of doctrine, has ſince that period diſturbed the church of the United Brethren.

In 1735 the Count, who under God had been the inſtrument of renewing the Brethren's church, was conſecrated one of their biſhops, having the year before been examined and received into the clerical orders by the Theological Faculty of Tubingen. Dr Potter, then archbiſhop of Canterbury, congratulated him upon this event, and promiſed his aſſiſtance to a church of confeſſors, of whom he wrote in terms of the higheſt reſpect for their having maintained the pure and primitive faith and diſcipline in the midſt of the moſt tedious and cruel perſecutions. That his Grace, who had ſtudied the various controverſies about church-government with uncommon ſucceſs, admitted the Moravian epiſcopal ſucceſſion, we know from the moſt unqueſtionable authority; for he communicated his ſentiments on the ſubject to Dr Secker while biſhop of Oxford, and from his Lordſhip they came through a dignitary of the church of England to the compiler of this article. In conformity with theſe ſentiments of the archbiſhop, we are aſſured that the parliament of Great Britain, after mature inveſtigation, acknowledged the *Unitas Fratrum* to be a Proteſtant epiſcopal church; and in 1794 an act was certainly paſſed in their favour.

We have elſewhere (ſee HERRNHUT) mentioned the fa-

favourable report that was made to the court of Dreſden by a deputation which was appointed to examine into the principles and practices of the United Brethren; of which the conſequence was, a toleration through all Saxony, as well as in Upper Luſatia. It is, however, acknowledged by the author of the manuſcript which we are abridging, that ſome of the converts to the faith and diſcipline of the *Unitas Fratrum*, having previouſly imbibed extravagant notions, propagated them with zeal among their new friends in a phraſeology extremely reprehenſible; and that Count Zinzendorf himſelf ſometimes adopted the very improper language of thoſe fanatics, whom he wiſhed to reclaim from their errors to the ſoberneſs of truth; but it is added, that much of the extravagance and abſurdity which has been attributed to the Count, is not to be charged to him, but to thoſe perſons who, writing his *extempore* ſermons in ſhort hand, printed and publiſhed them without his knowledge or conſent. This account of the matter appears indeed extremely probable; and it is but juſtice to the Count to acknowledge, that he ſeems to have been very deſirous to diſclaim the improper expreſſions, and to vindicate his church from countenancing that impurity which, whether juſtly or not, was attributed to himſelf.

This eminent benefactor to the United Brethren died in 1760; and it is with reaſon that they honour his memory, as having been the inſtrument by which God reſtored and built up their church, But they do not regard him as their head, nor take his writings, nor the writings of any other man, as the ſtandard of their doctrines, which they profeſs to derive immediately from the word of God.

It has been already obſerved, that the church of the United Brethren is epiſcopal; but though they conſider epiſcopal ordination as neceſſary to qualify the ſervants of the church for their reſpective functions, they allow to their biſhops no elevation of rank or pre-eminent authority; their church having from its firſt eſtabliſhment been governed by ſynods, conſiſting of deputies from all the congregations; and by other ſubordinate bodies, which they call *conferences*. The ſynods, which are generally held once in ſeven years, are called together by the elders who were in the former ſynod appointed to ſuperintend the whole unity. In the firſt ſitting a preſident is choſen, and theſe elders lay down their office; but they do not withdraw from the aſſembly, for they, together with all biſhops, *ſeniores civiles*, or lay-elders, and thoſe miniſters who have the general care or inſpection of ſeveral congregations in one province, have ſeats in the ſynod without any particular election. The other members are, one or more deputies ſent by each congregation, and ſuch miniſters or miſſionaries as are particularly called to attend. Women approved by the congregations are alſo admitted as hearers; and are called upon to give their advice in what relates to the miniſterial labour among their ſex; but they have no deciſive vote in the ſynod. The votes of all the other members are equal.

In queſtions of importance, or of which the conſequences cannot be foreſeen, neither the majority of votes nor the unanimous conſent of all preſent can decide; but recourſe is had to the *lot*. For adopting this unuſual mode of deciding in eccleſiaſtical affairs, the Brethren allege as reaſons the practices of the ancient Jews and the apoſtles; the inſufficiency of the human underſtanding amidſt the beſt and pureſt intentions to decide for itſelf in what concerns the adminiſtration of Chriſt's kingdom; and their own confident reliance on the comfortable promiſes that the Lord Jeſus will approve himſelf the head and ruler of his church. The *lot* is never made uſe of but after mature deliberation and fervent prayer; nor is any thing ſubmitted to its deciſion, which does not, after being thoroughly weighed, appear to the aſſembly eligible in itſelf.

In every ſynod the inward and outward ſtate of the unity, and the concerns of the congregations and miſſions, are taken into conſideration. If errors in doctrine or deviations in practice have crept in, the ſynod endeavours not only to remove them, but by ſalutary regulations to prevent them for the future. It conſiders how many biſhops are to be conſecrated to fill up the vacancies occaſioned by death; and every member of the ſynod gives his vote for ſuch of the clergy as he thinks beſt qualified. Thoſe who have the majority of votes are taken into the *lot*, and they who are approved are conſecrated accordingly; but by conſecration they are veſted with no ſuperiority over their Brethren, ſince it behoves him who is the greateſt to be the ſervant of all.

Towards the concluſion of every ſynod, a kind of executive board is choſen, and called *the Elder's Conference of the Unity*. At preſent it conſiſts of 13 elders, and is divided into four committees or departments: 1. The *miſſion's* department, which ſuperintends all the concerns of the miſſions into Heathen countries. 2. The *helper's* department, which watches over the purity of doctrine and the moral conduct of the different congregations. 3. The *ſervant's* department, to which the economical concerns of the Unity are committed. 4. The *overſeer's* department, of which the buſineſs is to ſee that the conſtitution and diſcipline of the Brethren be every where maintained. No reſolution, however, of any of theſe departments has the ſmalleſt force, till it be laid before the aſſembly of the whole *Elder's Conference*, and have the approbation of that body. The powers of the *Elder's Conference* are indeed very extenſive. Beſides the general care which it is commiſſioned by the ſynods to take of all the congregations and miſſions, it appoints and removes every ſervant in the unity, as circumſtances may require; authoriſes the biſhops to ordain preſbyters or deacons, and to conſecrate other biſhops; and, in a word, tho' it cannot abrogate any of the conſtitutions of the ſynod, or enact new ones itſelf, it is poſſeſſed of the ſupreme executive power over the whole body of the United Brethren.

Beſides this general conference of elders, which ſuperintends the affairs of the whole unity, there is another conference of elders belonging to each congregation, which directs its affairs, and to which the biſhops and all other miniſters, as well as the lay-members of the congregation, are ſubject. This body, which is called the *Elder's Conference of the Congregation*, conſiſts, 1. Of the *miniſter* as preſident, to whom the ordinary care of the congregation is committed, except when it is very numerous, and then the general inſpection of it is entruſted to a ſeparate perſon, called the *Congregation Helper*; 2. Of the *warden*, whoſe office it is to ſuperintend with the aid of his council all outward concerns of the congregation and to aſſiſt every individual with his advice; 3. Of a *married pair*, who care particularly for the ſpiritual welfare of the married people; 4. Of a *ſingle clergyman*, to whoſe care the young men are more particularly committed; and, 5. Of *thoſe women*, who aſſiſt in caring for the ſpiritual and temporal welfare of their own ſex, and who in this conference have equal votes with the men. As the *Elder's Conference of each Congregation* is anſwerable for its proceedings to the *Elder's Conference of the Unity*, viſitations from the latter to the former are held from time to time, that the affairs of each congregation, and the conduct of its immediate governors, may be intimately known to the ſupreme executive government of the whole church.

We have already mentioned the epiſcopacy of the Brethren,

thren, and the very limited powers of their biſhops; and have to add, that, in their opinion, epiſcopal conſecration does not confer any power to preſide over one or more congregations; and that a biſhop can diſcharge no office but by the appointment of a ſynod, or of the Elder's conference of the Unity. Preſbyters among them can perform every function of the biſhop except ordination: for if we underſtand the manuſcript before us, he confirms by the laying on of hands young perſons when they firſt become candidates for the communion. Deacons are aſſiſtants to the preſbyters much in the ſame way as in the church of England; and in the Brethren's churches deaconeſſes are retained, for the purpoſe of privately admoniſhing their own ſex, and viſiting them in their ſickneſs: but though they are ſolemnly bleſſed to this office, they are not permitted to teach in public, and far leſs to adminiſter the ſacraments. They have likewiſe *ſeniores civiles*, or lay elders, in contradiſtinction to ſpiritual elders or biſhops, who are appointed to watch over the conſtitution and diſcipline of the Unity of the Brethren; over the obſervance of the laws of the country in which congregations or miſſions are eſtabliſhed; and over the privileges granted to the Brethren by the governments under which they live. They do not conſider a regular courſe of literary education as at all neceſſary to qualify perſons for admiſſion into orders, provided they poſſeſs a thorough knowledge of the word of God, what they call *ſolid Chriſtian experience*, and a well regulated zeal to ſerve God and their neighbours.

We have mentioned elſewhere (HERRNHUT) their daily meetings in church for worſhip and edification. On Sunday, beſides the public prayers, which are either read from a liturgy or pronounced extempore by the miniſter, one or two ſermons are preached in every church or chapel; and after the morning ſervice an exhortation is given to the children. Previous to the holy communion, which is adminiſtered on ſome Sunday once a-month, and likewiſe on *Maunday Thurſday*, each perſon who intends to communicate converſes with one of the elders on the ſtate of his ſoul, expreſſing his deſire to partake of the ſacrament. The celebration of the communion is generally preceded by a *love-feaſt*, which is alſo kept on other ſolemn occaſions. On Maunday Thurſday, before communion, the Brethren have a ſolemn *foot-waſhing*; and at this, and we ſuppoſe at other times, they greet one another with *the kiſs of charity*. Theſe ceremonies they conſider as religious rites, authoriſed thro' all ages of the church by our Saviour himſelf and his two apoſtles St Peter and St Paul*.

Our limits will not permit us to give a ſyſtematic view of the doctrinal tenets of the Brethren. Though they acknowledge no other ſtandard of truth than the ſacred Scriptures, they adhere to the Augſburg Confeſſion, and ſpeak reſpectfully of the 39 articles of the church of England. They profeſs to believe that the kingdom of Chriſt is not confined to any particular party, community, or church; and they conſider themſelves, though united in one body or viſible church, as ſpiritually joined in the bond of Chriſtian love to all who are taught of God, and belong to the univerſal church of Chriſt, however much they may differ in forms, which they deem non-eſſentials. But the reader who wiſhes to have a fuller account of this ſociety of Chriſtians, we muſt refer to *Cranz's Ancient and Modern Hiſtory of the Proteſtant Church of the United Brethren*, printed in London, 1780; and to a work entitled *An expoſition of Chriſtian Doctrine as taught in the Proteſtant Church of the United Brethren*, London, 1784.

UNITED PROVINCES, or *UNITED Netherlands*, otherwiſe called the *Republic of Holland*, conſiſt of the ſeven provinces of Holland, Zealand, Frieſland, Groningen, Overyſſel, Zutphen, and Utrecht. They are bounded on the weſt by the German Ocean; on the eaſt by the circle of Weſtphalia; and on the ſouth by Flanders, Brabant, and the duchy of Cleves. They compoſe the greateſt part of the ancient Batavia, whoſe inhabitants were formerly ſo much renowned for their valour. Under the Romans they were exempt from impoſts and taxes, in conſequence of bearing the honourable title of *Allies of the Republic*.

1 Batavians in high eſteem under the Romans.

2 Fall under the dominion of Spain.

The Netherlands came into the poſſeſſion of the houſe of Auſtria by the marriage of Mary of Burgundy with the emperor Maximilian: but on that prince's reſigning the imperial crown, the 17 provinces of the Netherlands devolved of right on Don John of Spain; but he and his ſucceſſor Philip le Beau dying in a ſhort time after, they, in 1505, fell under the dominion of Charles V. at that time a minor.

At this period the ſeven provinces, which now compoſe the Republic of Holland, enjoyed a kind of independence; but the policy and warlike diſpoſition of Charles ſoon reduced them to obedience. When he reſigned the ſceptre to his ſon Philip, the Low Countries were in a moſt flouriſhing condition. In this ſmall tract of country were reckoned no fewer than 350 large cities incloſed with walls, and 6300 conſiderable towns, all become rich by their application to the arts and to commerce. At the ſame time, the love of liberty was very prevalent among the inhabitants, and they were jealous of every invaſion of their rights and privileges. The arbitrary government of Philip was therefore very diſagreeable to his ſubjects in the Low Countries, and the partiality ſhown on all occaſions to the Spaniards ſoon loſt their affections altogether.

3 Flouriſhing ſtate of the provinces at that time.

4 Perſecution of the Reformed.

The extreme ſuperſtition, however, and cruel bigotry of Philip, proved the greateſt ſource of diſcontent. The doctrines of the reformers had been preached and received with avidity in the Low Countries. A cruel perſecution of the reformed had been commenced by Charles V. inſomuch that he is ſaid to have deſtroyed no fewer than 100,000 perſons on account of religion. This cruelty had no effect except to increaſe the number of heretics; which being obſerved by Mary queen of Hungary, ſiſter to the emperor, ſhe invited him to the Low Countries, that he might perſonally behold the bad effects of his cruelty. On this the emperor granted a toleration, but Philip was altogether inflexible. In order to proceed more effectually againſt the reformed, a court of inquiſition was inſtituted; and under pretence that the three biſhoprics, which at that time comprehended the whole country, were too large, 17 of theſe dignitaries were erected, three with the title of archbiſhops. To afford ſufficient revenues for theſe, it became neceſſary to ſuppreſs ſeveral abbeys, which of itſelf produced great diſcontent. But what gave the finiſhing ſtroke to the whole was, Philip's announcing his intention of reſiding conſtantly in Spain; his appointing the ducheſs of Parma, his natural ſiſter, to be regent of the Netherlands; and giving her for a counſellor cardinal Granvele, a bloody perſecutor of the reformed; at the ſame time that the provinces were oppreſſed by the violences of foreign troops, for the payment of whom they were alſo oppreſſed by taxes. Three councils were eſtabliſhed at Bruſſels; one to preſide over the laws and courts of juſtice; a ſecond to direct every thing reſpecting peace or war; and the third to manage the revenues: but ſtill the ducheſs of Parma was ordered to conſult Granvele in every matter, and make him at all times her chief confidant.

5 Court of inquiſition eſtabliſhed.

6 Ducheſs of Parma appointed governeſs.

7 Univerſal diſcontent.

The ducheſs took upon her the government of the Low Countries in the year 1560; and was no ſooner arrived at Bruſſels, than complaints poured in from all quarters againſt the inquiſition, cardinal Granvele, and the new biſhoprics.

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* John xiii. 14. 1 Peter v. 14. Rom. xvi. 16.

The ducheſs endeavoured to allay the ferment by fair words, but in vain. At the head of the malcontents were the prince of Orange, count Egmont, and count Horn, who ſtrenuouſly inſiſted on calling an aſſembly of the States-general, and laying before them the grievances by which the country was oppreſſed. The event was, that in 1564 the cardinal was obliged to reſign his dignity; which yet did not produce any good effect, as he was ſucceeded by two of his creatures, Barlaimont and Viglius, who trod exactly in his footſteps. They puſhed on the inquiſition to freſh executions; ſtigmatized the principal nobility as heretics; and on all occaſions ſhowed ſuch violent and intolerable zeal for the Catholic religion, that one of Philip's miniſters repreſented to him the danger there was of a total revolt of the provinces, unleſs the rigours of perſecution were ſomewhat relaxed.

8
Extreme bigotry of Philip.

But Philip no ſooner received this intelligence, than he replied, "that he had rather be without ſubjects, than be a king of heretics." Agreeable to this reply, all the obnoxious decrees were enforced with double rigour; upon which the ſtate of affairs became ſo alarming, that it was thought neceſſary to ſend count Egmont into Spain, in order to have a perſonal interview with the king on the ſubject. Philip, accuſtomed to deceive, gave a ſmooth anſwer, abated the rigour of his decrees, and ordered the governante ſometimes to conſult with the prince of Orange. Thus tranquillity was for a time reſtored; but in the year 1566, it being diſcovered that a ſcheme for the total extirpation of the Proteſtants had been concerted by the queen-mother of France, her ſon Charles IX. and Iſabella queen of Spain, in a conference at Bayonne, matters became worſe than ever. That the information received concerning this deteſtable combination was true, very ſoon appeared, from Philip's diſclaiming all the favourable interpretations which had been put upon his anſwer to count Egmont, and from his ordering the inquiſition to proceed with more fury than ever.—

9
A general aſſociation againſt the inquiſition.

The conſequence of this was a general aſſociation againſt this abominable tribunal, which was ſubſcribed by all orders and degrees of men, Roman Catholics as well as Proteſtants. The confederates, headed by Henry de Brodenrode, a deſcendant of the ancient earls of Holland, waited on the ducheſs of Parma, in ſuch a formidable body, that ſhe was obliged to diſmiſs them with an abſolute promiſe that their demands ſhould be granted. Theſe demands were, that the inquiſition ſhould be aboliſhed, and the edicts againſt liberty of conſcience recalled; and for this ſhe immediately interpoſed all her intereſt with Philip. Sir William Temple alleges, that Philip, in conſequence of the governante's remonſtrances, granted all that was deſired, but too late. All other hiſtorians, however, agree that he was inflexible, and that the ducheſs could procure no better conditions than that heretics ſhould from that time forward be hanged inſtead of being burned. Even this appeared a conceſſion unworthy of the king; the royal name was therefore forbid to be uſed.

Before the confederates proceeded to extremities, they ſent deputies to Madrid; but, according to ſome authors, they were refuſed admittance into the king's preſence. It appears, however, that they had found means of repreſenting the true ſtate of affairs to the king, and of informing him that the diſturbances proceeded from the deteſtation in which the inquiſition was everywhere held in the Low Countries. Their repreſentations produced no other effect than an equivocal promiſe, which was evidently never intended to be kept.

10
The people break out into acts of rebellion.

The governante received orders to proceed againſt heretics with the utmoſt ſeverity; upon which the people broke out into acts of open rebellion. In ſeveral towns of Flanders the churches were deſtroyed, images pulled down, and all thoſe acts of violence committed which are the uſual operations of a lawleſs mob. The principal inhabitants, however, ſtill remained quiet, and even did all in their power to reſtrain the violence of the commonalty; ſo that, had Philip made any kind of reaſonable conceſſion, the public tranquillity might have been reſtored.

11
New oath of allegiance required.

Inſtead of this, however, a new oath of allegiance was adminiſtered by the governante, and all perſons were obliged to ſwear that they would regard as traitors and enemies to their country all whom the king ſhould think proper to proſcribe. This extraordinary proceeding was followed by the moſt cruel perſecution that can be imagined; at the ſame time that the duke of Alva was ſent into the Netherlands with an army of 10,000 veteran troops, to put the laſt hand to the miſery of the people, and fully to eſtabliſh the deſpotiſm of the court.

12
Prince of Orange retires.

Counts Egmont and Horn took the above mentioned oath; but the prince of Orange could by no means be induced to it, and therefore retired into Germany, along with counts Brodenrode and Hoogſtrate. Their example was followed by great numbers of all ranks and conditions; and after the arrival of the army commanded by the duke of Alva, ſuch multitudes continued to emigrate, that the ducheſs of Parma informed the king, that within a few days 100,000 families had left his dominions; that in a ſhort time the country muſt be depopulated, in which caſe there would be no occaſion for a governante; ſhe therefore begged leave to reſign, before ſhe ſhould have the mortification and diſgrace of being left alone in the Netherlands.

13
Ducheſs of Parma reſigns.

14
Is ſucceeded by the duke of Alva.

Philip immediately complied with the requeſt of the princeſs, and the duke of Alva was appointed to ſucceed her in the government. It may eaſily be imagined that the miſeries of the people would now become intolerable. The king was a proud and mercileſs tyrant, ſet at too great a diſtance from his ſubjects to be thoroughly ſenſible of their calamities, and totally deſtitute of compaſſion had he known them ever ſo well. The new governor was of the ſame diſpoſition; and the army he commanded was fierce, rapacious, and cruel, deſiring nothing more ardently than to enrich themſelves at the expence of the inhabitants. The whole country was filled with blood and horror; counts Egmont and Horn were ignominiouſly executed, and the eſtate of the prince of Orange was confiſcated. Theſe laſt proceedings drove the people into deſpair; and they invited the prince to return, in order to take upon him the defence of the country from ſuch inſufferable tyranny and oppreſſion.

15
Prince of Orange invited by the people to return.

All this time the prince of Orange, and his brother Louis of Naſſau, had been labouring to form alliances for the defence of the liberties of their country. He had repreſented matters in ſuch a light to the emperor Maximilian, that his Imperial majeſty ſent an ambaſſador to Philip, exhorting him to treat his ſubjects in the Netherlands with leſs rigour.

16
Hoſtilities commence, to the diſadvantage of the prince.

This embaſſy was haughtily received; Philip continued his perſecutions, and the prince of Orange his preparations for entering the Low Countries. His firſt efforts, however, were very unſucceſsful. A detachment of Germans in the ſervice of the prince attempted to penetrate into Brabant and ſurpriſe Ruremond; but were defeated by a detachment from the duke of Alva's army. Another party, conſiſting chiefly of French, attempted to penetrate into Artois by the way of Picardy; but their officers were arreſted by order of Charles IX. Louis of Naſſau, however, defeated a body of Spaniards, and killed 600 of them on the ſpot; but the vigilance of his enemies prevented him from drawing any advantage of conſequence from this victory.

The duke of Alva was ſo much chagrined at the defeat ſuſtained by his party, that he inſtantly aſſembled his troops from all quarters. His army then appeared too formidable to be oppoſed, and the prince of Naſſau with count Hoog-

ſtrate

17 Prince of Naſſau and count Hoogſtrate defeated by the duke of Alva.

18 Prince of Orange defeated, and diſbands his army.

ſtrate retired towards the river Ens. But being hard puſhed by the duke of Alva, and mutinies ariſing among their troops for want of pay, they were ſoon brought to an action, and totally defeated. The infantry were entirely cut in pieces; the cavalry were ſaved, but all the baggage and artillery were taken by the enemy. In the mean time, the prince of Orange was haſtening to the relief of his diſtreſſed allies with an army of 28,000 men; but having the misfortune of being alſo defeated, and count Hoogſtrate killed in the action, his ſoldiers deſerted in ſuch crowds, that he was at laſt obliged to diſband his army and return to Germany.

19 Cruelty of the duke of Alva.

20 His intolerant principles and exactions.

This diſaſter happened in the year 1569. The duke of Alva reſolved to make the moſt of his time. He entered Bruſſels in triumph; and let looſe his vengeance againſt all who had in the leaſt aſſiſted, or been ſuppoſed to aſſiſt, the prince of Orange. All the priſoners taken in the laſt campaign were put to death: and, not contented with this barbarity, the cruel governor projected nothing leſs than the total extirpation of the reformed religion, by the deſtruction of every one who profeſſed it; and of rendering himſelf deſpotic, by erecting citadels in all the conſiderable towns, which were to be garriſoned by his ſoldiers. He began with Amſterdam, in which he laid the foundations of a ſtrong citadel. The people complained of it as an infringement of their rights, but the duke was deaf to their complaints. At Antwerp he cauſed his ſtatue to be erected; and here he was figured treading on the necks of two ſmaller ſtatues, which repreſented the two eſtates of the Low Countries. This piece of inſolent vanity exaſperated the people to a great degree; and they were ſtill farther provoked by a demand of the hundredth part of every man's eſtate to be paid immediately for the ſupport of the army, beſides the tenth of all the merchandiſe, and the twentieth of all immoveables, to be annually levied as a ſtanding revenue. The provinces remonſtrated, and refuſed to ſubmit to ſuch intolerable exactions: the governor was inflexible; and being incenſed at their reſiſtance, he ſent the regiment of Lombardy to live at free quarters in the province of Utrecht.

21 Duke of Alva attempts in vain to eſtabliſh his new taxes at Bruſſels.

22 Briel taken by the Orange party.

All this time the prince of Orange was employed in laying plans for the deliverance of his diſtreſſed country; but in 1571, the duke of Alva growing impatient, ordered the edict concerning the new taxes to be publiſhed at Bruſſels. The city was inſtantly filled with confuſion; the ſoldiers ſeized on the goods of the inhabitants by force; tradeſmen ſhut up their ſhops; and the peaſants refuſed to bring proviſions to the market. The ſtates offered to pay a ſubſidy of 2,000,000 of florins annually in lieu of the intended tax; but their offer was rejected. The drum beat to arms, and orders were iſſued to hang all who refuſed to comply. The ſoldiers were preparing to obey, when news arrived of the ſurrender of Briel in the iſland of Voorn, at the entrance of the Meuſe, to a ſquadron of ſhips of war that had been fitted out by the prince of Orange. Lumey, who commanded the ſquadron, made a deſcent on the iſland from 40 ſhips, deſtroyed the churches, broke the images, and executed the prieſts, but offered no violence to the other inhabitants.

23 Duke of Alva deſiſts from enforcing his taxes.

However unimportant the conqueſt of ſo inconſiderable a place might appear, it alarmed the duke of Alva, and produced the moſt extravagant rejoicings in Bruſſels. The duke regarding it as the harbinger of further oppoſition, dropped his taxes and executions for the preſent, and diligently applied himſelf to ſuppreſs the growing ſpirit of rebellion. He withdrew the garriſon from Bruſſels, and detached it under the command of Maximilian Hermin Boſſu, againſt the ſhips of war which were called *Gueux*. This officer, endeavouring to force Briel, was defeated by the Orange faction, and forced to retire with loſs to the iſland of Beyerland. Trifling as this victory might ſeem, it ſerved to animate the depreſſed ſpirits of the enemies to the government. The prince of Orange, ſenſible of the advantage of poſſeſſing this iſland, exhorted the nobility of his party to fortify and garriſon it; his orders were obeyed, by which means he ſoon became maſter of Delfshaben, a town ſituated on the oppoſite banks of the Meuſe. It appeared in Boſſu's retreat how unpopular the duke of Alva was in every part of the country. Dordrecht ſhut its gates againſt him; Rotterdam refuſed to admit his troops; but Boſſu obtaining permiſſion that they ſhould paſs through in ſeparate ſmall diviſions, ſeized the gates, and began a general maſſacre of the inhabitants. Four hundred periſhed by the ſword, the town was pillaged, the women were raviſhed, and every poſſible act of barbarity and inhumanity committed. Retribution was ſoon made by the enemy. Alva had detached Oſſorio d'Angulo with a body of forces to ſecure Fluſhing, a conſiderable port in Zealand, and to erect a citadel. The inhabitants denied Oſſorio admittance, ſhut their gates, and ſeized Pacaneo, a famous engineer, who had come to meaſure the ground where the citadel was to be erected. Apprehending that attempts would be made to force them to ſubmiſſion, they petitioned Lumey, admiral of the Gueux, for aſſiſtance; and he furniſhed them with 200 men, under the command of Captain Treſlong. On the arrival of this reinforcement, the Spaniſh engineer was hanged, and an unſucceſsful attempt made to ſurpriſe Middleburg, the capital of the iſland of Walcheren. Not diſpirited by this diſappointment, the Zealanders aſſiduouſly proſecuted their cruizes upon the Spaniards, and obtained as much wealth as purchaſed a large ſtore of arms and ammunition at Antwerp. Joined by great numbers of Engliſh and Scotch adventurers, they ventured to attack the duke of Medina Celi, ſent with a ſtrong ſquadron to ſucceed the duke of Alva in the government of the Netherlands. The duke was completely defeated, a great number of his ſhips were taken, and a booty, amounting to near 1,000,000 livres, was carried off by the Zealanders.

24 A party of his forces defeated by the Gueux.

25 The Gueux take Delfshaben.

26 Inhabitants of Rotterdam maſſacred by the Spaniards.

27 Duke de Medina Celi entirely defeated by the Zealanders at ſea.

The duke of Alva now ordered a ſquadron of ſhips to be equipped at Amſterdam, to bridle the inſolence of Lumey and the Zealanders, while he buſied himſelf in raiſing an army to oppoſe the prince of Orange and Lewis de Naſſau, who were making great preparations in Germany and France. To augment the army in the field, he had draughted moſt of the garriſons. By this means the prince's friends gained poſſeſſion of North Holland; and Louis de Naſſau was projecting a ſcheme to ſurpriſe Mons, with the inhabitants of which he held a ſecret correſpondence. The deſign ſucceeded; which emboldened moſt of the cities and towns in Holland to declare againſt the government. The count de Bergues gained over ſeveral cities in Overyſſel, Guelderland, and Frieſland. In a word, the revolt became ſo general, that the duke of Alva ſoon found he could not long reſiſt the torrent. He now, when too late, publiſhed an edict to appeaſe the people, ſetting forth, that he would conſent to remit the moſt oppreſſive taxes, if the ſtates could ſuggeſt any other means of raiſing the neceſſary ſupplies. He convoked the States-general to meet at the Hague, but his orders were now diſregarded; and the States, in contempt of his authority, aſſembled at Dordrecht, inviting deputies from the prince of Orange, the nobility, and the towns that had declared againſt the governor. Here money was raiſed to enable the prince of Orange to begin his march. His forces amounted to 15,000 foot and 7000 horſe. He had promiſed to advance three months pay; and was enabled to perform his engagements by the liberality and public ſpirit of the States-general and the cities.

28 Moſt of the towns in Holland declare againſt the Spaniards.

29 Proceedings of the States-general in favour of the prince of Orange.

He ſhowed the addreſs with which he could manage and direct the people; and without the name of ſovereign of the provinces under his government, he poſſeſſed the authority. He preſided at all military operations by ſea and land; made and diſpoſed of offices at pleaſure; aſſembled the States; and publiſhed all ordonnances and regulations relative to the preſent ſtate of affairs, without controul. However, he conducted matters with the utmoſt delicacy, and uſed his power with great moderation, to avoid giving offence to the free ſpirit of the Hollanders. The Popiſh religion was baniſhed the churches, and perſons of that perſuaſion were, with great caution, admitted into public employments. Not only the king's revenue and church tythes were appropriated to the public ſervice, but the eſtates of thoſe who remained firm in their loyalty. In ſhort, the moſt vigorous meaſures were taken for reſiſting the tyranny of Spain; and thoſe perſons who had refuſed the tythes to the government, voluntarily ſubſcribed their all to ſupport a party formed in defence of liberty.

30
His ſucceſſes.

While the States-general were employed in ways and means to maintain an army, the prince of Orange advanced to Ruremonde, which he took by aſſault, on the refuſal of the city to ſupply him with neceſſaries. From thence he marched to Brabant, and raiſed heavy contributions. He took Mechlin, Oudenarde, and Dendermonde; and could not reſtrain the exceſſes of the ſoldiers, who pillaged the churches, maſſacred the prieſts, and committed other barbarities. Next he approached to Mons, beſieged by the duke of Alva, with deſign, if poſſible, to engage him to give battle. The duke baffled all his endeavours to force him, and carried Mons by capitulation. The whole Spaniſh dominion, however, lately ſo inſolent and exulting, was ready to expire in the Netherlands, had it not been revived by the maſſacre of the Proteſtants in Paris.

While the fate of Mons was depending, the ſtates of Holland met at Haarlem, to deliberate on the defence of the province and the proſecution of the war. Amſterdam was in the enemy's hands, which greatly obſtructed all their meaſures. It was therefore determined to beſiege it; and the enterpriſe was committed to Lumey, chief of the Gueux. After putting the States to conſiderable expence, the project miſcarried through Lumey's miſconduct. Water was his element, but his vanity led him to diſplay his abilities as a land-officer. He made regular approaches, and was foiled in every attempt.

31
Is obliged to retire.

32
Succeſs and cruelty of the duke of Alva.

The reduction of Mons, and the depreſſion of ſpirit conſequent on the maſſacre at Paris, obliged the prince of Orange to retire to Holland, and encouraged Alva to inveſt Dendermonde, Oudenarde, and Mechlin. The latter, being in no condition to reſiſt, opened its gates; but the Spaniſh ſoldiers choſe to ſcale the walls, to give an air of aſſault to the enterpriſe, and countenance to the horrid barbarities intended. Proteſtants and Catholics were maſſacred without diſtinction. The town was pillaged, and the booty eſtimated at 400,000 florins. All the other towns were evacuated by the garriſons, and loaded with heavy impoſitions by Alva. As to the prince, he had now removed the ſeat of war into the province of Holland. Only this province and Zealand remained firm to their engagements; the reſt, overwhelmed with conſternation, capitulated on the beſt terms they could procure from the government. However, the country being ſtrong by its nature and ſituation among the waters, and more ſo by a fierce, rough, and ſturdy people, proud of their ancient fame, and the moſt implacable enemies of Spaniſh tyranny, it was determined to make the moſt vigorous reſiſtance. Frederic de Toledo was diſpatched by Alva to begin the operations in Holland. He had already reduced Zutphen and Guelderland; and, fluſhed with ſucceſs, appeared before Waerden, which he ſummoned to admit a garriſon. The burghers replied, that they were intruſted by the king with the defence of the place, and could not receive a military force without violence to their privileges and engagements. They ſoon had reaſon to repent their firmneſs: the town was taken by ſurpriſe; and all the burghers, aſſembled in the great church to take the oaths of fidelity to the king, were wantonly butchered. Infants, old men, women, and the ſick, were all put to the ſword, without pity or remorſe; and of all the barbarities hitherto committed, this was the moſt horrible. It was imagined that the terror inſpired by ſuch inſtances of ſeverity, would reduce the people to obedience, and ſhake the obſtinacy of the other towns. The contrary effects were produced; rage and deſpair took poſſeſſion of every breaſt; and all determined to ſuffer the laſt extremities rather than ſubmit to ſo cruel a tyranny.

33
Haarlem beſieged.

34
And taken.

Having finiſhed this tragedy, Frederic went to Amſterdam, to deliberate with the officers of the army about the ſiege of Haarlem. Here it was determined, before they proceeded to extremities, that the city of Amſterdam ſhould write to the magiſtrates, exhorting them, in the moſt pathetic terms, to ſubmit, rather than incur the puniſhment inflicted on Waerden. The council of Haarlem met to take this letter into conſideration. Some were for ſoliciting an immediate reinforcement from the prince of Orange; and others, who apprehended the prince was too weak to afford the neceſſary relief, were for making the beſt terms poſſible with the king. Thoſe of the latter opinion were the magiſtrates. Accordingly, without conſulting the burghers, deputies were diſpatched to Frederic to ſtipulate conditions. In their abſence, Ripperda, a gentleman of Friſeland, ſtrongly attached to the prince of Orange and the cauſe of liberty, aſſembled the chief burghers; and ſo animated them againſt the Spaniards, that they reſolved to ſtand a ſiege, and ſuffer all the horrors of war, rather than ſubmit. They ſent to the prince of Orange to acquaint him with their determination, and to implore aſſiſtance. Four companies of Germans were detached to reinforce the garriſon of Haarlem; and the deputies, on their return, were ſeized as traitors to their country, ſent to the prince of Orange, and by his order beheaded. Frederic was preparing to compel the burghers to ſubmiſſion. On the 19th of December he inveſted the town, after carrying Sparendem fort by aſſault, with great loſs and ſlaughter of his ſoldiers. A variety of errors were committed in the attack, in the defence, and manner of ſuccouring Haarlem. The aſſailants and defendants had equally ſhown themſelves ignorant of the art of war, and implacable in their reſentment. The prince of Orange uſed every expedient to relieve the town; but all his attempts were fruſtrated by untoward accidents, and the vigilance of the Spaniards. At laſt, quite ſpent with fatigue, deſpairing of relief, weakened by loſſes, and totally exhauſted of proviſions and ammunition, the burghers of Haarlem ſurrendered upon more favourable terms than they could well expect. A few only of the moſt obſtinate were executed; the reſt were pardoned on taking an oath of fidelity, and paying an acknowledgment of 15,000 florins.

35
Succeſſes of the Zealanders by ſea.

During the ſiege of Haarlem, the Zealanders were performing glorious atchievements by ſea, and gaining victories over the Spaniſh naval armaments. All the efforts of the governor of Antwerp could not prevent their carrying off a great number of ſhips out of the harbour. To revenge the inſult, and relieve Middleburg and Rammekins blocked up by the Zealanders, he equipped a ſquadron, and gave battle to Wertz, the Zealand admiral, but was defeated. After repairing and augmenting his fleet, he again ſet ſail with ſixty large veſſels, encountered a ſquadron of Zealanders much inferior in ſtrength, and met with his former fortune. Moſt of his ſhips were ſunk or taken; but he found means to puſh into Middleburg, with the broken remains of his ſquadron, to the great joy of the garriſon, now reduced by the ſcarcity of proviſions to the laſt extremity. D'Avila's diſgrace did not end here; for, on his return to Antwerp, he was a third time attacked and defeated, with conſiderable loſs, by Wertz, who thus repaired the diſappointment of an unſucceſsful attempt made on Tolen.

36 The Spaniards repulſed before Alcmar.

Soon after the reduction of Haarlem, Alva, perceiving that his ſeverity anſwered no other purpoſe than irritating the people more againſt the Spaniſh government, publiſhed a proclamation, couched in the moſt ſoothing terms: but the people were not diſpoſed to confide in promiſes ſo often violated, nor to throw themſelves on the clemency of a prince and governor who had ſhown themſelves inflexible, implacable, perfidious, and inhuman. They now expected the worſt that could happen, and bid defiance to fortune. The Spaniards were preparing to inveſt Alcmar, and the Hollanders put every means in practice to reſiſt them. Eight months pay was due to the garriſon, who began to mutiny; but contributions were raiſed, which ſilenced their clamours. Frederic of Toledo, with 16,000 men, ſat down before a town fortified by no regular works, and defended only by 300 burghers, and 800 ſoldiers, in extreme want of proviſions, and without the proſpect of relief. Sonoi, the governor, deſpairing of being able to ſuſtain a ſiege, wrote to the prince of Orange, that a place deſtitute of troops, proviſions, ammunition, money, and every neceſſary, ought to be evacuated, and the few ſoldiers in garriſon, and the burghers, ſaved from falling into the hands of the enemy. But the prince of Orange ſo animated them by a letter, that, to a man, the townſmen, governor, and ſoldiers, determined to ſacrifice their lives, and ſpill the laſt drop of their blood in the breach. Perſeverance had made the Zealanders maſters of Rammekins, contrary to all hope and probability; the ſame virtue, the prince obſerved, might ſave Alcmar, a town of the utmoſt conſequence to the cauſe of liberty. What particularly inſpired the defendants with courage, was the prince's good fortune in ſurpriſing Gertrudenburg. Frederic puſhed the ſiege with great vigour. He ordered the inhabitants of Haarlem to work in the trenches, and ſuſtain the firſt fire of their friends and countrymen. On the 18th of September, a battery of 20 pieces of heavy cannon began to play; a breach was ſoon effected; the aſſault was given, and repulſed with vigour, though ſuſtained by the bulk of the Spaniſh army. From a Spaniſh officer taken, the garriſon were informed, that Alva had given orders to retire, in caſe he failed in the third aſſault; but if he ſucceeded, to put all to the ſword. Their courage was whetted by this account, and preparations were cheerfully made for withſtanding the utmoſt efforts. Frederic was foiled in every attempt; the aſſailants were driven from the breach with prodigious ſlaughter; the Spaniſh ſoldiers refuſed to mount the walls; in a word, the ſiege was raiſed, and the town relieved, to the exceeding joy of the prince of Orange, and great mortification of Alva.

37 They are defeated at ſea.

This advantage was attended with another of leſs importance, but which equally ſerved to inſpirit the Hollanders. The duke of Alva's grand fleet, equipped with great labour and expence, was defeated by the Zealanders. Though the action did not prove deciſive, it greatly chagrined the duke, as Boſſu, one of his beſt officers, was taken priſoner, and his fleet afterwards dreaded to look the enemy in the face.

38 Mutiny in the Spaniſh army.

Notwithſtanding this ſucceſs, the affairs of the States were yet in a moſt precarious ſituation; and their ability to ſupport themſelves appeared in the higheſt degree problematical. The Duke of Alva had reſigned the government, and his ſucceſſor Don Louis de Requeſnes had orders to puſh the war with vigour, while his antagoniſts prepared for the moſt obſtinate reſiſtance. The firſt advantage appeared on the ſide of the prince of Orange, by the ſurrender of Middleburg. But this was ſoon balanced by the defeat and death of prince Louis of Naſſau. The Spaniards, however, were prevented from purſuing the advantage they had gained, by a mutiny among their troops. This mutiny took place on a regular and well concerted plan. The ſoldiers depoſed all their officers, appointed new ones, and eſtabliſhed a ſort of community, veſting one of their number with the chief authority. The diſtreſſes of the Spaniards on account of this tumult were likewiſe augmented by a victory gained by the Zealanders at ſea; when almoſt 40 of the Spaniſh ſhips were taken or deſtroyed. Philip then perceiving that numberleſs difficulties would attend the reduction of the provinces by force, publiſhed an act of grace; but in ſuch a limited manner, that it was unanimouſly rejected. Requeſnes then determining to cloſe the campaign with ſome remarkable exploit, laid ſiege to Leyden. The city was reduced to the utmoſt diſtreſs for want of proviſions; the whole country was laid under water; and they could receive no relief except what was obtained by boats forcing themſelves through the enemy to the city. In ſhort, they were reduced to the brink of deſtruction, when a violent ſouth-weſt wind drove the inundation againſt the works of the beſiegers with ſuch violence, that they were obliged to relinquiſh the enterprize for fear of being entirely ſwallowed up. In their retreat they were attacked by the garriſon, and 500 of them deſtroyed. This diſappointment ſo provoked the Spaniſh ſoldiery, that they depoſed Valdes the commander, whom they had choſen for themſelves, and proclaimed their old one: a ſecond mutiny enſued, and they marched in a tumultuous manner to Utrecht. Here, however, they met with a very unfavourable reception. Barlaimont the governor declared them rebels and traitors to their king; and gave free liberty to every one to maſſacre them wherever they could be found. The mutineers attempted to ſet fire to the gates; but being repulſed, and their leader ſlain, they capitulated, were received into favour, and ſent into winter-quarters.

39 The States offer the ſovereignty to queen Elizabeth, &c.

40 Philip diſtreſſed in his finances.

The year 1575 commenced with ſome negociations for peace; but theſe proving ineffectual, though the emperor interpoſed his mediation as far as poſſible, the war was renewed with redoubled fury. Fortune now declared in favour of the Spaniards; and the States were reduced to ſuch deſpair, that they began ſeriouſly to think of making an offer of the provinces to ſome Proteſtant power who might be able to defend them againſt the tyranny of the Spaniards. This offer was made to queen Elizabeth of England; but ſhe declined it, for political reaſons. A negociation was even ſet on foot for this purpoſe with France, in favour of the duke of Anjou; but it ended in nothing beſides the advantage of eſtabliſhing a mart at Calais for the diſpoſal of the prizes made by the Gueux. Philip, however, notwithſtanding his power, had the utmoſt difficulty in ſupporting the expence of the war. He had already borrowed more than 40,000,000 crowns from the Spaniſh and Genoeſe merchants, and the intereſt ſtill unpaid now amounted to as much as the capital. The war had beſides coſt a greater ſum ſent in ſpecie from Spain and the Indies, which, with the immenſe loſſes occaſioned by the ſtagnation of trade in the Netherlands, had quite exhauſted the treaſury. Large arrears were due to the troops; they were every day mutinying, and ſome broke out into actual rebellion. To remedy theſe evils, Requeſnes demanded a ſupply of the provinces; and they anſwered him, by requiring reſtitution of their privileges, and diſmiſſion of the Spaniſh troops. Flanders, in particular, paid the deſired ſubſidy, by balancing it againſt half the damages the province ſuſtained from the miſconduct of the governors, and the wars wantonly and unneceſſarily excited. While this affair was in agitation, Requeſnes died of an ardent fever: the council of ſtate aſſumed the adminiſtration, and the prince of Orange took the opportunity of the confuſion that enſued to lay the firſt foundation of the Pacification of Ghent, by which his affairs were conſiderably retrieved, and the greateſt blow given to the court of Spain ſhe had yet ſuſtained. All now was anarchy in the Low Countries. The garriſon of Ziriczee mutinied for want of pay; and to appeaſe them, the council of ſtate ſent 100,000 livres, which the Walloon regiments under Madragon ſeized upon, after expelling the Spaniſh ſoldiers, and wounding and murdering their officers. This did not unite the Spaniſh mutineers among themſelves; they turned out the few remaining officers, and made new appointments. Joining with the garriſon of Lillo, they marched, to the number of 2000 men, towards the capital; committed horrible outrages; overwhelmed the inhabitants of Bruſſels with conſternation; and, upon the 26th of July, ſeized upon Aloſt, confined the principal burghers, and hanged up a king's officer. The moſt favourable conditions were offered by the council of ſtate, in order to appeaſe the tumult, and proviſions were ſent to the mutineers. This created ſuſpicion in the inhabitants of Bruſſels, that the mutiny was excited by the connivance of the council, with a view of ruining the provinces, without incurring the reſentment and odium conſequent on any appearance of legal oppreſſion. They arreſted the council, declared the Spaniards rebels, and took meaſures in concert with the other cities and provinces for expelling foreigners out of the Netherlands. A confederacy to this purpoſe was formed between the provinces of Hainault, Artois, and Flanders, to which all the reſt except Luxemburgh acceded; and Don John of Auſtria, who had entered the Low Countries in quality of governor and ſucceſſor to Requeſnes, was obliged to live in obſcurity in Luxemburgh until the ſtorm ſhould ſubſide.

41
Confuſion in the Spaniſh affairs.

The prince of Orange was all this while profiting by theſe commotions. He had long laboured to have the States-general convoked; and he now ſaw them not only aſſembled, but preparing to make head againſt the Spaniards, by a ſtrange viciſſitude of fortune, ariſing from accidents which all his penetration and ſagacity could not foreſee. United in councils againſt the common enemy, every meaſure was taken for reducing the citadels of Ghent, Antwerp, and Maeſtricht, the chief places in the hands of the Spaniards, and what muſt principally contribute to their expulſion. Ghent citadel was taken on the 27th of November, by the aſſiſtance of a ſtrong reinforcement of troops and artillery ſent by the prince of Orange. At Antwerp, the ſtates of Brabant were leſs ſucceſsful. The citadel was vigorouſly attacked; but the mutineers at Aloſt entering the citadel to aſſiſt their countrymen, a ſally was made, the beſiegers were driven from their trenches, great part of the town was conſumed by fire, and the reſt pillaged for three days with every kind of inſolence and brutality, at a time when Antwerp was the moſt flouriſhing and populous city in the Netherlands, and indeed among the moſt wealthy in Europe. It is affirmed that the treaſure carried off amounted to four millions, beſides an infinity of rich merchandiſe. This terrible calamity united Papiſts and Proteſtants without diſtinction in a confederacy, and co-operated with the meaſures of the prince of Orange to form the Pacification of Ghent: which was a confederacy of all the provinces to expel foreign ſoldiers; to reſtore the ancient form of government; to refer matters of religion to the ſeveral ſtates of the provinces; for ever to unite the other 15 provinces in the ſame common intereſt with Holland, Zealand, and the prince of Orange; to renew the commerce and amity between them; to aſſemble the ſtates in the manner practiſed under the houſe of Burgundy and Charles V.; to ſuſpend all the rigorous edicts of the duke of Alva on the ſubject of religion, until the States-general ſhould take the matter into conſideration; to releaſe all the natives made priſoners, mutually, without ranſom; and to reſtore all things upon the ſame footing as before the war, and the tyrannical government of the duke of Alva.

42
Antwerp taken and pillaged.

45
Pacification of Ghent.

44
The States receive aſſiſtance from queen Elizabeth.

The States general began by ſoliciting aid from the queen of England. Their ambaſſador had a gracious reception; and Elizabeth advanced them 20,000l. ſterling, on condition that the French ſhould not be invited into the Netherlands, that they would accept of reaſonable terms of accommodation if offered, and that the loan ſhould be repaid the enſuing year. Next a ceſſation of hoſtilities was agreed upon with Don John, upon his aſſurances that every reaſonable requeſt of the provinces ſhould be granted. On the 27th of December, deputies were ſent with propoſals to Don John to diſband the foreign troops: but he deſired to know what ſecurity the States would give for their allegiance after the departure of the Spaniſh forces; and remonſtrated againſt the unreaſonableneſs of diſarming the king, while his rebellious ſubjects were in arms, and ready to ſeize the firſt opportunity of deſerting their obedience. He likewiſe demanded ſecurity with reſpect to religion; and inſiſted ſo warmly on this head, that it was obvious he had no inclination to part with the Spaniſh army before the provinces of Zealand and Holland embraced the Catholic religion. After much altercation, neceſſity at length obliged Don John to grant all that was required, to confirm the Pacification of Ghent, and diſmiſs the Spaniſh army. He had the king's authority for his proceedings; the treaty was proclaimed at Bruſſels and Antwerp on the 17th of February; and Don John immediately acknowledged governor, and the king's lieutenant of the Netherlands.

45
Don John accedes to the Pacification of Ghent.

46
Objections made to the pacification by the provinces of Holland and Zealand.

It muſt be obſerved, however, that when this edict was ſigned, the provinces of Holland and Zealand, by the advice of the prince of Orange, made the following objections, *viz.* that the States-general had not eſtabliſhed the right of aſſembling this ſovereign tribunal in the perſons originally inveſted with that power by the conſtitution; that in ſome particular inſtances they had ſuffered an infraction of their privileges; that the Spaniſh troops were allowed to carry off the immenſe wealth they had acquired in the Netherlands, and by the deſtruction of the city of Antwerp in particular; that no ſtipulation was made in favour of thoſe diſpoſſeſſed of their eſtates, &c. For theſe reaſons the States and the prince refuſed to ſign the edict, though they conſented to all the articles that did not contradict thoſe ſpecified. This raiſed a contention, by which the public peace was ſoon broken. Don John was ſtrenuous in recommending violent meaſures againſt the prince and his party. To this purpoſe he wrote a letter in cypher to the king; but this letter fell into the hands of Henry IV. of France, who tranſmitted it to the prince of Orange. Eſcovedo, ſecretary to Don John, was next ſent into Spain with a meſſage to the ſame purpoſe; but the governor becoming impatient for his return, left the country himſelf, under pretence of complimenting Margaret queen of Navarre on her journey to Spaw. In this expedition he ſeized on the citadel of Namur: but attempted to juſtify his conduct to the States, by repreſenting, that he was under a neceſſity of retiring to a place of ſafety, while he ſaw the flames of war and rebellion ready to break out all around him; and concluded with deſiring the States to diſarm the burghers of Bruſſels, who were cloſely attached to the

47
Hoſtilities recommenced.

prince of Orange. This letter was anſwered by an invitation from the States to return; promiſing at the ſame time, that they would, to the utmoſt of their power, bring to puniſhment, all thoſe who ſhould form any deſigns againſt him. This, however, was not only refuſed, but the whole tenor of his conduct afterwards ſhowed, that he was reſolved to commence hoſtilities, and that he was encouraged to do ſo by Philip.

48
Don John depoſed.

The event was, that Don John was depoſed from his dignity, the archduke Matthias was appointed governor-general, and preparations were made for a new and vigorous war. The Spaniſh troops were ordered to aſſemble in Naples and Milan; levies were made in Burgundy and Luxemburgh; and a reſolution was taken of ſupporting Don John with the whole power of the Spaniſh monarchy.

49
New treaty with queen Elizabeth.

To oppoſe this formidable power, the States, in 1578, entered into a new treaty with the queen of England; by which that princeſs agreed to advance them 100,000l. ſterling, and to aſſiſt the provinces with 5000 foot and 1000 horſe: on condition that the loan ſhould be repaid with intereſt in eight months: that certain towns ſhould be ceded to her in ſecurity; and that the States ſhould defray the expence of tranſporting their troops, and take them into pay while they acted in their ſervice. Elizabeth, however, afterwards departed from theſe conditions, under pretence that the French would ſuſpect her having ſome deſigns on the Netherlands, and would for that reaſon unite their forces with thoſe of Spain againſt her. Inſtead of the Engliſh troops, ſhe now propoſed to ſend John Caſimer, Count Palatine, with 3000 foot and 3000 horſe; refuſing at the ſame time to pay the money ſtipulated, until the States had conſented to this alteration.

Before this treaty was concluded, Don John was joined by an army of 16,000 foot and 2000 horſe, all choſen veterans, commanded by Alexander Farneſe, duke of Parma, the beſt officer in the Spaniſh ſervice. Being thus ſuperior to the prince of Orange, the Spaniards gained ſeveral advantages; which, however, were more than balanced by the loſs of the city of Amſterdam.

30
Amſterdam concludes a treaty with the prince of Orange.

This place had been cloſely blocked up for ſeveral months by ſea and land, and at laſt concluded a treaty with the friends of the prince of Orange; by which it was ſtipulated, that the Proteſtants ſhould hold their religious meetings without the walls, and have a burying-place within; that the garriſon ſhould be diſbanded, and 600 men, commanded by the burghers, levied for the defence of the city: that all perſons baniſhed on account of religion ſhould be recalled; that Amſterdam ſhould enjoy all its ancient privileges, and that all vacancies in public employments ſhould be filled without diſtinction of party or connection. This capitulation, however, was ſoon after broken; the Catholic magiſtrates were driven out of the city, attended by the prieſts and Popiſh clergy of every denoimnation; the images were pulled down, and only the reformed clergy ſuffered to preach publicly. Some ineffectual negociations next took place; after which the States, ſenſible that the misfortunes and loſſes in the winter aroſe from the irreſolution of the provincial ſtates, veſted the archduke, the council of ſtate, and the prince of Orange, with a power of levying what number of troops they ſhould think neceſſary, and diſpoſing of them as they thought proper, without referring to the ſtates in every particular: they only recommended that they would proportion the expences to the revenue, which at that time amounted to 600,000 livres.

51
Revolution in Guelderland.

About this time a revolution greatly beneficial to the common cauſe, was effected in Guelderland; John of Naſſau, brother to the prince of Orange, had been appointed governor of this province. Upon entering on the adminiſtration, he perceived that the whole conduct of affairs was in the hands of perſons ſtrongly affected to king Philip and the Catholic religion; moſt of the cities profeſſed Popery; and the count, who had ſworn to the pacification of Ghent, was reſtrained from attempting any change in religion. The face of affairs, however, took a ſudden turn; John acquired great popularity, and ſoon diſcovered that foreigners were the leading perſons. By his artifice and policy he ſtimulated the people againſt them; they were deprived of their ſeats in the provincial ſtates, and turned out of their offices in the government of the cities. Thus Naſſau obtained the chief direction, and was able to co-operate with the meaſures planned by his brother.

52
And in Groningen.

Another revolution happened in Groningen, of which the ſieur de Billy was governor. Billy was by birth a Portugueſe, by religion a Catholic, and conſequently a dependent on the court of Spain: he refuſed to accede to the union of the provinces, and the States-general found it neceſſary to ſend to him Francis Martin Stella, with propoſals for ſigning the pacification of Ghent. Billy, ſuſpecting that the deputy's real deſign was to excite a revolt in the province, put him to the torture to extort confeſſion; after having firſt wounded him with his own hand. The deputy bore the moſt excruciating tortures with firmneſs; and having a ſurgeon to dreſs his wound to enable him to undergo a ſecond trial, he communicated ſomething in the Greek language, which the ſurgeon ſoon made public: in conſequence, the mob aſſembled, reſcued Stella, declared for the pacification of Ghent, and obliged Billy to quit his government. The change of councils in theſe two provinces was of the utmoſt ſervice to the confederacy; and would have enabled the province to have encountered the whole power of Spain, had not their affairs been diſtracted by diſſenſions among themſelves.

At laſt the prince of Orange, perceiving that little confidence was to be placed in the unanimity of provinces rent by faction, different in religion, and divided by ambition, political maxims, and private intereſt, formed the ſcheme of more cloſely uniting the provinces of which he was governor, and cementing them with thoſe more contiguous, in which the Proteſtant intereſt prevailed. Such an alliance was ſubject to fewer difficulties than attended the more general one of uniting all the provinces; it was in fact the only meaſure that could be propoſed with ſafety, and it was proſecuted with that alacrity and addreſs for which William was deſervedly celebrated.

53
Union of Utrecht.

On the 23d of January 1579, deputies from the provinces of Holland, Zealand, Utrecht, Frieſland, Groningen, Overyſſel, and Guelderland, met at Utrecht, and ſigned the alliance, ever ſince know by the name of the *Union of Utrecht*, the baſis of that commonwealth ſo renowned by the appellation of the *United Provinces*. This treaty of alliance was founded upon the infraction of the pacification of Ghent ſolemnly acceded to by Philip, and the late invaſion of certain towns in Guelderland. It was not hereby intended to divide the ſeven provinces from the other ten, or to renounce the pacification of Ghent; its object was to preſerve the liberty ſtipulated in that pacification, by more vigorous operations, and united councils. The chief articles of this union are the following.

The ſeven provinces ſhall unite themſelves in intereſt as one province, never to be ſeparated or divided by teſtament, donation, exchange, ſale, or agreement; reſerving to each particular province and city all its privileges, rights, cuſtoms, and ſtatutes. In all diſputes ariſing between either of the provinces, the reſt ſhall interpoſe only as mediators. They ſhall aſſiſt each other with life and fortune againſt every foreign attempt upon any particular province, whether to eſtabliſh ſovereignty, the Catholic religion, arbitrary meaſures, or whatever elſe may appear inconſiſtent with the liberties of the provinces and the intention of the alliance. All frontier towns belonging to the United Provinces ſhall, if old, be fortified at the expence of the provinces; if new, at the joint expence of the union. The public impoſts and duties ſhall be farmed for three months to the higheſt bidder, and employed with the king's taxes in the public ſervice. No province, city, or member of the union, ſhall contract an alliance with any foreign prince or power, without the concurrence of all the other members. Foreign powers ſhall be admitted into the alliance, only by conſent of all the contracting parties. As to religion, the provinces of Holland and Zealand ſhall act in that particular as they think adviſable: the reſt ſhall adhere to the purport of the edict publiſhed by the archduke Matthias, which preſcribed that no man ſhould be oppreſſed on the account of conſcience. All the inhabitants from the age of 18 to 60, ſhall be trained and diſciplined to war. Peace and war ſhall be declared by the unanimous voice of all the provinces, other matters that concern the internal policy ſhall be regulated by a majority. The ſtates ſhall be held in the uſual conſtitutional manner, and coinage ſhall be deferred to future determination. Finally, the parties agree, that the interpretation of theſe articles ſhall remain in the States-general; but in caſe of their failing to decide, in the ſtadtholder.

This alliance was ſo univerſally approved, that in a ſhort time the cities of Ghent, Nimeguen, Arnheim, Leewarden, Venlo, Ypres, Antwerp, Breda, Bruges, with ſeveral other towns, beſides a great number of noblemen and perſons of diſtinction, embraced and ſigned the union. Thus the foundation of a commonwealth was laid, but in a fluctuating and uncertain ſtate of affairs, when men were actuated by different paſſions, views, and intereſts; intimidated by the great ſtrength of the Spaniſh monarchy, and ſupported chiefly by a zealous adherence to liberty, and firm reſolution to periſh in defence of freedom. The firſt coin ſtruck after this alliance is expreſſive of the ſituation of the infant republic. Here was repreſented a ſhip labouring amidſt the waves, unaſſiſted by ſails or oars, with this motto, *Incertum quo fata ferant.*

54
Firſt coin ſtruck by the republic of Holland.

It was expected, that the important object of this alliance would have attracted the attention of the Walloons, and indeed of all the Catholic inhabitants of the Netherlands: it in fact did ſo, but in a different manner from what was imagined. The Walloons not only refuſed to accede to the union, but they made the ſtrongeſt remonſtrances to the States-general upon the danger, impropriety, and illegality of ſuch a confederacy. It appears from Strada and Bentivoglio, that the duke of Parma was at the bottom of their intrigues. He ſtimulated and prompted their meaſures, inſpiring them with a jealouſy of the Proteſtant deſigns on the Catholic religion. In the end, he contracted an alliance with them; and thereby confirmed by his own example the legality and neceſſity of the union of Utrecht. Immediately they began levying an army; but ſtill kept up appearances with the confederated provinces, though it was obvious that hoſtilities muſt ſoon commence. To prevent the effuſion of blood, the emperor, as mediator, ſet on foot another negociation; but Philip would allow no reaſonable terms of accommodation, and give no ſecurity for liberty of religion. Inſtead of granting equitable conditions, he laboured to detach the prince of Orange from the union; made him extraordinary propoſals; offered to reſtore him to all his eſtates, indemnify his loſſes, raiſe him to the height of power, and give him the firſt place in his eſteem and favour. But William was too wiſe to rely on the promiſes of a king who had ſhown himſelf perfidious. He determined to ſhare the fate of the United Provinces, to fulfil his engagements, and the hope conceived of his conduct.

55
Intrigues of the duke of Parma.

While the prince of Orange was buſied in conciliating factions, forming alliances, and ſtrengthening the union, the duke of Parma was taking meaſures to diſconcert his projects, and reduce the provinces to the king's obedience. He diſpatched Gonzaga and Mondragon with 8000 men to lay ſiege to Marſien. The town was taken by aſſault; the governor hanged; and 45 of the chief inhabitants were tortured to death, for having valiantly defended themſelves, and faithfully diſcharged their duty. It is ſaid the duke of Parma diſavowed this bloody proceeding, ſo inconſiſtent with the character of a hero. After ſome farther inconſiderable advantages obtained in the neighbourhood of Ruremonde, the king's army inſulted Antwerp, where the archduke and the prince of Orange then reſided. The States army was intrenched near Borgerhont, a poſt attacked without ſucceſs by the duke of Parma, after a briſk ſkirmiſhing of two hours between the armies. La Noue, however, the general of the ſtates army, not chooſing to expoſe himſelf to continual alarms from the enemy's cavalry, retired under the cannon of Antwerp.

56
His ſucceſſes.

57
Maeſtricht taken, and the inhabitants maſſacred.

On La Noue's retreat, the duke of Parma inveſted Maeſtricht. The ſiege began on the 8th of March, and continued without remiſſion to the 29th of June. This defence was deemed very extraordinary, as the fortifications were in bad order, the garriſon ſlender, and the place but poorly provided with the neceſſaries of a ſiege. One Sebaſtian Tappin, an engineer by profeſſion, a Proteſtant, and a brave and alert ſoldier, by his indefatigable vigilance raiſed continual obſtructions to the duke's approaches. The garriſon had ſuſtained frequent aſſaults, and made divers bloody ſallies, by which they were ſo much fatigued, that during a parley the town was ſurpriſed and a great many ſoldiers were put to the ſword; but Tappin was ſaved by favour of the duke of Parma, who gave ſtrict orders that he ſhould have quarter. For three days Maeſtricht was a ſcene of the utmoſt deſolation and horror, the Spaniſh ſoldiers committing every exceſs and enormity, in deſpite of all the endeavours of the general to reſtrain their licentiouſneſs, and maintain diſcipline. With ſuch diligence did the duke apply himſelf to this ſiege, that, unable to ſupport the fatigue, he was ſeized with a fever, which had nearly proved fatal. His ſituation inſpired the enemy with freſh courage. They ventured to appear in the field; reduced Aloſt, and ſome other places of little conſequence; but could not prevent the loſs of Menin taken by aſſault, though it was ſoon after retaken by the prince of Orange. In Brabant the ſtates likewiſe obtained ſome advantages, though of too unimportant a nature to merit attention. The truth is, all the United Provinces were in a deplorable ſituation; and their trifling ſucceſſes were owing entirely to accident, or the duke of Parma's illneſs. Several provinces contributed nothing to the common cauſe; others furniſhed but a ſmall proportion of the taxes agreed upon at the union. The army had large arrears due, and lived at diſcretion; in a manner more oppreſſive to the people than taxes to the amount of their regular pay. The people clamoured againſt the ſtates; they threw the blame on the officers for relaxing in the point of diſcipline; and the officers recriminated, alleging, that the fault was in the ſtates, who failed in performing their engagements to the army. All was in confuſion; but as no perſon would acknowledge his error, there appeared little hopes of amendment. In a word, nothing beſides the ſame diſtreſs in the Spaniſh army could have prevented the duke of Parma from reducing the revolted provinces to accept any terms he ſhould think fit to preſcribe. He was equally in want of money; and his late treaty with the Walloons required that he ſhould diſmiſs all his foreign troops in the ſpace of ſix weeks after the publication of the treaty. His ſituation indeed was ſo deplorable, that he requeſted leave to reſign his command, and retire with the foreign ſoldiers to Italy;

58
Diſtreſſed ſituation of the republic.

but the court of Spain had too much confidence in his ability to entruſt ſo important a charge to another. In this ſtate of affairs the animoſity of the parties remained, without the power of ſhowing their reſentment. The ſtates were reſolute, but unable to defend their liberties. Philip was determined, but too weak to be deſpotic; and both were obliged to content themſelves with publiſhing bitter remonſtrances againſt each other.

59
Duke of Anjou choſen ſovereign.

At laſt the prince of Orange renewed the treaty with the duke of Anjou. The queen of England was again offered the ſovereignty, but ſhe declined it for political reaſons. The duke of Anjou was, however, oppoſed by a great number of the Reformed, on account of the ſhare his mother had in the horrid maſſacre of the Proteſtants at Paris. All arguments to remove their prejudices were in vain. Anjou was a Roman Catholic, and that alone was ſufficient to render him deteſtable. The prince of Orange urged the neceſſity of receiving the prince. Theologians and civilians allowed that it was lawful to have recourſe in extremity to a Papiſt, but the people continued obſtinate. This determined the prince of Orange to have recourſe to the States-general, to whom he ſent a long remonſtrance, pointing out the cauſes why the confederacy did not produce the intended effect; and exhorting them to re-conſider the affair reſpecting the duke of Anjou. In conſequence, the States-general referred the prince's remonſtrances to the provincial ſtates and cities; and after long deliberations, and warm debates, it was at length determined, in 1580, to call in the duke of Anjou, as the only reſource in ſo great a calamity. Accordingly the year began with a ſolemn treaty, whereby the United Provinces renounced their allegiance to Philip, and acknowledged Francis Hercules de Valois, duke of Alençon and Anjou, for their ſovereign. The treaty conſiſted of 27 articles, of which this we have mentioned was the chief. Deputies were ſent to the duke of Anjou, to explain the articles, and congratulate him on his acceſſion. As to the archduke Matthias, finding himſelf unſupported by the emperor, the empire, and the numerous friends whom he expected would have joined him on his elevation, he expreſſed no reſentment at the conduct of the provinces, which with great moderation he attributed to neceſſity. He only demanded to know their intention with reſpect to his own perſon; and the ſtates made their apology, by repreſenting the ſituation of their affairs, aſſuring him of their eſteem, permitting him to reſide in the Netherlands as long as he thought convenient, and highly applauding the prudence and equity of his conduct during his adminiſtration. As to the provinces of Holland and Zealand, they were left wholly in the hands of the prince of Orange, whoſe power as ſtadtholder was in no reſpect limited by the duke's ſovereignty. After all, Grotius affirms, that the duke's authority was merely nominal, that the real power devolved on the prince of Orange, whoſe name, however, was uſed in all public acts only in a ſubaltern capacity. It was apparent indeed to the French, that William concealed ambitious views under the cloak of patriotiſm; but it was not convenient to diſcover their ſentiments.

60
Prince of Orange proſcribed.

When the king of Spain was informed of this open defection of the Provinces, he attributed the whole to the prince of Orange, and proceeded directly to proſcribe him; he confiſcated his eſtate, upbraided him with ingratitude, and attempted to ſtain his character with ignominy. He even promiſed a reward of 25,000 crowns to whoever ſhould bring him the prince of Orange dead or alive; the ſame to his heirs, in caſe the perſon periſhed in the enterpriſe; and he declared all thoſe proſcribed, their eſtates confiſcated, their honours and dignities aboliſhed, who adhered to William a month after the publication of this edict.

The prince of Orange did not ſilently paſs over this proſcription. He employed one Villiers, a Frenchman, to refute the edict: his anſwer was well received, and is recorded by hiſtorians as a proof of the ſpirit, the equity, the prudence, and the moderation of the prince. However, when it was propoſed to the ſtates for their opinion, with a requeſt they would publiſh it in their own name, they declined it; aſſigning for a reaſon, that it contained ſome facts too little known to be credited, and perhaps too much acrimony and reſentment againſt a prince whoſe power they ſtill dreaded. With theſe recriminations ended the tranſactions of the year.

61
The States publicly exclude Philip from the ſovereignty.

The following year the ſtates, after long deliberations at the Hague, publiſhed an edict, excluding king Philip from any ſovereignty, right, or authority over the Netherlands. This writing appeared on the 26th of July 1581, under the title of *The abdication of Philip king of Spain.* It was extremely well drawn up; ſtated in the ſtrongeſt manner the mutual privileges of the king and people; proved that the allegiance of the latter was voided by the breach of contract on the ſide of the former; enumerated the oppreſſive and tyrannical acts of his government; ſet aſide his authority for the moſt cogent reaſons; forbad money to be coined in his name; and took every other ſtep towards independence. It was in vain for Philip to remonſtrate: he knew the ſtates were to be convinced only by the ſword; to this therefore he appealed. The duke of Parma blocked up Cambray ſo cloſely, that the garriſon was reduced to the extremity of living upon horſes, dogs, and cats; though they ſtill refuſed to capitulate, in hopes of being ſuccoured. At length the duke of Anjou aſſembled a body of 10,000 foot and 4000 horſe, and approached Cambray. The viſcount de Turenne and count Voulandois undertook to force themſelves with a body of men into the town; but they were ſurrounded and taken priſoners by the Spaniards. This diſappointment did not diſcourage the duke of Anjou; he ſtill preſſed forward with intention to attack the Spaniſh lines: but the duke of Parma, not caring to hazard a battle, deſerted his works, and retired to Bouchain. As ſoon as the duke of Anjou entered the city, he took an oath to govern it agreeable to its ancient laws, and to preſerve the citizens in the full poſſeſſion of all its liberties. He was now preſſed by the ſtates and the prince of Orange to march directly into Flanders: he endeavoured to comply; but his army, compoſed chiefly of volunteers, was ſo weakened by deſertion that the deſign was laid aſide.

62
Cambray relieved by the duke of Anjou.

63
Succeſſes of the Spaniards.

It was about this time that the duke of Anjou reſumed the notion of addreſſing Elizabeth queen of England. Not deterred by the ill ſucceſs of his former negociation, he determined upon a voyage to England; an excurſion which proved equally unſucceſsful to himſelf and unfortunate to the United Provinces, as during his abſence the duke of Parma made himſelf maſter of Tournay, which concluded the tranſactions of this campaign. He was magnificently entertained, led into a perſuaſion that all would ſucceed according to his wiſh, and at length tired out with tedious expectation. In his abſence, St Guilan was reduced by the prince of Eſpinoi. This general directed his march towards Dunkirk, with intention to join the French forces. The duke of Parma, who had notice of his motion, repaired to ſeize the opportunity of inveſting Tournay. He began his approaches, and was vigorouſly received by that garriſon, inſpirited by the courage of the princeſs Maria d'Eſpinoi, niece of the count Horn ſo cruelly beheaded by the duke d'Alva. The town was ſtormed in breach by the duke of Parma, who ſupported the aſſailants in perſon, received a wound, and had the mortification to ſee his Spaniards thrown headlong from the walls. The duke of Anjou repeatedly promiſed ſuccours; but either forgot, or could not perform his engagements: the latter indeed is the moſt probable; as he was certainly a dupe to the ſuperior policy of Elizabeth, who had not yet declared openly in favour of the States. In the end, deſpairing of relief, haraſſed with perpetual watching, and weakened by loſſes, the garriſon capitulated on the 29th of November. The conditions were honourable; and the princeſs d'Eſpinoi was treated with particular marks of diſtinction by the duke of Parma, who highly eſteemed the heroic qualities of this amazon. This advantage was ſucceeded by another, obtained by the Spaniſh general Verdugo, over the confederate army in Frieſland, commanded by general Norris and William Lewis of Naſſau, a young prince of great expectation. It appears from the Spaniſh account, that Norris was attacked in a defile, where he could not draw out his troops in battalia; and that he was put in confuſion, and defeated with great loſs. On the other hand, the Dutch writers allege, that he attacked the enemy; but being inferior to them in cavalry, retreated in good order, with ſcarce any loſs.

64
Duke of Anjou makes his public entry.

The year 1582 began with a ſpectacle very unuſual in the Netherlands, the public entry of a ſovereign elected by the people. The duke of Anjou ſetting ſail from England on the 8th day of February, arrived on the 10th at Fluſhing, where he was received by the princes of Orange and d'Eſpinoi. Next day they ſet out for Antwerp with a magnificent retinue, and went up the Scheld attended by 50 barges. His reception at Antwerp was ſplendid beyond any thing ever ſeen in the provinces: they even exceeded the preparations made for Philip himſelf on his being appointed to the government in the Netherlands by Charles V. his father. A theatre was erected before the walls of the citadel, in which was placed a chair of ſtate, covered with cloth of gold. There the duke was ſeated, and the conditions were read to him, upon which he was received as duke of Brabant. When he had ſworn to obſerve the articles, he was clothed with the ducal robe, and his head adorned with the ducal coronet by the prince of Orange; who ſaid, "I will pin it in ſuch a manner that it will not be eaſily ſhaken:" an expreſſion which at that time was taken for a happy omen, though it ſoon proved fallacious.

65
Prince of Orange aſſaſſinated.

While the ſtates of Brabant were employed in feſtivity and mirth, a Biſcayan merchant, named *Gaſper Anaſtra*, had contrived a project to redeem his ſhattered fortune by the death of the prince of Orange. He corrupted one of his domeſtics, by the promiſe of half the reward, to ſtrike the blow. The aſſaſſin entered the citadel; and as the prince was paſſing after dinner into another room, diſcharged a piſtol, and dangerouſly wounded him behind the ear. The prince was ſtunned with the force of the ball, and before he recovered the aſſaſſin was killed by his attendants; which prevented for a time the abſolute diſcovery of the plot, though it afterwards appeared from circumſtances. It was traced that he had confeſſed the ſecret to a Dominican named *Antonio Tunnermon*, receiving from the wicked prieſt abſolution, and a promiſe of eternal reward. Tunnermon was hanged, drawn, and quartered, his limbs being fixed upon the walls of Antwerp. But though for this time the prince eſcaped the danger, he was in 1584 aſſaſſinated at Delft, by one Balthazar Gerrard or Guion, a perſon who had before ſerved his highneſs with fidelity and zeal. He was at that very time employed by the prince to carry letters into France, and had received money to bear his expences, with which he purchaſed piſtols to murder his benefactor. At the criminal's examination, it appeared that he had long meditated this bloody action, and was confirmed in his reſolution by the Jeſuits and Catholic prieſts; he even affirmed on the rack, that the duke of Parma was privy to the deſign, who promiſed he ſhould have the reward: upon the whole, Gerrard ſeems to have been an enthuſiaſt, and his crime the reſult rather of inſanity, than of any concerted ſcheme, or malicious intention. His puniſhment, however, regarded only the action: it was cruel beyond meaſure, ſhocking to humanity, and a ſtriking inſtance of the vehement party-ſpirit of the times; not of the juſtice of the judges, or the attachment of the people to the prince of Orange.

66
Prince Maurice choſen ſtadtholder.

67
Succeſs of the Spaniards.

68
Duke of Parma obliged to move towards France.

The United Provinces were now in a moſt deplorable ſituation. The duke of Anjou had been totally unable to reſiſt the duke of Parma, in conſequence of which many towns had been taken; and in other reſpects the ſtates had ſuſtained immenſe loſſes. The duke of Anjou, chagrined and diſappointed, had retired to France, where he died. But above all, the loſs of the prince of Orange ſeemed to give the finiſhing ſtroke to the affairs of the ſtates; and confuſion and anarchy now reigned in their councils. The provinces of Zealand and Holland alone endeavoured to repair the loſs, and ſhow their gratitude to William by electing his ſon Maurice their ſtadtholder and captain-general by ſea and land. Maurice was at that time only 18 years of age; but appeared in every reſpect worthy of the high dignity which had been conferred upon him. The firſt ſtep taken by the confederates was a ſolemn renewal of the treaty of Utrecht; after which the moſt vigorous preparations were made for the defence of the country. But before any thing of conſequence could be done, the duke of Parma had reduced Liſkenſhouk, Dendermonde, Vilvorde, Ghent, and Antwerp; which ſtruck the ſtates with ſuch terror, that they again offered the ſovereignty to queen Elizabeth. This was once more refuſed; though that princeſs engaged, by a new treaty, to aſſiſt the ſtates both with men and money. An army was accordingly ſent into the Netherlands under the command of the earl of Leiceſter: but it does not appear that this was of any eſſential ſervice to the cauſe; for the conduct of that general was ſo exceedingly improper that he was not only baffled in every military enterpriſe, but drew upon himſelf a general odium. It is very probable indeed that the States could not long have ſupported themſelves in ſuch circumſtances, had not Philip raſhly engaged in a war with England, with whoſe naval power he could ſcarce be enabled to cope by any ſuperiority in numbers whatever. The defeat of the Spaniſh armada in 1588* gave ſuch a blow to the power of that nation, as totally diſabled them from carrying on the war in the Netherlands. Inſtead of ſending the proper aſſiſtance to the duke of Parma, that general received orders to haſten to the aid of the duke of Mayence, who had been defeated by Henry IV. The duke was obliged to comply with this order, though he was ſenſible the loſs of the United Provinces muſt be the conſequence. Prince Maurice now carried every thing before him; and by the end of the year 1591, the Dutch ſaw their frontiers extended, the whole country ſecured by rivers and covered by fortified towns, with the greateſt probability of driving the Spaniards out of Frieſland in another campaign.

* See England, nº 312.

The remainder of the hiſtory of this war is only a detail of the Spaniſh loſſes and misfortunes, which now enſued. Their affairs were at laſt totally ruined by a deciſive victory gained by prince Maurice, in the year 1600, over the archduke Albert, who had been appointed the Spaniſh governor of the Netherlands. King Philip II. died in 1598, leaving the affairs of his kingdom in the moſt diſtreſſed ſituation; notwithſtanding which, his ſucceſſor Philip III. was too haughty to conſent to peace, or allow that the States were free, though he was plainly unable to keep

them

69 A twelve years truce concluded with Spain.

them in ſubjection. At laſt, in 1606, the courts of Madrid and Bruſſels, began to think of peace in good earneſt. In 1607 a ſuſpenſion of hoſtilities took place, and in 1609 a treaty was concluded. In the firſt article of the treaty, the archduke, in his own and the king of Spain's name, acknowledged the United Provinces, and renounced all claim to ſovereignty over them, but in ſuch general terms as would admit of altercation. In the ſecond, a truce for 12 years, by ſea and land, through all the dominions of both parties, was concluded. By the third article, the parties were to remain in poſſeſſion of what they now held, without ceſſion or exchange. In the fourth, a general amneſty was ſtipulated, and full freedom of trade by ſea and land to each others dominions granted. This neceſſarily implied a ceſſation of hoſtilities in the Indies; however, great debates afterwards aroſe upon this account. Spain obſerving the rapid progreſs of the Hollanders in the India trade, apprehended they would ſoon become too powerful in that quarter; and the Dutch were willing to maintain the advantage of their ſuperiority. Both, for this reaſon, diſputed the article; yet it could not be ſet aſide without deſtroying the whole treaty, and the fruits of all their laboured conferences. The fifth article regulated the imports, and the duties to be paid by the ſubjects of the archduke and the States, trading to each others dominions, which were to be on the ſame footing with thoſe of other nations. The archduke uſed his utmoſt endeavours to have the duties at Lillo, on the Scheld, aboliſhed, and the commerce of Antwerp reſtored to its former grandeur; but this was ſo diametrically oppoſite to the intereſt of the Hollanders, that it was impoſſible it ſhould ever take place. The ſixth and ſeventh articles likewiſe regarded commercial affairs. But it would be unneceſſary to dwell on particulars. Sufficient is it, that the truce was mutually beneficial, Spain being no longer in condition to ſupport the war, and the Hollanders having obtained the end of all their deſperate reſiſtance and invincible perſeverance in the cauſe of liberty. Philip of Naſſau, by the truce, entered into poſſeſſion of all his paternal eſtates in the Spaniſh Netherlands and Burgundy; while the ſtates rewarded the faithful ſervices of Maurice with a penſion of 25,000 florins, to be paid annually out of the public treaſury, beſides an appointment of 60,000 francs as governor general. Penſions were likewiſe ſettled on the other princes of the houſe of Naſſau: all were gratified in a manner that demonſtrated the high ſenſe the republic had of their merit, though they might poſſibly be diſappointed in their great deſign of raiſing prince Maurice to the ſovereign authority.

70 War renewed.

71 Spaniſh flota taken.

72 Peace concluded

No ſooner were the Dutch freed from this extreme danger, and felt the bleſſings of liberty, than diſſenſions among themſelves took place. The diſputes betwixt the Arminians and Calviniſts produced violent diſturbances, which frequently ended in the perſecution of the former. In 1621 war was renewed with Spain; and it may be remarked, that during the whole courſe of it, the ſubjects of the republic traded to the Spaniſh ports, as if there had been an entire friendſhip ſubſiſting between the two nations. It was no uncommon practice with them to ſupply towns with proviſion that were beſieged by their own armies; and to furniſh the enemy with ammunition and other neceſſaries, without which they could not carry on the war. Their motive and apology for this conduct was, that thus they kept in their own hands the profits by which other nations would be enriched. By ſteadily purſuing this line of conduct, making as many prizes as they could by force, and at the ſame time making as much profit of their enemies as could be obtained by a lucrative trade, it is no wonder that the republic ſhould flouriſh, and rival in wealth the greateſt nations of Europe. In 1628 the Spaniards met with a dreadful blow by the capture of their flota from Mexico. This was the greateſt prize the Hollanders had ever met with; being valued at no leſs than 15,000,000 livres. From this time the Spaniards were everywhere defeated and baffled in almoſt every enterprize they undertook; nevertheleſs, they carried on the war, with an obſtinacy hardly to be matched, for 20 years longer. At laſt, in 1648, a treaty was concluded, by which his Catholic Majeſty renounced all right and ſovereignty over the Lords the States-general of the United Provinces, who were henceforth declared a free and independent republic, and that both ſides ſhould remain in the unmoleſted poſſeſſion of what they held ſeverally at the ſigning of the treaty.

73 Flouriſhing ſtate of the republic.

74 Cauſe of the war with France.

From this time to the year 1670 we meet with nothing very remarkable in the hiſtory of the United Provinces. By invariably purſuing the maxims of prudence, induſtry, and frugality, the republic had attained the higheſt pitch of grandeur. Amſterdam was become the emporium of Europe, and the richeſt city in the univerſe. Holland alone contained 3,000,000 of ſouls, and all the other provinces were proportionably populous. The States diſpatched miniſters and conſuls to China, Siam, and Bengal, to the Great Mogul, the king of Perſia, the khan of Tartary, the Grand Signior, the czar of Muſcovy, and the princes of Africa. They were conſidered as an important weight in the ſcale of Europe, and no treaty was concluded without their ambaſſadors. The triple alliance with England and Sweden, into which they had entered, gave Louis ſuſpicion that they propoſed to ſet bounds to his ambition, and clip thoſe bold pinions which had ſo ſwiftly conveyed his conqueſts over the Low Countries. Van Beuningen's inſolence, in comparing himſelf to Joſhua ſtopping the courſe of the ſun, which was the French king's device, highly diſguſted his majeſty; who was ſhocked at the preſumption and pride of a republic juſt ſtarted out of obſcurity, and gained, in the ſpace of a century, from the ocean. But what was ſtill more alarming to Louis, was the probability that the Dutch would ruin the manufactures of France, and his new eſtabliſhed commerce of the Indies. His jealouſy diſcovered itſelf in divers inſtances; and the penſioner De Witt, who at that time had the leading of affairs, his brother, and his party, did all in their power to remove theſe prejudices; but the unhappy differences which then prevailed in the United Provinces fruſtrated all their endeavours.

75 Treaty between the kings of France and England.

Louis now ſought every opportunity of breaking with the Dutch; leſs perhaps from any dread of their power, or ability to injure him, than with a view to enlarge his dominions by the entire conqueſt of the Low Countries. He knew that the whole ſtrength of the republic conſiſted in her marine: that her frontier was weak, her provinces divided, and the chief power in the hands of men, inveterately ſet againſt the family of Orange, the ancient captains of the republic. His firſt attempt was to diſſolve the triple alliance, and diſengage from it Charles II. king of England. In this buſineſs the ducheſs of Orleans was employed: ſhe went to England under pretence of viſiting the king her brother; and her negociation was ſucceſsful. In the mean time Louis poſſeſſed himſelf of Lorrain, under pretence that duke Charles was forming alliances in the empire againſt France.

The following year was ſpent in negociations with the emperor, Spain, and Sweden, with the electors of Cologne and Brandenburg, with the biſhop of Munſter, and other ſpiritual and German princes. The deſign of Louis was to prevent their acceding to the triple alliance; from which he had already weaned one power, the moſt conſiderable of the whole. The biſhop of Munſter beheld with uneaſineſs the growing power of the United Provinces: he pretended that they had made ſeveral attempts upon the counties of Stirum, Culemberg, Bentheim, and Eaſt Frieſland; that they had ſeized on Ravenſtein on the Meuſe, and ſeveral other places belonging to his biſhopric. In his own defence he concluded a treaty with France, and prevailed on the elector of Cologne to follow his example. By ſigning a treaty with theſe two princes, the king opened a way to Holland by the Meuſe and the Rhine; he eſtabliſhed by this means places of arms and magazines in a country diſtant from his own dominions, and ſecured a retreat in caſe his enterpriſe proved abortive. With reſpect to the emperor, every artifice was uſed to keep him neutral; and indeed his own inclinations co-operated but little in favour of the Dutch, whom he regarded as ſubjects revolted from the princes of his family, and in poſſeſſion of ſeveral places belonging to the empire. In Sweden, Louis's negociations were equally ſucceſsful; for here he prevailed ſo far with Charles XI. as to obtain a ſtipulation, that if the emperor, or any of the princes of the empire, joined their forces to the Dutch, a Swediſh army ſhould march into the very heart of Germany and join the French, in order to force thoſe princes to obſerve the treaty of Weſtphalia.

76 Brandenburg aſſiſts the republic.

Of all the Germanic body, the elector of Brandenburg alone intereſted himſelf for the ſafety of the States-general. The peace of Weſtphalia had prevented this enterpriſing prince from extending his dominions in Germany, and retaking Pomerania from the Swedes. He had long aſpired at the ſtadtholderſhip of Holland; and though that office had been for ſix years ſuppreſſed, yet he flattered himſelf, that in caſe of a war he might obtain it, perpetuate it in his family, and in time reduce Holland by dint of force, intrigue, and ſtratagem. With this view, he rejected the propoſals of ſeveral princes of the empire, and even thoſe of France, endeavouring by every poſſible method to inſinuate himſelf into the friendſhip and confidence of the States. In the end he concluded a treaty with them, whereby it was ſtipulated that he ſhould aſſiſt the republic with 25,000 men. Beverning, the Dutch ambaſſador at Madrid, diſconcerted all the ſchemes of France at that court, and engaged the queen of Spain to furniſh money and troops for the defence of the United Provinces. Thus was the face of Europe wholly changed. France and England, who had contributed largely to the raiſing and aggrandizing the republic, were now incited to deſtroy her; while Spain, which for an age had been endeavouring to ſuppreſs her, was arming for her ſupport. Pierre de Groot, the Dutch miniſter at the Hague, was employed to penetrate into Louis's deſigns; he gave his conſtituents notice that he foreſaw a terrible ſtorm ready to fall upon them, which they might nevertheleſs break by ſeaſonable ſubmiſſions and proper acknowledgments. Upon this the States wrote to the king, endeavouring to appeaſe his wrath; but finding him inexorable, they prepared for receiving him, and provided for the ſecurity of their provinces. But the long peace the republic had enjoyed deſtroyed her ſtanding forces, and little confidence could be repoſed in her new levied ſoldiers.

77 Hoſtilities commenced.

As ſoon as matters were ripe for execution, Louis ordered an army of 100,000 men to file off towards the Rhine. Before the opening of the campaign, and previous to his declaration of war, he divided his army into four columns; commanding one in perſon, with the marſhal Turenne under him. Another was led by the prince of Conde, aſſiſted by the marſhals Humieres and Bellefonds; the third was headed by Crequi; and the fourth marched to Weſtphalia under the conduct of the duke of Luxemburgh, to join the biſhop of Munſter. As the marſhals Crequi, Bellefonds, and Humieres, refuſed to receive orders from Turenne, they were baniſhed; but after ſix months exile, were recalled, at the inſtance of the whole body of marſhals in France, upon their making proper ſubmiſſions.

Such an army drawing towards their frontiers could not but terrify the Dutch, now torn by civil factions. The partiſans of the Orange family were for aboliſhing the perpetual edict, and raiſing William III. to the dignity enjoyed by his predeceſſors; but the De Witt faction oppoſed him violently, though they could not prevent the young prince from being choſen captain-general and high admiral. Many perſons hoped that William's new dignity would incline his uncle Charles II. to return to the triple alliance: but that hope was fruſtrated by the conduct of his majeſty; who, in conjunction with the moſt Chriſtian king, declared war againſt the States-general on the 7th day of April. A month after, the elector of Cologne and biſhop of Munſter followed the example of the two kings. The Dutch put themſelves in the beſt poſture of defence that circumſtances would admit. Maeſtricht was ſtrongly garriſoned; the prince of Orange had aſſembled an army of 25,000 men, with which he advanced to the banks of the Iſſel, and the Dutch fleet cruiſed off the mouth of the Thames to prevent the junction of the naval forces of England and France, which amounted to 150 ſhips. All Europe watched the firſt motions of two powerful kings, ſeconded by the beſt generals of the age.

His moſt Chriſtian majeſty joined his army at Charleroy. It was compoſed of 23 companies of *gens d'armes*, life-guards, muſqueteers, and light-horſe, two regiments of the French and Swiſs guards, 14 regiments of foreign infantry, and 60 regiments of light horſe or dragoons, compriſing in all an army of 110,000 fighting men, under the command of marſhal Turenne as captain-general. Holland could only be attacked by the Rhine or the Meuſe; and the generals and miniſters differed by which of theſe inlets they were to make the firſt impreſſions. At laſt, after ſeveral deliberations, it was determined to make both attacks at the ſame time, in order the more to diſconcert their councils. It is probable that Turenne always oppoſed the ſiege of Maeſtricht; for we find him immediately after the ſurrender of Maſeik ſtrongly diſſuading the king from that enterprize, in oppoſition to the ſentiments of the prince of Conde. At laſt he prevailed; and it was reſolved in council to advance towards the Rhine, and beſiege at the ſame time the towns of Rhinberg, Veſſel, Orſoi, and Burick. Theſe places were all well fortified, and deemed the keys of Holland; however, the Dutch did not appear diſturbed at their being inveſted, as they were only under the protection, and did not immediately belong to, the United Provinces. They were beſides in hopes that any attempts upon the territory of Cleves would haſten the preparations of the elector of Brandenburg, and even rouze the emperor into a ſenſe of the danger he was in from the vaſt deſigns of Louis. Nothing could oppoſe armies ſo well appointed, led by generals ſo ſkilful and ſo experienced.

78 Succeſſes of the French.

The four towns ſurrendered within a few days of each other; and Rhinberg, that held out longeſt, opened its gates on the ſeventh of June. A few days after, the town and fort of Rhees, and the town of Emerick, ſurrendered; upon which the king reſolved to paſs the Rhine by a ford, over which the cavalry were to ſwim. This bold enterpriſe was projected and conducted by Conde; who, in the face of two regiments of foot, and ſeveral ſquadrons of horſe, under general Wartz, intrenched on the oppoſite ſide, effected the paſſage, in the ſame order, and with as much regularity, as if he had marched his troops on dry land. The enemy made a ſtout reſiſtance; but were driven from their poſt, after having killed the duke de Longueville on the ſpot, and wounded the prince of Conde, which diſabled him for ſome time from attending the ſervice, and obliged him to reſign the command of his army to Turenne.

It is almoſt incredible with what rapidity towns and fortreſſes yielded to the fortune of his majeſty's arms. The reduction of Betau, the moſt fruitful country of the United Provinces, and the ſurrender of Tolhus fort, obliged the prince of Orange to abandon the Iſſel, leſt he ſhould be attacked in the rear, and to retire to the very heart of the country, as far as Rhenen, in the province of Utrecht. By this means the town of Arnheim, the forts of Knotſemborough, Voorn, St André, and Shenck, this laſt, the ſtrongeſt in the Netherlands (having coſt the great Henry Frederick prince of Orange a ſeven months ſiege), with a variety of other forts and towns, ſurrendered as ſoon as ſummoned; and at laſt Nimeguen, a town ſtrong from the nature of the works and fortifications, and garriſoned by 8000 fighting men, including the inhabitants, was inveſted. After the citizens had for eight days exhibited ſignal proofs of courage in defence of their liberties, they were forced to yield to the ſuperior ſkill of Turenne.

In the mean time the Biſhop of Munſter and elector of Cologne, having joined that body of troops under the command of the duke of Luxemburgh, the united army entered the province of Overyſſel, and by dint of cruelty, and terror which the duke ſpread, reduced the towns as ſoon as he appeared before them. Animated by that implacable rage that conſtantly attends religious wars, the two prelates obliged the duke to exert a ſeverity, by no means ſuited to his nature, againſt heretics and the rebellious ſubjects of the houſe of Auſtria. Next the king's forces penetrated into the province of Utrecht, where their conqueſts went on with the ſame rapidity, and put the capital of the province in the utmoſt danger.

79 The Dutch obliged to overflow their country.

To retard its fate, the Dutch could imagine no other expedient than opening their ſluices, and overflowing the country. The other towns followed the example of Utrecht; and Holland, Brabant, and Dutch Flanders, was one vaſt lake, the towns riſing like iſlands in the midſt of the waters. Farther to ſtem the torrent of Louis's conqueſts, the people were perſuaded the only barrier was to lodge the ſupreme power in the hands of the prince of Orange. They accordingly obliged the ſtates of Holland and Weſt Frieſland to unite the dignity of ſtadtholder to thoſe of captain-general and high-admiral, with which the prince was already inveſted. They likewiſe ſent remonſtrances ſo pathetic to the king of England, that Charles, moved with the ſituation of the republic, and jealous of the deſigns of Louis, diſpatched the duke of Buckingham and earl of Arlington into Holland, to quiet the fears of the Dutch, and inſiſt upon the king's penetrating no farther into Holland. In caſe of Louis's refuſal, Charles declared he would break the alliance; as he perceived that, inſtead of ſecuring Zealand to the Engliſh, agreeable to the treaty, the deſigns of France were to unite the whole republic to their own monarchy. His moſt Chriſtian majeſty had in fact no great regard to the menaces of his ally: but as perſiſting obſtinately to advance into a country which the inundation rendered impaſſable, might terminate in the ruin of all his ſchemes, he ſeemed, out of compliment to the king of England, to liſten to terms of accommodation; which, after all his victories, could not fail of proving advantageous. In the ſpace of three months he had conquered the provinces of Guelderland, Overyſſel, and Utrecht, taken about 50 towns and forts, and made 24,000 priſoners. Conde and Turenne adviſed his majeſty to ſend the priſoners to work upon the canal of Languedoc, and to leave all the places that were not eſſential to the preſervation of his conqueſts; the miniſter Louvois was of a different opinion, and his ſentiments determined the king. The priſoners were releaſed for a trifling ranſom, and the king's army totally reduced and exhauſted by the continual drains made to garriſon the conquered places.

80 Unſucceſsful negociation.

A negociation was ſet on foot at Boxtel, near Bois-le-duc, whither the king, attended by the Engliſh ambaſſadors and the Dutch deputies, repaired: but the terms required of the republic were ſo hard, that they were rejected with diſdain by the Dutch; who, animated by their ſtadtholder, reſolved to wait a change of fortune in the midſt of the waters. They uſed every expedient to rouſe the princes of Germany in their defence; and ſo ſucceſsfully that the elector of Brandenburgh, the neareſt and moſt intereſted prince, prepared to take the field. The undaunted courage, the vigilance, the public ſpirit of the prince of Orange, gained him the entire confidence and affection of the republic; and excited their reſentment againſt the two brothers De Witts, his implacable enemies, whom they accuſed of receiving penſions from Louis. The ſuggeſtion was falſe; but poſſibly their love of liberty, and jealouſy of the houſe of Orange, had carried thoſe two great politicians too far in their pacific meaſures and complaiſance to the power of the French monarch. The penſionary was attacked in the ſtreet by the populace; but by his perſonal bravery broke through the crowd, and ſaved his life, though covered with wounds. Soon after the ſedition broke out afreſh, and the partiſans of the houſe of Orange again ſtirred up the animoſity of the republic againſt the De Witts. Several crimes were laid to the penſioner's charge, but he cleared himſelf. Suborned witneſſes accuſed his brother of an attempt to poiſon the prince of Orange. Cornelius was impriſoned and treated with great barbarity. While he was under the torture, he ſung that ode of Horace, *Juſtum et tenacem propoſiti virum*.

81 The De Witts cruelly murdered.

His brother took him out of priſon after ſentence of baniſhment was pronounced; the tumult roſe high, and both the De Witts were cruelly torn in pieces in the ſtreets. William of Orange ſeemed touched at this terrible ſacrifice; he made the penſionary's eulogium, and ordered the murderers to be proſecuted; however, the clemency he ſhowed them, the advantages he obtained by the maſſacre, and the animoſity he bore the De Witts, convinced all men that he countenanced the murder.

William of Orange, in the mean time, daily ingratiated himſelf more. He gave up his whole fortune for the ſafety of the ſtate; and exerted himſelf with ſuch prudence and ability, that all Europe began to unite againſt the two kings by the month of July. Every prince in Germany was in motion to ſuccour the Dutch. The emperor, the king of Denmark, the elector of Brandenburg, the duke of Brunſwick Lunenburg, the landgrave of Heſſe, immediately ordered their troops to join; ſeveral of the other princes were preparing to take the field. All were jealous, England began to waver, and there was not a power in Europe upon whom Louis XIV. could heartily rely. The army of Brandenburg, commanded by the elector in perſon, and the forces of the empire under the famous Montecuculi, joined near Heidelſheim, and compoſed a body of 40,000 men.

82 Exploits of Turenne.

Turenne, now appointed generaliſſimo of the king's army on his majeſty's return to Paris, marched to oppoſe the enemy's paſſing the Rhine. For three whole months were the elector and Montecuculi employed in abortive attempts to effect a paſſage at Mentz, Coblentz, Straſburgh, and other places. This anſwered the purpoſe of making a powerful diverſion in favour of the Dutch, though they could not accompliſh their deſign of joining the prince of Orange. After repeated diſappointments, the Imperial army directed its march to Weſtphalia; and Turenne followed, in order to keep the biſhop of Munſter ſteady to his engagements. For half the campaign,

paign, he, with a body of 16,000 men baffled every ſtratagem of the elector and Montecuculi, the latter the moſt renowned general of the empire, at the head of an army near triple his ſtrength. He obliged them to go into winter-quarters, in a country haraſſed and exhauſted; and confirmed the biſhop of Munſter in the alliance of France, at the very time he was on terms with the emperor. He obliged the elector of Brandenburg, who took the chief command during Montecuculi's illneſs, to abandon the ſiege of Werle; took Unna, Kamen, Altena, Berkembam, and ſeveral other towns and fortreſſes. By continuing his operations, he forced the elector out of his winter-quarters again into the field, chaſed him from poſt to poſt, until he obliged him to quit Weſtphalia, repaſs the Weſer, and retire with precipitation into the biſhopric of Hildeſheim. After taking poſſeſſion of the elector's towns in Weſtphalia, he purſued him into the biſhopric of Hildeſheim; and at length, by mere dint of ſuperior genius, forced him to ſeek ſhelter in his hereditary dominions. All this was effected after Louvois had appointed the marſhal's army quarters in Alſace and Lorrain, amidſt the rigours of a ſevere winter, oppoſed by a ſuperior enemy, by the artifices of Louvois, and ſeconded only by his own prudence, and the affections of his troops, which he maintained in defiance of all the difficulties, hardſhips, and dangers, they encountered. It was indeed ſuppoſed, that Montecuculi was prevented from giving Turenne battle by the remonſtrances of prince Lobkowitz, the emperor's ambaſſador, influenced by the gold of Louis. Certain indeed it is, that Montecuculi's illneſs aroſe from his chagrin at ſeeing all his projects fruſtrated by the unſteady dilatory conduct of the court of Vienna. Louis's negotiations diſturbed Europe no leſs than his arms. His tools and creatures ſwarmed in every court. Leopold could not be prevented from declaring in favour of Holland; but his miniſters were bought off from ſeconding the emperor's intentions. The whole Engliſh nation exclaimed againſt the alliance of their king with France; but Charles ſtood in need of French gold to ſupply his extravagance and profligacy. The elector of Bavaria had indeed been compelled by Louis to retire to his capital; but it was by dint of intrigue that he was forced from his alliance with Holland, and conſtrained to ſign a peace with France.

While Turenne was thus employed on the Rhine, Conde having recovered of his wounds, returned to the command of the army in Holland. He beſieged and took Maeſtricht in 13 days. Having repaired the fortifications, he propoſed making himſelf maſter of ſeveral other towns; but the inundations everywhere ſtopped his courſe. All his attempts to draw off the waters were in vain; and he was forced to content himſelf with preſerving, without pretending to extend, the king's conqueſts.

Whatever glory the king might have acquired by land, certain it is that the conduct of his admirals deſerved equal praiſe with that of his generals. In little more than 12 months the French were taught the art of naval war. Before, they fought ſhip to ſhip; but underſtood nothing of thoſe evolutions by which whole fleets imitate the movements of armies. The duke of York, afterwards James II. invented the method of giving all orders at ſea by means of ſignals: this and every other part of the art the French borrowed from the Engliſh; and became ſo apt ſcholars, that they ventured to give battle to the Hollanders, the great rivals of the Engliſh on that element. Their fleet, amounting to 40 ſail, beſides fire-ſhips, joined to the Engliſh, gave battle three different times to the Dutch. De Ruyter gained additional glory in theſe engagements; and D'Eſtrees the French admiral gained the eſteem of De Ruyter.

In the mean time, Spain declared in favour of the Dutch; and prevailed upon the emperor to act more heartily in the cauſe of Holland, and defence of the liberties of Europe. The prince of Orange was reinforced by 10,000 Spaniards, ſent to him by the governor of the Low Countries. Philip had concluded a treaty with the States at the Hague, whereby he declared war againſt France, engaged the emperor to make a powerful diverſion on the Rhine, ſtipulated not to accept of peace before the Dutch had retrieved all their loſſes, and obtained from them a promiſe to liſten to no terms of accommodation before his Catholic majeſty was reinſtated in all his poſſeſſions in the Low Countries, previous to the peace of the Pyrenees. Montecuculi was ordered to advance with 30,000 men to Franconia; and Turenne, joining the troops of Colonge and Munſter, paſſed the Main, and took poſt in the electorate of Mentz. The prince of Orange receiving no impediment from Conde, who was forced on account of the inundations to repaſs the Meuſe, thought this a proper time for action, as the enemy had no conſiderable forces in the heart of the United Provinces. He ordered ſome troops to file off ſecretly to Amſterdam and Muyden; lined with infantry the intrenchments which ſecured the paſſage to Holland; and to deceive the duke of Luxemburgh, who commanded in Utrecht, ſent ſome forces by ſea to attack Bommel. The duke, not penetrating the prince's deſign, came to ſuccour the place; and William, finding his ſtratagem ſucceed, marched to Naerden, and with 25,000 men inveſted and took the place before the duke could provide for its ſecurity. Upon this ſucceſs, the Dutch took courage, fortune inclined in their favour, and in a ſhort time all the horrors of war were removed from the interior parts of the United Proivnces to the Spaniſh Netherlands. Neither the experience nor conſummate addreſs of Turenne, the genius of Vauban, or the indefatigable vigilance of Louvois, could repair the error committed in ruining the army to garriſon the conquered towns. Even Conde's fire ſeemed extinguiſhed in the waters with which the Dutch had drowned their country. Inſtead of penetrating farther, he was obliged to retreat. Turenne could not prevent the junction of Montecuculi and the prince of Orange, nor the loſs of Bonne. This junction, and the declaration of Spain, obliged the armies of France to abandon the three provinces with ſtill more rapidity than they had conquered them. The triumphal arch at St Dennis was hardly erected as a monument of Louis's victories, before the fruits of thoſe victories were relinquiſhed. In a word, the parliament of England would no longer ſuffer Charles to be the mercenary tool of France; the late ill ſucceſs cooled the elector of Cologne and the biſhop of Munſter in their friendſhip; and Louis, forſaken by all his allies, found himſelf under the neceſſity of maintaining ſingly a war againſt the empire, Spain, and the United Provinces.

83
Fortune declares againſt the French.

84
State of the republic to the preſent time.

From that time the United Provinces have been diſtinguiſhed among the European nations as a very conſiderable maritime and commercial power. Their connection with Britain by the Revolution in 1688, when William III. ſtadtholder of Holland became king of this iſland, brought on a much cloſer connection between the two nations than had ever taken place before. By means of this connection, William formed a plan of humbling his great adverſary Louis XIV. who had ſo lately brought his country to the verge of ruin. For this purpoſe he renewed the war in 1689, and commanded the army in perſon. However, he was overmatched by the abilities of Luxemburg the French general; who oppoſed him, and obliged him to conclude a peace in 1697. His enmity to the French king, however, was not yet extinguiſhed. The remaining part of his life he employed in forming the moſt powerful confederacy againſt that monarch; and ſo much was he wrapped in this project, that even in his dying moments it ſeemed to prevail over every other conſideration*. His meaſures, however, were adopted by his ſucceſſor Queen Anne; and the French monarchy had nearly ſunk under the united efforts of the forces of Britain, Holland, and Germany, headed by the experienced generals Marlborough and Eugene. But at laſt the whole plan was diſconcerted by a revolution in the Britiſh miniſtry; the Dutch were diſappointed in the moment of their expectations, and obliged to conſent to the peace of Utrecht, which left them expoſed to the attempts of France as much as ever. A barrier compoſed of a great number of fortified towns was indeed granted them; but barriers of this kind are a ſlender defence againſt the modern improvements in war. In the war of 1739, theſe towns were taken one after another by Marſhal Saxe, who thus revenged the exploits of the duke of Marlborough; while the Dutch and Britiſh army, commanded by the late duke of Cumberland, were driven from place to place, without being able to make one ſucceſsful effort from the beginning of the war to the end of it. See BRITAIN, nº 342—429.

It is probable that the bad ſucceſs of this war cooled the affections of the Dutch towards Britain ſo much, that ever ſince they have acted rather as concealed enemies than friends. In the war of 1755, their attachment to France was evident; and in the laſt, it proceeded to ſuch an height, as to oblige the Britiſh miniſtry to declare war againſt them. The iſſue of this war is ſtill freſh in our memories. A ſingle naval engagement was the only event of conſequence that took place, and ſhowed that both were formidable antagoniſts to each other.

This war was undertaken in oppoſition to the wiſhes of the ſtadtholder, who having been maintained in his prerogatives chiefly by the powerful influence of Britain and Pruſſia, could have no motive for making a rupture with the court of London. The ſubſequent tranſactions of the States-general have been related under other articles (ſee PRUSSIA and REVOLUTION). Having deſerted the grand alliance formed againſt the diſturbers of the peace of Europe, and the office of the ſtadtholder being aboliſhed, the Dutch republic, under the name of an *ally*, is now in reality little better than a province, of France. The conſequence of this alliance is what might have been expected. The Britiſh government, obliged to attack its enemies wherever it might find them, commenced hoſtilities againſt the United Provinces, and in the compaſs of a very ſhort period wreſted from them their moſt valuable poſſeſſions both in the eaſtern and in the weſtern world.

85 Climate, &c. of the United Provinces.

The ſeven United provinces being in great part ſurrounded by the ſea, lying low, and abounding in marſhes, have a damp and unwholeſome air. Rains and fogs are frequent; and the gout, ſcurvy, rheumatiſm, and agues, very common and difficult of cure. The effects of human induſtry here are wonderful in the dykes and dams erected for defending the country againſt the inundations of the ſea, and in ditches, canals, mills, and ſluices, for draining the marſhes. The quantity of grain produced is not ſufficient for home conſumption; but the paſtures in the marſhes are ſo rich, that they can ſpare a great deal of butter and cheeſe for exportation. They have alſo a good breed of ſheep, whoſe wool is highly valued. There is turf, madder, tobacco, ſome fruit, and iron; but all the pit-coal and timber uſed in this country, and indeed moſt of the neceſſaries of life, are imported. All the provinces either lie upon, or communicate with, the North Sea, by means of that called the *Zuyder*, or *South Sea*; which was formed partly by the Rhine's right branch, then increaſed by the Vecht, which has now another outlet, overflowing the low ſwampy grounds thro' which it paſſed; and partly by the ſea, in the 13th century breaking in, and overflowing a large tract of ground contiguous to that before laid under water by the Rhine. The principal rivers are the Rhine, the Meuſe, the Scheld, and the Vecht. The firſt is divided into ſeveral branches, one of which joins the Old Iſſel, and after that falls into the Zuyder Sea; another named the *Leck*, at the village of Krimpen, mingles with the Meuſe; a third, called the *Crooked Rhine*, is branched out at Leyden into canals, of which one runs into the lake of Haerlem, and another loſes itſelf in the ſand hills between Catwyk on the Rhine, and Catwyk on the ſea; and a fourth, called the *Waal*, falls into the Meuſe over-againſt Workum. The Meuſe, after dividing itſelf into two branches, and again uniting theſe, falls into the North Sea below Rotterdam. The Scheld below Antwerp divides itſelf into two branches, called the *Weſtern* and *Eaſtern Scheld*; the firſt ſeparating Flanders from Zealand; and the other, running north by Bergen-op-Zoom, and afterwards eaſt, between the iſlands of Beveland and Schowen, falls into the ſea a little below. The Vecht runs from eaſt to weſt through the province of Overyſſel, and falls into the Zuyder Sea. There are many ſmaller rivers that join theſe, and a vaſt number of canals; yet there are few good harbours in the provinces. The beſt are thoſe of Rotterdam, Helvoetſluys, and Fluſhing. As to the harbour of Amſterdam, it is indeed one of the largeſt and ſafeſt in Europe; but there is a bar at the entrance of it, over which large veſſels cannot paſs without being lightened or unloaded. There are no mountains in theſe provinces; and the only lake, properly ſo called, is that of Haerlem. The provinces are extremely well cultivated, and very populous; eſpecially that of Holland, which, in this reſpect, perhaps has not its equal in the univerſe. The towns are very agreeable, being kept clean, and having canals in the middle of the ſtreets, planted with trees. The number of inhabitants is computed at about 2,000,000. The animals here are much the ſame as in England; but their horſes and horned cattle are of a larger ſize. Storks build and hatch on their chimneys; but, being birds of paſſage, they leave the country about the middle of Auguſt, with their young, and return the February following. It is ſaid there are ſome wild boars and wolves here; and that neither oyſters nor herrings are to be found upon the coaſt: but of other fiſh they have the ſeveral ſorts, both in their ſeas and rivers, that they have in Britain.

86 Religion.

The eſtabliſhed religion here before the Revolution was the Preſbyterian, or Calviniſm: none but Preſbyterians were admitted into any office or poſt in the government, excepting the army; all religions and ſects, however, were tolerated, and had their reſpective meetings or aſſemblies for public worſhip, among which the Papiſts and Jews were very numerous. Since the late alliance with France, no particular religion is eſtabliſhed; and the phlegmatic Dutch have drunk deep of the cup of infidelity, mixed by their new and volatile allies.

There are five univerſities in the provinces, viz. thoſe of Utrecht, Leyden, Franeker, Groningen, and Harderwic; but the three laſt are inconſiderable. The diſſenters in England often ſend their children to theſe univerſities for education. Before the Reformation there was an archbiſhop at Utrecht who had for his ſuffragans the biſhops of Deventer, Groningen, Middleburg, Haerlem, and Lewarden. The language here is a dialect of the German, but French is much ſpoken by the better ſort.

87 Commerce, &c.

With regard to the commerce of this country, their Eaſt India company had the monopoly of the fine ſpices for more than 100 years, and was long the moſt opulent and powerful of any in the world. Though the country itſelf produces very few things, yet almoſt all the products and commodities of the globe may be found here, nearly as cheap as in the countries where they are made or produced. A vaſt variety of manufactures are carried on in the provinces, and with extraordinary ſkill and diligence; and a great number of hands are employed, and much wealth acquired, by the herring, cod, and whale fiſheries. No nation has hitherto equalled them in the curing of herrings; thoſe cured at Glaſgow, in Scotland, are thought to come neareſt to them. About 150 ſail were annually employed in the whale-fiſhery, and about 200 in the herring. The profits of the latter, in a good year, after all deductions, were thought to amount to 200,000 Holland guilders. The principal manufactures here are thoſe of linen, paper, and earthen ware of all ſorts. Ship-building alſo employs vaſt numbers of hands. The trade of this country, however, upon the whole, has long been declining; owing partly to a decline of their ancient parſimony and induſtry; but chiefly to the improvement of manufactures, trade, and navigation, in other countries; and at preſent (1796) it is almoſt annihilated.

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* See Britain, nº 339, 340.

88 Conſtitution. The late conſtitution was ſomewhat ſingular. Moſt of the towns in the ſeveral provinces are little republics, whoſe deputies, with the nobility, compoſed the ſtates thereof; and the deputies of the provinces, in like manner, compoſed the States-general. Every town or province might ſend as many deputies as they pleaſed to the aſſemblies of the provincial ſtates, or States-general; but thoſe of each town or province had but one voice, and preſided by turns. No reſolution taken by the States-general was of any force till confirmed by the ſeveral provinces. The legiſlative power in the towns was veſted in the ſenates; and the executive in the burgomaſters, ſyndics, &c. The ſtates of the provinces were ſtyled, Noble and Mighty Lords: but thoſe of Holland, Noble and Moſt Mighty Lords: and the States-general, High and Mighty Lords, or the Lords the States-general of the United Netherlands, or their High Mightineſſes. Beſides the States-general, there was alſo a council of ſtate, conſiſting of deputies from the ſeveral provinces, making twelve in all; of which Holland ſent three; Guelderland, Zealand, and Utrecht, two a-piece; and Frieſland, Groningen, and Overyſſel, one. In this council every deputy preſided a week by turns, and the ſtadtholder had a deciſive voice when the votes happened to be equal. The principal affairs that came under their deliberation, were thoſe relating to the army and finances. The ſtadtholder was alſo preſident of the ſtates in every province, but had no ſeat in the States-general. One diſſenting voice in the provincial ſtates prevented their coming to any reſolution. See STADTHOLDER.

Such was the conſtitution of the ſeven United Provinces. They are now employed in framing for themſelves a new one, upon the plan dictated to them by their maſters the French.

With reſpect to the adminiſtration of juſtice in this country, every province has its tribunal, to which, except in criminal caſes, appeals lie from the petty and country courts; and it is ſaid, that juſtice is nowhere diſtributed with more impartiality.

89 Taxes. The taxes in theſe provinces are ſo many, and ſo heavy, eſpecially in Holland, that it is not without reaſon aſſerted, that the only thing that has eſcaped taxation there is the air they breathe. The ordinary revenues of the republic are computed at between two and three millions Sterling annually. Out of 100 guilders, the province of Holland contributes 58; and conſequently above one half of the whole public expences. For the encouragement of trade, the duties on goods and merchandiſe are ſaid to be exceeding low.

90 Forces by ſea and land. With reſpect to their land-forces in time of peace, they ſeldom exceed 40,000, and very often fall ſhort of that number. They employ a great many foreigners in their ſervice; and in time of war hire whole regiments of Germans. Their navy, were they to enter heartily into any war, could ſoon be made formidable, as they have always vaſt quantities of timber prepared for building ſhips, and great numbers of ſhip carpenters and mariners. It is under the direction of the five admiralty colleges, who, to defray the charges thereof, levy the duties on exports and imports.

91 Character. As to the character of the Dutch, the boors or huſbandmen are induſtrious enough, but heavy, and ſlow of underſtanding. The ſeamen are a plain, blunt, but rough, ſurly, and ill-mannered ſort of people. Their tradeſmen are ſomething ſharper, and make uſe of all their ſkill to take advantage of thoſe they deal with. Every claſs of men is extremely frugal. All appetites and paſſions run lower and cooler here than in other countries, avarice excepted. Quarrels are very rare; revenge is ſeldom heard of; and jealouſy ſcarcely ever known. It is very uncommon for any of them to be really in love, or even to pretend to it; nor do the women ſeem to care whether they are or not. People converſe pretty much upon a level here; nor it is eaſy to diſtinguiſh the man from the maſter, or the maid from the miſtreſs, ſuch liberties do they allow their ſervants, or rather are obliged to allow them; for they may not be ſtruck or corrected by them, but the diſpute muſt be left to the magiſtrate. The Dutch are tall and ſtrong built; but both men and women have the groſſeſt ſhapes that are to be met with anywhere. Their garb, except among the officers of the army and ſome few others, is exceeding plain, and the faſhions change as ſeldom as in Spain. The men are addicted to drinking, which ſome think neceſſary in this foggy air, both for their health and the improvement of their underſtandings. Among their diverſions, that of ſkating in winter is one of the chief. It is amazing to ſee the crowds in a hard froſt upon the ice, and their great dexterity in ſkating; both men and women darting along with inconceivable velocity. The Dutch are remarkable for their cleanlineſs: nothing can exceed the neatneſs of their houſes, towns, and villages. Many of them have diſtinguiſhed themſelves by their learning, and ſome even by their wit and ingenuity; witneſs Eraſmus, Grotius, &c. The Dutch excel alſo in painting and engraving; and ſome of them have been no contemptible ſtatuaries.

UNITY, in poetry. There are three unities to be obſerved, viz. the unity of action, that of time, and that of place. In the epic poem, the great, and almoſt the only, unity, is that of the action. Some regard indeed ought to be had to that of time; for that of place there is no room. The unity of character is not reckoned among the unities. See POETRY, Part II. Sect. 3.

UNIVERSAL, ſomething that is common to many things; or it is one thing belonging to many or all things.

UNIVERSE, a collective name, ſignifying the whole world; or the aſſemblage of heaven and earth, with all things therein. See ASTRONOMY and GEOGRAPHY.

UNIVERSITY, is the name of a corporation formed for the education of youth in the liberal arts and ſciences, and authorized to admit ſuch as have ſtudied in it, to certain *degrees* in different faculties, which not only ſerved as certificates of proficiency in ſcience, but alſo confer on thoſe who obtain them conſiderable privileges within the univerſity, as well as ſome rank in the ſtate without it. Univerſities generally comprehend within them one or more colleges: but this is not always the caſe; for the univerſity of St Andrew's was in being before either of its colleges was founded, and it would continue in being with all its privileges though both its colleges were levelled with the duſt.

In every univerſity with which we are acquainted, there are four faculties, viz. *Theology*, *Law*, *Phyſic*, and the *Arts and Sciences*, comprehending mathematics, natural and moral philoſophy, &c.; and in Oxford, Cambridge, and ſome other univerſities, *Muſic* is conſidered as a fifth faculty. In each of theſe there are two degrees, thoſe of *Bachelor* and *Doctor*; for though in the univerſities of Great Britain and Ireland there is no ſuch degree as *Doctor in Arts and Sciences*, the *Maſter of Arts* anſwers to the degree of *Doctor in Philoſophy*, which is conferred by many of the univerſities on the continent.

Univerſities in their preſent form, and with their preſent privileges, are inſtitutions comparatively modern. They ſprang from the convents or regular clergy, or from the chapters of cathedrals in the church of Rome, where young men were educated for holy orders, in that dark period when the clergy poſſeſſed all the little erudition which was left in Europe. Theſe convents were ſeminaries of learning probably from their firſt inſtitution; and we know with certainty, that in Old Aberdeen there was a monaſtery in which youth were inſtructed in *theology*, the *canon law*, and the *ſchool philoſophy*, at leaſt 200 years before the univerſity and King's College were founded. The ſame was doubtleſs the caſe in Oxford and Cambridge, and probably in every town in Europe where there is now a univerſity, which has any claim to be called ancient; for it was not till the more eminent of the laity began to ſee the importance of literature and ſcience, that univerſities diſtinct from convents were founded, with the privilege of admitting to degrees, which conferred ſome rank in civil ſociety. Theſe univerſities have long been conſidered as lay corporations; but as a proof that they had the eccleſiaſtical origin which we have aſſigned to them, it will be ſufficient to obſerve, that the Pope arrogated to himſelf the right of veſting them with all their privileges; and that, prior to the Reformation, every univerſity in Europe conferred its degrees in all the faculties by authority derived from a papal bull.

It is perhaps no improbable conjecture, that the church of Rome derived her idea of academical honours from the Jews, among whom literary diſtinctions extremely ſimilar ſubſiſted before the nativity of our Saviour. Among them, the young ſtudent, with reſpect to his learning, was called a *diſciple*; from his minority a *junior*; and the *choſen* or *elected*, on account of his election into the number of diſciples. When he had made ſome progreſs in knowledge, and was deemed worthy of a degree, he was by impoſition of hands made חבר, *a companion* to a *Rabbi*, the perſon who officiates uſing this form, *I aſſociate thee*, or, *Be thou aſſociated*; and as ſoon afterwards as he was thought worthy to teach others, the *aſſociate* was raiſed to the rank of *Rabbi*. Whether this proceſs ſuggeſted the idea or not, it has certainly ſome reſemblance to that by which a young man in our univerſities paſſes through the degree of *Bachelor* to that of *Maſter of Arts* or *Doctor*.

The moſt ancient univerſities in Europe are thoſe of OXFORD, CAMBRIDGE, PARIS, SALAMANCA, and BOLOGNA; and in the two Engliſh univerſities, the firſt founded colleges are thoſe of *Univerſity*, *Baliol*, and *Merton*, in the former, and *St Peter's* in the latter. Oxford and Cambridge, however, were univerſities, or, as they were then called, *ſtudies*, ſome hundreds of years before colleges or ſchools were built in them; for the former flouriſhed as a ſeminary of learning in the reign of Alfred the Great, and the other, could we believe its partial partizans, at a period ſtill earlier. The univerſities of Scotland are four, St ANDREW'S, GLASGOW, ABERDEEN, and EDINBURGH. In Ireland there is but one univerſity, viz. that of DUBLIN, founded by Queen Elizabeth, and very richly endowed.

An idle controverſy has been agitated, whether the conſtitution of the Engliſh or of the Scotch univerſities be beſt adapted to anſwer the ends of their inſtitution; and, as might be expected, it has been differently decided, according to the partialities of thoſe who have written on the ſubject. Were we to hazard our own opinion, we ſhould ſay, that each has its advantages and diſadvantages; and that while the Engliſh univerſities, aided by their great ſchools, to which the Scotch have nothing that can be compared, are unqueſtionably fitted to carry their young members fartheſt in the knowledge of the learned languages, the mode of teaching in the Scotch univerſities is better adapted to the promotion of arts and ſciences, and the communication of that knowledge which is of moſt importance in active life.

UNIVERSITY-Courts, in England. The two univerſities enjoy the ſole juriſdiction, in excluſion of the king's courts, over all civil actions and ſuits whatſoever, where a ſcholar or privileged perſon is one of the parties; excepting in ſuch caſes where the right of freehold is concerned. And then by the univerſity charter they are at liberty to try and determine, either according to the common law of the land, or according to their own local cuſtoms, at their diſcretion; which has generally led them to carry on their proceſs in a courſe much conformed to the civil law.

This privilege, ſo far as it relates to civil cauſes, is exerciſed at Oxford in the chancellor's court; the judge of which is the vice-chancellor, his deputy, or aſſeſſor. From his ſentence an appeal lies to delegates appointed by the congregation; from thence to other delegates of the houſe of convocation; and if they all three concur in the ſame ſentence, it is final, at leaſt by the ſtatutes of the univerſity, according to the rule of the civil law. But if there be any diſcordance or variation in any of the three ſentences, an appeal lies in the laſt reſort to judges delegates appointed by the crown, under the great ſeal in chancery.

As to the juriſdiction of the univerſity courts in criminal matters, the chancellor's court at Oxford, and probably alſo that of Cambridge, hath authority to try all offences or miſdemeanors under the degree of treaſon, felony, or mayhem; and the trial of treaſon, felony, and mayhem, by a particular charter, is committed to the univerſity juriſdiction in another court, namely, the court of the lord high ſteward of the univerſity.

The proceſs of the trial is this. The high ſteward iſſues one precept to the ſheriff of the county, who thereupon returns a panel of 18 freeholders; and another precept to the bedells of the univerſity, who thereupon return a panel of 18 matriculated laymen, *laicos privilegio univerſitatis gaudentes*: and by a jury formed *de medietate*, half of freeholders and half matriculated perſons, is the indictment to be tried; and that in the guildhall of the city of Oxford. And if execution be neceſſary to be awarded in conſequence of finding the party guilty, the ſheriff of the county muſt execute the univerſity proceſs; to which he is annually bound by an oath.

VOCABULARY, in grammar, denotes the collection of the words of a language, with their ſignifications, otherwiſe called a *dictionary*, *lexicon*, or *nomenclature*. See DICTIONARY.

A vocabulary is properly a ſmaller kind of dictionary, which does not enter ſo minutely into the origin and different acceptations of words.

VOCAL, ſomething that relates to the voice or ſpeech; thus vocal muſic is that ſet to words, eſpecially verſes, and to be performed by the voice; in contradiſtinction to inſtrumental muſic, compoſed only for inſtruments, without ſinging.

VOCATIVE, in grammar, the fifth ſtate or caſe of nouns. See GRAMMAR.

VOETIUS (Giſbert), an eminent divine of the 16th century, was profeſſor of divinity and the Oriental tongues at Utrecht, where he was alſo miniſter. He aſſiſted at the ſynod of Dort; and died in 1676, aged 87. He wrote a great number of works; and was the declared enemy of Des Cartes and his philoſophy. His followers are called *Voetians*.

Voetius had two ſons, *Daniel* and *Paul*, who alſo wrote ſeveral works. *John Voetius*, the ſon of Paul, was doctor and profeſſor of law at Herborn: he wrote a commentary on the Pandects, which is eſteemed, and other works on law.

VOICE, a ſound produced in the throat and mouth of an animal, by an apparatus of inſtruments for that purpoſe.

Voices are either articulate or inarticulate. Articulate voices are thoſe whereof ſeveral conſpire together to form ſome aſſemblage or little ſyſtem of ſounds: ſuch are the voices expreſſing the letters of an alphabet, numbers of which joined together form words. Inarticulate voices are ſuch as are not organized, or aſſembled into words; ſuch is the barking of dogs, the braying of aſſes, the hiſſing of ſerpents, the ſinging of birds, &c.

The formation of the human voice, with all the varieties thereof obſerved in ſpeech, muſic, &c. makes a very curious article of inquiry: and the apparatus and organiſm of the parts adminiſtering thereto, is ſomething exceedingly ſurpriſing. Thoſe parts are the trachea or wind-pipe, through which the air paſſes and repaſſes into the lungs; the larynx, which is a ſhort cylindrical canal at the head of the trachea; and the glottis, which is a little oval cleft or chinck left between two ſemicircular membranes ſtretched horizontally withinſide the larynx; which membranes, though capable of joining cloſe together, do generally leave an interval, either greater or leſs, between them, called the *glottis*. A particular deſcription of each part may be ſeen in ANATOMY, Part IV. Sect. 5.

VOICE, in grammar, a circumſtance in verbs, whereby they come to be conſidered as either active or paſſive, *i. e.* either expreſſing an action impreſſed on another ſubject, as, *I beat*; or receiving it from another, as, *I am beaten*. See GRAMMAR.

VOICE, in matters of election, denotes a vote or ſuffrage.

VOICE, in oratory. See DECLAMATION; READING, nº 5.; and ORATORY, nº 129—131.

VOLANT, in heraldry, is when a bird, in a coat of arms, is drawn flying, or having its wings ſpread out.

VOLATILE, in phyſics, is commonly uſed to denote a mixed body, whoſe integrant parts are eaſily diſſipated by fire or heat; but is more properly uſed for bodies whoſe parts are eaſily ſeparated from each other, and diſperſed in air.

VOLATILE *Alkali*, in the new French nomenclature *ammoniaca*, one of the three alkaline ſalts. It conſiſts, as Mr Berthollet and ſeveral other chemiſts have proved, of 807 parts in 1000 of azot, and 193 of hydrogen. Several experiments, publiſhed by Dr Prieſtley, led the way to this analyſis, though he himſelf did not ſee their reſult. It is chiefly procurable from animal ſubſtances by diſtillation, during which proceſs the azot and hydrogen neceſſary to its formation unite in proper proportions; it is not however procured pure by this proceſs, being mixed with oil and water, and moſtly ſaturated with carbonic acid. To ſeparate theſe ſubſtances, it is firſt combined with an acid, the muriatic for inſtance, and then diſengaged from that combination by the addition of lime or pitch. In its greateſt degree of purity it can only exiſt in a gaſſeous form, at leaſt in the common temperature of the atmoſphere. It was at firſt obtained chiefly from urine, and was therefore called *ſal urinæ*; afterwards from horns, eſpecially from thoſe of the hart, hence its name, *ſal cornu cervi*, "hart's horn." See CHEMISTRY-*Index*.

VOLATILISATION, the art of rendering fixed bodies volatile, or of reſolving them by fire into a fine ſubtile vapour or ſpirit which eaſily diſſipates and flies away. All bodies, even the moſt fixed, as gold, may be volatiliſed, either of themſelves, or with the admixture of ſome volatile ſubſtance or ſpirit, by diſtillation or ſublimation.

VOLCANO, a name given to burning mountains, or to vents for ſubterraneous fires.

The number of volcanoes with which we are at preſent acquainted is very conſiderable, not much leſs than 100. In Europe there are Ætna, Veſuvius, Hecla, Stromboli, Vulcano; in Aſia, one in Mount Taurus, three in Kamptſchatka, five in Japan, two in the Philippines, and a great number more ſcattered through the iſlands in the South Sea; in Africa, one in Fez, one in the iſland Bourbon, one in Fuego, one of the Cape Verd iſlands; and in America, ſeveral in the Andes, Morne Garou in St Vincent, and two diſcovered by Captain Cook on the weſtern coaſt of North America. There are others, but theſe are beſt known.

It is remarkable that all the volcanoes with which we are acquainted, four or five perhaps excepted, are ſituated at a ſmall diſtance from the ſea. Moſt of them have been burning from time immemorial; ſome few however have burſt out in our time. Volcanoes all occupy the tops of mountains, we find none of them in plains; ſome of them indeed, which are ſituated in the ocean, do not riſe much above the ſurface; but even theſe volcanoes ſeem to be the apices of mountains, the greater part of which are covered by the ſea. The ſubſtances ejected by volcanoes are fixed and inflammable air, water, aſhes, pumice ſtone, ſtones that have undergone no fuſion, and lava. The phenomena which take place during the eruptions of volcanoes have been ſo fully deſcribed already in the articles ÆTNA, HECLA, ICELAND, and VESUVIUS, that any repetition here would be unneceſſary and improper. All that remains, therefore, is to explain the cauſes of volcanoes, or, to ſpeak more properly, to mention the opinions of philoſophers concerning the cauſes of volcanoes; for the real cauſe, we are afraid, after all that has been done, remains ſtill unknown. The moſt elaborate theory that has yet appeared is that of M. Houel.*

1
Suppoſed method of their formation.

According to him, water is neceſſary for the formation of volcanoes. All volcanoes are near the ſea: they are even extinguiſhed when the ſea retires from them, for we can ſtill perceive the craters of volcanoes in ſeveral lofty inland mountains; which diſcover what they have been formerly. He ſuppoſes that a long ſeries of ages was neceſſary for the formation of a volcano, and that they were all formed under the ſurface of the ſea. The firſt exploſion which laid open the foundation of the deep, would poſſibly be preceded by an earthquake. The waters would be parted by a vaſt globe of burning air, which would iſſue forth with a tremendous noiſe, opening at the ſame time, a large and wide vent for the immenſe flame that was to follow; and which, as it iſſued from the bottom of the ſea, would be ſpread over its ſurface by the firſt guſt of wind which followed. A fire which was to burn through thouſands of years could not be faint or feeble when it was firſt lighted up. Its firſt eruptions therefore have undoubtedly been very violent, and the ejected matter very copious. For a long ſeries of ages it would continue to diſcharge torrents of lava from the

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* Voyage Pictureſque.

boſom of its native earth; and its firſt crater would be compoſed of the fragments of the ſame earth.

2 Why the fire is not extinguiſhed by the waters of the ocean.

3 Ebullition of the ſea by the formation of a volcano.

Thus, according to our author, the foundations of the burning mountain would be laid in the bottom of the ſea; and even then it would have an hollow cup or crater on the top ſimilar to that which is to be found on all volcanoes at preſent. But the queſtion now very naturally occurs, by what means was the internal fire preſerved from extinction by the waters of the ocean, which muſt thus have been incumbent upon it? To this he replies, that "The fire, having diſpoſed the ſubſtances in fuſion to make an eruption, next laid open the earth, and emitted as much matter as it could diſcharge, with force ſufficient to overcome the reſiſtance of the column of water which would oppoſe its aſcent; but as the ſtrength of the fire diminiſhed, the matter diſcharged was no longer expelled beyond the mouth; but, by accumulating there, ſoon cloſed up the orifice. Thus only ſmall orifices would be left ſufficient for giving vent to the vapours of the volcano, and from which only ſmall bubbles of air could aſcend to the ſurface of the water, until new circumſtances, ſuch as originally gave occaſion to the eruption of the volcano, again took place in the bowels of the earth, and produced new eruptions either through the ſame or other mouths. The appearance of the ſea over the new formed volcano, in its ſtate of tranquillity, would then be ſimilar to what it is betwixt the iſlands of Baſilizzo and Pariaria. Columns of air-bubbles are there aſcending at the depth of more than 30 feet, and burſt on their arriving at the ſurface. This air would continue to diſengage itſelf with little diſturbance as long as it iſſues forth only in ſmall quantity, until, at the very inſtant of exploſion, when prodigious quantities, generated in the burning focus, would make their way all at once, and the ſame phenomena which originally took place would again make their appearance."

4 Action of ſubmarine volcanoes.

A volcano, while under water, cannot act preciſely as it does in the open air. Its eruptions, though equally ſtrong, cannot extend to ſo great a diſtance. The lava accumulates in greater quantity round the crater; the ſands, aſhes, and pozzolano are not carried away by the winds, but are depoſited around its edges, and prevent the marine ſubſtances which are driven that way by the waters from entering. Thus they agglomerate with theſe bodies, and thus a pyramidal mount is formed of all the materials together.

In this manner Mr Houel ſuppoſes that the mountain was gradually raiſed out of the ſea by the accumulation of lava, &c. at every eruption, and that the cavern of the volcano was gradually enlarged, being driven down into the bottom of the cavern by the continued action of the ſtones which the volcano is conſtantly throwing up: that it was there fuſed, and at laſt thrown out at the top of the mountain to accumulate on its ſides. Mr Houel's opinion about the volcanic fire we ſhall give in his own words.

5 Formation of lavas.

"We cannot form any idea of fire ſubſiſting alone, without any pabulum, and unconnected with any other principle. We never behold it but in conjunction with ſome other body, which nouriſhes, and is conſumed by it. The matter in fuſion, which iſſues from the focus, is but the incombuſtible part of that which nouriſhes the fire, and into the boſom of which that active principle penetrates in ſearch of pabulum. But as the fire acts only in proportion to the facility with which it can diſſolve and evaporate, I am of opinion, that it is only the bottom of the volcano on which it acts; and that its action extends no farther than to keep theſe ſubſtances which it has melted in a conſtant ſtate of ebullition. That fuſible matter being diſcharged from the mouth of the volcano, and hardening as it is gradually cooled by the action of the air, produces that ſpecies of ſtones which are diſtinguiſhed by the name of *lavas*. This lava, even when in the focus, and in a ſtate of fluidity, muſt alſo poſſeſs a certain degree of ſolidity, on account of the gravity and denſity of its particles. It therefore oppoſes the fire with a degree of reſiſtance which irritates it, and requires, to put it into a ſtate of ebullition, a power proportioned to the bulk of the maſs.

"That quantity of matter, when diſſolved by the action of the fire, muſt conſtantly reſemble any other thick ſubſtance in a ſtate of ebullition. Small exploſions are produced in various parts over the ſurface of every ſuch ſubſtance while in a ſtate of ebullition; and, by the burſting of theſe bubbles, a great number of ſmall particles are ſcattered around. This is the very proceſs carried on in the focus of a volcano, though on a ſcale immenſely more large; and the vaſt exploſions there produced expel every body which lies in their way with the utmoſt violence; nor is there any piece of lava which falls down from the upper part of the arch of weight ſufficient to reſiſt this violent centrifugal force.

6 Incredible force of volcanic exploſions.

"No eſtimate can be made of the power of theſe exploſions, but by obſerving the obſtacles they overcome, and what enormous bodies are raiſed up and thrown to an immenſe height and diſtance. Such vaſt pieces of lava are to be ſeen on the top of Veſuvius and Lipari, that the projectile force by which they have been thrown out appears altogether incredible. No perſon can harbour the leaſt ſuſpicion of their having been laid there by any human power; and the appearance of them demonſtrates that they have been ejected from the bottom of the volcano, not in a ſtate of fuſion, but coherent and ſolid. A piece of lava lies on the top of Ætna of more than a cubic fathom in bulk, and whoſe weight therefore cannot be leſs than 16 tons. What an amazing force then muſt it have required, not only to raiſe this enormous maſs from the volcanic focus, but to make it deſcribe a parabola of about a league in diameter after it had come out of the crater?

"When we conſider how much the volcanic focus is ſunk below the baſe of the mountain, that the mountain itſelf is 10,000 feet high, and that conſequently there muſt have been a power ſufficient to raiſe ſuch a maſs 12,000 feet perpendicular, the boldeſt imagination muſt be loſt in amazement.—This may ſerve to give us ſome idea of the nature of that power which operates in the foci of volcanoes; a power which is unknown and inconceivable, and may juſtly be reckoned among the myſteries of nature."

7 Eruption of water from Ætna in 1775 explained.

The pabulum by which the internal fire is ſupported, Mr Houel thinks to be ſubſtances contained in the mountain itſelf, together with bitumen, ſulphur, and other inflammable materials which may from time to time flow into the focus of the volcano in a melted ſtate through ſubterraneous ducts, and the exploſions he aſcribes to water making its way in the ſame manner. The water is converted into ſteam, which fills the cavern and puſhes the melted lava out of the crater; this opinion is corroborated by the copious ſmoke which always precedes an eruption. But, combined with the water, there is always a quantity of other ſubſtances, whoſe effects precede, accompany, or follow the eruptions, and produce all the various phenomena which they diſplay. The eruption of water from Ætna in the year 1775 proceeded undoubtedly from this cauſe. The ſea, or ſome of the reſervoirs in Ætna or the adjacent mountains, by ſome means diſcharged a vaſt quantity of water into the focus of the volcano. That water was inſtantly reſolved into vapour, which inſtantly filled the whole cavern, and iſſued from the mouth of the crater. As ſoon as it made its way into the open atmoſphere, it was condenſed again into water, which ſtreamed down the ſides of the mountain in a dreadful and deſtructive torrent.

Thus we have given a view of Mr Houel's theory, according to which volcanoes originally began at the bottom of the ſea; and not only the mountain, but all the adjoining country, was formed by ſucceſſive eruptions. It is rather a theory of mountains raiſed by ſubterraneous heat than of volcanoes, and does not attempt to explain the origin of the fire, which is the principal difficulty; neither does his theory account for the immenſe height to which matters are ſometimes thrown during eruptions. This indeed it is impoſſible to account for, without ſuppoſing that the reſiſtance of the air is diminiſhed. The exceſſive oppoſition of the atmoſphere to bodies moving with very great degrees of velocity has been taken notice of under the article Gunnery. If it has ſo much effect then upon ſolid and round globes of iron, what ought it to be on irregular maſſes of rock, or ſtreams of liquid lava? Nevertheleſs, in the great eruption of Veſuvius in 1779, Sir William Hamilton informs us, that a vaſt ſtream of lava was projected to the height of at leaſt 10,000 feet above the top of the mountain. Had the air reſiſted this liquid matter as it does a cannon ball, it muſt have been daſhed in pieces almoſt as ſoon as it iſſued from the crater. Either the extreme heat of the lava, therefore, or ſome other cauſe, muſt have contributed very much to diminiſh, or rather, in a manner to annihilate the reſiſtance of the atmoſphere at that time. As for the lighter materials, though they may be ſuppoſed to be carried to a vaſt diſtance by the wind, after being projected to a great height in the air, it is inconceivable how their motion was not ſuddenly ſtopped, and they ſcattered all around the top of the volcano by the violence of the blaſt. Subſtances of this kind, when quietly carried up with ſmoke, will indeed fly to a great diſtance; for we are aſſured, that the aſhes of the great fire at London in 1666 were carried by the wind to the diſtance of 16 miles. It is therefore the leſs incredible, that thoſe of the great eruption of Veſuvius in 1779 ſhould be carried to the diſtance of 100 miles, as we are informed was the caſe.

8 Central fire ſuppoſed to be the cauſe.

To account for the volcanic fire, Dr Woodward and others have had recourſe to the hypotheſis of a central fire, to which the volcanoes are only ſo many chimneys or ſpiracles. Dr Hutton, in his theory of the earth, adopts the ſame opinion; but as it did not immediately concern the ſubject of which he treated, he evades any queſtion concerning its origin, by declaring himſelf ſatisfied of its exiſtence without any inquiry into its origin.

9 Beds of pyrites, &c.

Others, as Dr Liſter, have had recourſe to the well known experiment of the fermentation of ſulphur and iron, which will take fire when mixed in conſiderable quantity, and moiſtened with water. Pyrites, therefore, which are a natural mixture of theſe two ſubſtances, it is ſuppoſed, may naturally give riſe to volcanoes. Inſtances are indeed adduced, which undeniably prove that theſe ſubſtances will ſpontaneouſly take fire when thrown together in large heaps. Of this we have a remarkable example in the following anecdote.—"A covetous copperas maker at Deptford having bought up all the pyrites he could find, in order to ruin the trade of his neighbours, collected a vaſt quantity below a ſhed in order to ſecure them from the rain. He was ſoon, however, puniſhed for his avarice; for the pyrites began to ſmoke, glowed like red-hot coals, and melted into a kind of vitrified and partly metallic ſubſtance, grievouſly annoying the neighbourhood for a long time with the ſulphureous ſteam they emitted." Beds of pyrites, therefore, taking fire in the earth, by means of a fermentation occaſioned by water, are now generally ſuppoſed to be the cauſe of volcanoes; and the obſervation, that volcanoes are generally near the ſea, is thought to confirm this hypotheſis.

10 Great quantities of pyrites will take fire ſpontaneouſly.

When the matter is properly conſidered, however, it muſt be evident, that neither of theſe hypotheſes can anſwer the purpoſe. The central fire of Dr Woodward and others is a cauſe too magnificent even for volcanoes. If any ſuch fire is ſuppoſed, we muſt imagine a burning globe in the centre of the earth, whoſe heat is ſufficient to vitrify the moſt ſolid and refractory terreſtrial ſubſtances. But of what dimenſions are we to ſuppoſe this globe? Is it one, two, three, four, or more thouſands of miles in diameter?—Very large indeed it muſt be; for we could ſcarce ſuppoſe that ſtones could be projected even from the depth of 500 miles into the air. But even this ſuppoſition is inadmiſſible; for as the fire of volcanoes is at times exceedingly augmented from ſome cauſe or other, were this cauſe general, as it muſt be in caſe of a burning central globe, the whole number of volcanoes exiſting on earth would be in a ſtate of eruption at once. Beſides, if we were to ſuppoſe a burning globe of 7000 miles in diameter to ſuffer the leaſt dilatation throughout its vaſt bulk, which muſt be the undoubted conſequence of an augmentation of heat from any unknown cauſe, all the volcanoes in the world would not be ſufficient to give vent to it, though they ſhould ſpout forth inceſſant cataracts of lava for centuries together. A diſſolution of the whole globe muſt therefore undoubtedly take place; and though we ſhould leſſen the diameter of our burning globe by 1000 miles, our difficulties will be as far from being removed as before.

11 Volcanoes not occaſioned by central fire.

Volcanic fire, therefore, cannot originate from any general collection of burning materials diſperſed throughout the vaſt maſs of ſolid earth which lies betwixt the ſurface and the centre. All the volcanoes at preſent in an active ſtate would not be ſuch a vent for that fire as a tobacco-pipe would be to a glaſs-houſe furnace. We muſt have recourſe then to ſome operation by which we know that nature can kindle and extinguiſh fires occaſionally; and if we can ſuppoſe ſuch an operation to take place in the bowels of the earth, we may then reaſonably conclude, that we have diſcovered a cauſe adequate to the production of volcanoes. Such a cauſe, however, cannot be pyrites, ſulphur, or nitre, in any quantity under the ſurface of the earth. It is impoſſible that beds of pyrites can remain for thouſands of years under the ſame part of the ſurface of the earth, be occaſionally inflamed and ejected, and afterwards undergo a renovation, in order to enable them to go through a ſimilar operation. Nitre is never found in a foſſil ſtate; nor can it be inflamed in ſuch a manner as to make any conſiderable exploſion without a thorough mixture with ſulphur and charcoal; neither would all the quantity which we can ſuppoſe to exiſt under the baſe of any mountain in the world be ſufficient to give force to *one* of thoſe dreadful volleys which are diſcharged by volcanoes an hundred times in a day. Beſides, neither pyrites nor ſulphur can be inflamed without acceſs of air; which cannot take place in the bowels of the earth; for it muſt be remembered, that the firſt queſtion is concerning the means by which the fire was originally kindled. Moſt writers, however, ſeem to overlook this difficulty, and to be ſolicitous only about the immediate cauſe of the exploſive force, which is generally aſcribed to ſteam of one kind or other. Mr Houel in general calls it the force of fire, or of ſteam; though he does not enter very particularly into its nature. Mr Whitehurſt ſays, that it is the force of "fire and water, which is the primary agent in all ſuch operations of nature." He alſo gives a figure, ſhowing how, by means of confined ſteam, a jet, either of hot water, or of liquid fire, may be produced. But this applies only to a particular caſe, which we cannot ſuppoſe always to happen; but volcanoes are conſtantly attended with exploſions; nay, ſo great is the tendency of volcanic matters to this violent operation, that many ſtones have been obſerved to burſt in the air like bombs.

12 They cannot be ſet on fire by pyrites, ſulphur, or nitre.

13 Hypotheſes concerning the cauſe of the exploſive force.

14 Great tendency of volcanic matters to exploſion.

15 Explosive force of water peculiar to certain circumſtances.

bombs, after they were thrown out of the volcano; and Mr Houel even informs us, that ſuch have burſt three times during their flight. Water therefore cannot be always the cauſe of volcanic exploſions. When thrown upon melted lead, ſalts, or eſpecially copper, it explodes indeed with vaſt force. With the laſt mentioned metal it is peculiarly and incredibly violent; inſomuch, that it is ſaid that furnaces have been burſt, and buildings thrown down, by the mere circumſtance of ſome of the workmen ſpitting among the melted metal; and Mr Whitehurſt calculates the force of aqueous ſteam, when thus ſuddenly and violently heated, to be no leſs than 28 times ſtronger than inflamed gunpowder.

Many philoſophers attempt to account for the origin and continuance of volcanoes by the agency of the electric fluid; but their theory is ſo ill ſupported by facts, that we think it would be improper at preſent to take up room with detailing it. It is certain that volcanoes exhibit many electrical appearances, and that great quantities of the electrical fluid are diſcharged at every eruption. But our knowledge of electricity is ſtill too limited to draw any certain concluſion from theſe appearances.

VOLERY, a great bird-cage, ſo large that the birds have room to fly up and down in it.

VOLGA, the largeſt river in Europe, riſes in the foreſt of Volkonſki, about 80 miles from Tver, a town in Ruſſia. This noble river waters ſome of the fineſt provinces in the Ruſſian empire, and at laſt falls into the Caſpian Sea by ſeveral mouths, below Aſtracan.

VOLITION, the act of willing. See METAPHYSICS.

VOLLEY, a military ſalute, made by diſcharging a great number of fire-arms at the ſame time.

VOLONES, in Roman antiquity, ſlaves who in the Punic war voluntarily offered their ſervice to the ſtate, which is the reaſon of the appellation; upon which they were admitted to citizenſhip, as none but freemen could be ſoldiers.

VOLT, in the manege, a round or circular tread; and hence, by the phraſe *to make volts*, is underſtood a gate of two treads, made by a horſe going ſidewiſe round a centre, in ſuch a manner that theſe two treads make parallel tracts; one larger, made by the fore-feet, and another ſmaller made by the hind feet; the croup approaching towards the centre, and the ſhoulders bearing out.

VOLTAIRE (Francis Arouet de), a celebrated French author, was born at Paris, February 20, 1694. His father, Francis Arouet, was *ancien notaire au Chatelet*, and treaſurer of the chamber of accounts; his mother, Mary-Margaret Draumart. At the birth of this extraordinary man, who lived to the age of 85 years and ſome months, there was little probability of his being reared, and for a conſiderable time he continued remarkably feeble. In his earlieſt years he diſplayed a ready wit and a ſprightly imagination; and, as he ſaid of himſelf, made verſes before he was out of his cradle. He was educated, under Father Poré, in the college of Louis the Great; and ſuch was his proficiency, that many of his eſſays are now exiſting, which, though written when he was between 12 and 14, ſhow no marks of infancy. The famous Ninon de l'Enclos, to whom this ingenious boy was introduced, left him a legacy of 2000 livres to buy him a library. Having been ſent to the equity ſchools on his quitting college, he was ſo diſguſted with the dryneſs of the law, that he devoted himſelf entirely to the muſes. He was admitted into the company of the Abbé Cheaulieu, the marquis de la Fare, the duke de Sully, the grand Prior of Vendôme, marſhal Villars, and the chevalier du Bouillon; and caught from them that eaſy taſte and delicate humour which diſtinguiſhed the court of Louis XIV. Voltaire had early imbibed a turn for ſatire; and, for ſome Philippics againſt the government, was impriſoned almoſt a year in the Baſtile. He had before this period produced the tragedy of *Oedipus*, which was repreſented in 1718 with great ſucceſs; and the duke of Orleans happening to ſee it performed, was ſo delighted, that he obtained his releaſe from priſon. The poet waiting on the duke to return thanks; "Be wiſe (ſaid the duke) and I will take care of you." "I am infinitely obliged (replied the young man); but I intreat your royal highneſs not to trouble yourſelf any further about my lodging or board."

He began his *Henriade* before he was 18. Having one day read ſeveral cantos of this poem when on a viſit to his intimate friend, the young preſident de Maiſons, he was ſo teaſed with objections, that he loſt patience, and threw his manuſcript into the fire. The preſident, Henaut, with difficulty reſcued it. "Remember (ſaid Mr Henaut to him, in one of his letters) it was I that ſaved the Henriade, and that it coſt me a handſome pair of ruffles." Some years after, ſeveral copies of this poem having got abroad, while it was only a ſketch, an edition of it was publiſhed, with many chaſms, under the title of *The League*. Inſtead of fame and friends, the author gained only enemies and mortification, by this firſt edition. The bigots took fire at it, and the poet was conſidered as highly criminal for praiſing admiral Coligny and queen Elizabeth. Endeavours were even uſed to get the piece ſuppreſſed; but this ſtrange deſign proved abortive. His chagrin, on this occaſion, firſt inſpired him with the thought of viſiting England, in order to finiſh the work, and republiſh it in a land of liberty. He was right; for king George I. and more particularly the princeſs of Wales, afterwards queen of England, raiſed an immenſe ſubſcription for him. Their liberality laid the foundation of his fortune; for on his return to France in 1728, he put his money into a lottery eſtabliſhed by M. Deſfortes, comptroller-general of the finances. The adventurers received a rent charge on the *Hotel-de-Ville* for their tickets: and the prizes were paid in ready money; ſo that if a ſociety had taken all the tickets, it would have gained a million of livres. He joined with a numerous company of adventurers, and was fortunate.

His *Lettres Philoſophiques*, abounding in bold expreſſions and indecent witticiſms againſt religion, having been burnt by a decree of the parliament of Paris, and a warrant being iſſued for apprehending the author in 1733, Voltaire very prudently withdrew; and was ſheltered by the marchioneſs du Chatelet, in her caſtle of Cirey, on the borders of Champagne and Lorraine, who entered with him on the ſtudy of the ſyſtem of Leibnitz, and the principia of Newton. A gallery was built, in which Voltaire formed a good collection of natural hiſtory, and made an infinite number of experiments on light and electricity. He laboured in the mean time on his Elements of the Newtonian Philoſophy, then totally unknown in France, and which the numerous admirers of Des Cartes were very little deſirous ſhould be known. In the midſt of theſe philoſophic purſuits he produced the tragedy of *Alzira*. He was now in the meridian of his age and genius, as was evident from the tragedy of *Mahomet*, firſt acted in 1741; but it was repreſented to the procureur-general as a performance offenſive to religion; and the author, by order of cardinal Fleury, withdrew it from the ſtage. *Merope*, played two years after, 1743, gave an idea of a ſpecies of tragedy, of which few models had exiſted. It was at the repreſentation of this tragedy that the pit and boxes were clamorous for a ſight of the author; yet it was ſeverely criticiſed when it came from the preſs. He now became a favourite at court, through the intereſt of madam d'Etiole, afterwards marchioneſs of Pompadour. He was appointed a gentleman of the bed-chamber in ordinary, and hiſtoriographer of France. He had frequently attempted to gain admittance into the Academy of Sciences, but could not obtain his wiſh till 1746, when he was the firſt who broke through the abſurd cuſtom of filling an inaugural ſpeech with the fulſome adulation of Richelieu ; an example ſoon followed by other academicians. From the ſatires occaſioned by this innovation he felt ſo much uneaſineſs, that he was glad to retire with the marchioneſs du Chatelet to Luneville, in the neighbourhood of king Staniſlaus. The marchioneſs dying in 1749, Voltaire returned to Paris, where his ſtay was but ſhort. The king of Pruſſia now gave Voltaire an invitation to live with him, which he accepted towards the end of Auguſt 1750. On his arrival at Berlin, he was immediately preſented with the *Order of Merit*, the *key of chamberlain*, and a *penſion* of 20,000 livres. From the particular reſpect that was paid to him, his time was now ſpent in the moſt agreeable manner ; his apartments were under thoſe of the king, whom he was allowed to viſit at ſtated hours, to read with him the beſt works of either ancient or modern authors, and to aſſiſt his majeſty in the literary productions by which he relieved the cares of government. But a diſpute which aroſe between him and Maupertuis ſoon brought on his diſgrace. Maupertuis was at ſome pains to have it reported at court, that one day while general Manſtein happened to be in the apartments of M. de Voltaire, who was then tranſlating into French, The Memoirs of Ruſſia, compoſed by that officer, the king, in his uſual manner, ſent a copy of verſes to be examined, when Voltaire ſaid to Manſtein, "Let us leave off for the preſent, my friend ; you ſee the king has ſent me his dirty linen to waſh, I will waſh your's another time." A ſingle word is ſometimes ſufficient to ruin a man at court; Maupertuis imputed ſuch a word to Voltaire, and ſucceeded. It was about this very time that Maupertuis publiſhed his very ſtrange Philoſophical Letters ; and M. de Voltaire did not fail to heighten, with his utmoſt powers of raillery, every thing which he found, or could make, ridiculous, in the projects of M. Maupertuis, who was careful to unite his own cauſe with that of the king ; Voltaire was conſidered as having failed in reſpect to his majeſty ; and therefore, in the moſt reſpectful manner, he returned to the king his chamberlain's key, and the croſs of his Order of Merit : accompanied with four lines of verſe ; in which he, with great delicacy, compares his ſituation with that of a jealous lover, who ſends back the picture of his miſtreſs. The king returned the key and the ribbon ; but they were not followed by an immediate reconciliation. Voltaire ſet out to pay a viſit to her highneſs the ducheſs of Gotha, who honoured him with her friendſhip as long as ſhe lived. While he remained at Gotha, Maupertuis employed all his batteries againſt him : Voltaire was arreſted by the king's orders, but afterwards releaſed.

He now ſettled near Geneva ; but afterwards being obliged to quit that republic, he purchaſed the caſtle of Ferney in France, about a league from the lake of Geneva. It was here that he undertook the defence of the celebrated family of Calas ; and it was not long before he had a ſecond opportunity of vindicating the innocence of another condemned family of the name of *Sirven*. It is ſomewhat remarkable, that in the year 1774, he had the third time a ſingular opportunity of employing that ſame zeal which he had the good fortune to diſplay in the fatal cataſtrophe of the families of Calas and Sirven.

In this retreat M. Voltaire continued long to enjoy the pleaſures of a rural life, accompanied with the admiration of a vaſt number of wits and philoſophers throughout all Europe. Wearied at length, however, with his ſituation, or yielding to the importunities of friends, he came to Paris about the beginning of the year 1778, where he wrote a new tragedy called *Irene*. By this time his underſtanding ſeems to have been impaired, either through the infirmities of age, or continued intoxication by the flattery of others ; and he ridiculouſly ſuffered himſelf to be crowned in public with laurel, in teſtimony of his great poetical merit. He did not long ſurvive this farce : for having overheated himſelf with receiving viſits, and exhauſted his ſpirits by ſupplying a perpetual fund of converſation, he was firſt ſeized with a ſpitting of blood : and at laſt becoming reſtleſs in the night-time, he was obliged to uſe a ſoporific medicine. Of this he unluckily one night took ſo large a doſe, that he ſlept 36 hours, and expired a very ſhort time after awaking from it.

VOLUME, in matters of literature, a book or writing of a juſt bulk to be bound by itſelf. The name is derived from the Latin *volvere*, "to roll up ;" the ancient manner of making up books being in rolls of bark or parchment. See Book.

VOLUNTARY, in muſic, a piece played by a muſician extempore, according to his fancy. This is often uſed before he begins to ſet himſelf to play any particular compoſition, to try the inſtrument, and to lead him into the key of the piece he intends to perform.

VOLUNTEERS, perſons who, of their own accord, either for the ſervice of their prince, or out of the eſteem they have for their general, ſerve in the army without being inliſted, to gain honour and preferment, by expoſing themſelves in the ſervice.

Such are the volunteers who have been long known in the army ; but the preſent age has witneſſed whole regiments of volunteers arming themſelves for a ſtill more laudable purpoſe. In conſequence of thoſe democratical principles which, in 1793, had been imported into Scotland from the Jacobins of France, a number of gentlemen in Edinburgh, eminent for their rank and reſpectability of character, aſſociated themſelves for the purpoſe of preſerving the internal peace of the city. Making their object known to government, they were, in 1794, embodied in a regiment, called The Royal Edinburgh Volunteers, with officers appointed by his majeſty ; and ſo aſſiduous were they in learning the exerciſe of the army, that, without incurring the imputation of national prejudice, we may venture to affirm, that there is not in the king's ſervice a regiment better diſciplined or more alert in their evolutions than the Edinburgh Volunteers, who conſiſt of lawyers, phyſicians, and opulent tradeſmen, attached to their king and the conſtitution of their country. They amount at preſent (1796) to 850. The example of the metropolis was quickly followed by many of the other towns of Scotland ; and in Glaſgow, Aberdeen, Stirling, and Perth, &c. there are now volunteer regiments, which have certainly contributed to preſerve the internal peace of the country, and are prepared to repel any foreign invaſion ſhould an enterprize ſo daring be ever attempted. Similar armaments have been formed, we believe, in many of the towns in England : and Great Britain, at preſent, can boaſt a mighty force, which, without receiving the pay of ſoldiers, is ready to fight *pro aris et focis*.

VOLVOX, in zoology ; a genus of animals belonging to the order of *vermes infuſoriæ*. The body is round, ſimple, and pellucid. There are ten ſpecies, all of which live in water.

VOLUSENUS See Wilson.

VOLUTA in natural hiſtory ; a genus of animals belonging to the claſs and order of *vermes teſtaceæ*. There are 144 ſpecies. The animals are of the ſlug kind; the ſhell is unilocular and ſpiral; the aperture narrow and without a beak: the columella plaited.

VOLUTE, in architecture, a kind of ſpiral ſcroll uſed in the Ionic and Compoſite capitals, whereof it makes the principal characteriſtic and ornament.

VOMICA, in medicine, an abſceſs of the lungs. See MEDICINE, nº 186.

Nux Vomica, in pharmacy, a flat compreſſed round fruit, of the breadth of a ſhilling, or ſomewhat more, and of about the thickneſs of a crown-piece.

It is the nucleus of a fruit of an Eaſt-Indian tree, the wood of which is the *lignum columbrinum* of the ſhops.

Some have preſcribed ſmall doſes of the nux vomica as a ſpecific againſt a gonorrhœa, and others againſt quartan agues. But we have ſo many good and ſafe medicines for all theſe purpoſes, that there ſeems no occaſion for our having recourſe to ſuch as theſe, which ſhow ſo many ſigns of miſchief.

VOMIT. See EMETIC.

VOMITING, a retrograde ſpaſmodic motion of the muſcular fibres of the œſophagus, ſtomach, and inteſtines, attended with ſtrong convulſions of the muſcles of the abdomen and diaphragm; which, when gentle, create a nauſea; when violent, a vomiting.

VOORN, one of the iſlands of Holland, bounded by the river Maes, which divides it from the continent and the iſland of Iſlemunde, on the north; by the ſea called the *Bies-boſch*, on the eaſt; by another branch of the Maes, which divides it from the iſlands of Goree and Overflackee, on the ſouth; and by the German ſea on the weſt; being about 24 miles long, and 5 broad.

VORTEX, in meteorology, a whirlwind, or ſudden, rapid, and violent motion of the air in gyres, or circles.

Vortex is alſo uſed for an eddy or whirlpool; or a body of water, in certain ſeas or rivers, which run rapidly around, forming a ſort of cavity in the middle.

VORTEX, in the Carteſian philoſophy, is a ſyſtem or collection of particles of matter moving the ſame way, and round the ſame axis.

VORTICELLO. See MICROSCOPE, Vol. XI. page 745.

VOSSIUS (John Gerard), one of the moſt learned and laborious writers of the 17th century, was of a conſiderable family in the Netherlands; and was born in 1577, in the Palatinate, near Heidelberg, at a place where his father, John Voſſius was miniſter. He became well ſkilled in polite literature, hiſtory, and ſacred and profane antiquities, and was made director of the college of Dort. He was at length made profeſſor of eloquence and chronology at Leyden, from whence he was called in 1633 to Amſterdam, to fill the chair of a profeſſor of hiſtory. He died in 1649. He wrote many learned works, of which a complete edition has been printed at Amſterdam, in 9 vols folio.

VOSSIUS (Iſaac), a man of great parts and learning, the ſon of John Gerard Voſſius, was born at Leyden in 1618. He had no other tutor but his father, and employed his whole life in ſtudying: his merit recommended him to a correſpondence with queen Chriſtina of Sweden; he made ſeveral journeys into Sweden by her order, and had the honour to teach her the Greek language. In 1670 he came over to England, where king Charles made him canon of Windſor; though he knew his character well enough to ſay, That there was nothing that Voſſius refuſed to believe, excepting the Bible. He appears indeed by his publications, which are neither ſo uſeful nor ſo numerous as his father's, to have been a moſt credulous man, while he afforded many circumſtances to bring his religious faith in queſtion. He died at Windſor caſtle in 1688.

VOTE, the ſuffrage or reſolve of each of the members of an aſſembly, where any affair is to be carried by a majority; but more particularly uſed for the reſolves of the members of either houſe of parliament.

VOTIVE MEDALS, thoſe on which are expreſſed the vows of the people for the emperors or empreſſes. See MEDAL.

VOW, a ſolemn and religious promiſe or oath. See OATH.

The uſe of vows is found in moſt religions. They make up a conſiderable part of the Pagan worſhip, being made either in conſequence of ſome deliverance, under ſome preſſing neceſſity, or for the ſucceſs of ſome enterprize. Among the Jews, all vows were to be voluntary, and made by perſons wholly in their own power; and if ſuch perſon made a vow in any thing lawful and poſſible, he was obliged to fulfil it. If he appointed no particular time for accompliſhing his vow, he was bound to do it inſtantly, leſt by delay he ſhould prove leſs able, or be unwilling, to execute his promiſe. Among the Romaniſts, a perſon is conſtituted a religious by taking three vows; thoſe of poverty, chaſtity, and obedience.

VOWS, among the Romans, ſignified ſacrifices, offerings, preſents, and prayers made for the Cæſars, and emperors, particularly for their proſperity and the continuance of their empire. Theſe were at firſt made every 5 years, then every 15, and afterwards every 20, and were called *quinquennalia*, *decennalia*, and *vincennalia*.

VOWEL, in grammar, a letter which affords a complete ſound of itſelf, or a letter ſo ſimple as only to need a bare opening of the mouth to make it heard, and to form a diſtinct voice. The vowels are ſix in number, *viz*, A, E, I, O, U, Y.

VOWEL (John). See HOOKER.

UPHOLSTER, UPHOLSTERER, or *Upholder*, a tradeſman that makes beds, and all ſorts of furniture thereunto belonging, &c.

UPLAND, denotes high ground, or, as ſome call it, *terra firma*, by which it ſtands oppoſed to ſuch as is mooriſh, marſhy, or low.

UPLAND, a province of Sweden, bounded on the north-eaſt by the Baltic Sea, on the ſouth by the ſea of Sudermania, and on the weſt by Weſtmania and Geſtricia, from which it is ſeparated by the river Dela. It is about 70 miles in length and 45 in breadth, and contains mines of iron and lead. Stockholm is the capital.

UPSAL, a rich and conſiderable city of Sweden, in Upland, with a famous univerſity, and an archbiſhop's ſee. The town is pretty large, and as ſtraight as a line; but moſt of the houſes are of wood, covered with birch-bark, with turf on the top. On an eminence, to the ſouth of the town, is a ruined caſtle. Thoſe that view the town from hence would take it to be a garden, whoſe ſtreets repreſent the alleys; and the houſes, which are covered with turf, the graſs-plats. It was formerly the reſidence of the kings, and is now the uſual place where they are crowned. It is ſeated on the river Sala, over which there are two bridges. It is 27 miles north-weſt of Stockholm. E. Long. 17. 48. N. Lat. 59. 52.

UPUPA, in ornithology; a genus belonging to the order of *picæ*. The beak is arcuated, convex, and ſomething blunt; the tongue is obtuſe, triangular, entire, and very ſhort; and the feet are fitted for walking. There are ten ſpecies; one of which, the *epops*, hoopoe, or dung-bird, is frequently ſeen in Britain. It may be readily diſtinguiſhed from all others that viſit this iſland by its beautiful creſt, which it can erect or depreſs at pleaſure. It is in length 15 inches; the bill is black, two inches and a half long, ſlender, and incurvated; the irides are hazel: the creſt conſiſts of a double row of feathers; the higheſt about two inches long; the tips are black, their lower part of a pale orange colour: the neck is of a pale reddiſh brown; the breaſt and belly white; the leſſer coverts of the wings are of a light brown; the back, ſcapulars, and wings, croſſed with broad bars of white and black; the rump is white; the tail conſiſts of only 10 feathers, white marked with black, in form of a creſcent, the horns pointing towards the end of the feathers. The legs are ſhort and black; the exterior toe is cloſely united at the bottom to the middle toe.

According to Linnæus, it takes its name from its note, which has a ſound ſimilar to the word; or it may be derived from the French *huppe*, or "creſted:" it breeds in hollow trees, and lays two aſh-coloured eggs: it feeds on inſects, which it picks out of ordure of all kinds. Dr Pallas affirms, that it breeds in preference in putrid carcaſes; and that he had ſeen the neſt of one in the privy of an uninhabited houſe, in the ſuburbs of Tzaritſyn.

Ovid ſays that Tereus was changed into this bird:

> *Vertitur in volucrem, cui ſtant in vertice criſtæ,*
> *Prominet immodicum pro longa cuſpidæ roſtrum:*
> *Nomen epops volucri.* Metam. lib. vi. l. 672.
>
> Tereus, through grief and haſte to be reveng'd,
> Shares the like fate, and to a bird is chang'd.
> Fix'd on his head the creſted plumes appear.
> Long is his beak, and ſharpen'd as a ſpear. *Croxall.*

UR (anc. geog.), a citadel of Meſopotamia, ſituated between the Tigris and Niſibis; taken by ſome for Ur of the Chaldees, the reſidence of Abraham. What ſeems to confirm this is, that from Ur to Haran, the other reſidence of the patriarch, the road lies directly for Paleſtine. And it is no objection that Ur is ſaid to be in Meſopotamia; becauſe the parts next the Tigris were occupied by the Chaldeans, as ſeems to be confirmed from Acts vii. 2, 4. It is called *Orche*, in Strabo; *Orchoe*, in Ptolemy.

URALLIAN CHAIN, a range of mountains which form part of the boundaries of Aſia, and anciently known by the name of *Riphæi Montes*. See RIPHÆI *Montes*, &c.

URANIA, in fabulous hiſtory, one of the nine Muſes, was ſuppoſed to preſide over aſtronomy. She is commonly repreſented in an azure robe, crowned with ſtars, and ſupporting a large globe with both hands.

URANIUM, a foſſil found at Johangeorgenſtad in Saxony, and at Joachimſtal in Bohemia, and is, by the miners, called *Pechblend*. M. Werner, a German mineralogiſt, being convinced that it was not a blend, gave it the name of *Ferrum Ochraceum Piceum*, and thought it contained the tungſtic acid combined with iron: but M. Klaproth is of a contrary opinion, and maintains that it is very different from wolfram. There are (he ſays) two varieties of pechblend: the one is of a dark grey colour, with very little brilliancy, the particles of which have the form of a flattened conchoid; it is not very hard, and, when triturated, becomes a black powder: its mean ſpecific gravity is 7, 5. The other is diſtinguiſhed by its black colour, though it ſometimes aſſumes a reddiſh tint: its ſurface is more brilliant than that of the former, and reſembles pit-coal; it is alſo leſs hard; and the black powder, to which it is reduced by trituration, has a greeniſh hue. This kind is generally diſcovered in compact maſſes, lying between ſtrata of a micaceous ſchiſt, which is found to be decompounded. In the internal parts of this ſtone, it is not uncommon to meet with veins of a peculiar yellow metallic earth. The pechblend is ſoluble in the nitric and in the nitro-muriatic acids, partially ſo in the muriatic, but not at all in the ſulphuric. From theſe ſolutions, the unſaturated ferruginous pruſſiat of potaſh, or phlogiſticated alkali, precipitates the metallic ſubſtance, which then reſembles kermes mineral in colour. This, when it does not unite in flakes, but is uniformly diffuſed in the ſolution, may be conſidered as one of the moſt diſtinguiſhing characters of the pechblend; another is, that the precipitates, affected by the volatile and fixed alkalis, are yellow; the fixed cauſtic alkalis giving it a lemon colour, the aerated a like yellow. This yellow oxyd, or calx, cannot be fuſed with alkalis. As this foſſil cannot be claſſed either among the zinc or iron ores, and is very different from tungſtein, M. Klaproth propoſes to give to it the appellation of *Uranium*; and he diſtributes it into the following ſpecies:

1. *Uranium ſulphuratum.* (*a*) Dark gray, often exhibiting traces of Galena. (*b*) Black, reſembling pit-coal.
2. *Uranium Ochraceum.* Brimſtone colour, lemon colour, deep yellow, reddiſh brown.
3. *Uranium Spathoſum.* (*a*) Tinged with green by copper. (*b*) Yellow. This is the green mica or chalcolithe.

URANOSCOPUS, in ichthyology, a genus of fiſhes belonging to the order of *jugulares*. The head is large, rough, and depreſſed, the upper jaw being ſhorter than the under one; there are ſix dentated rays in the membrane of the gills; and the anus is in the middle of the body. There are two ſpecies, one of which is found in the Mediterranean Sea.

RAPHAEL D'URBINO. See RAPHAEL.

URCHIN, in zoology. See ECHINUS.

URETERS, in anatomy. See ANATOMY, n° 101.

URETHRA, in anatomy. See ANATOMY, n° 107.

URIM *and* THUMMIM, among the ancient Hebrews, a certain oracular manner of conſulting God, which was done by the high prieſt dreſſed in his robes, and having on his pectoral or breaſt-plate.

Various have been the ſentiments of commentators concerning the urim and thummim. Joſephus, and ſeveral others, maintain, that it meant the precious ſtones ſet in the high-prieſt's breaſt-plate, which by extraordinary luſtre made known the will of God to thoſe who conſulted him. Spencer believes that the urim and thummim were two little golden figures ſhut up in the pectoral as in a purſe, which gave reſponſes with an articulate voice. In ſhort, there are as many opinions concerning the urim and thummim as there are particular authors that wrote about them. The ſafeſt opinion, according to Broughton, ſeems to be, that the words *urim* and *thummim* ſignify ſome divine virtue and power annexed to the breaſt-plate of the high-prieſt, by which an oraculous anſwer was obtained from God when he was conſulted by the high-prieſt; and that this was called *urim* and *thummim*, to expreſs the clearneſs and perfection which theſe oracular anſwers always carried with them; for urim ſignifies "light," and thummim "perfection:" theſe anſwers not being imperfect and ambiguous, like the heathen oracles, but clear and evident. The uſe made of the urim and thummim was to conſult God in difficult caſes relating to the whole ſtate of Iſrael; and ſometimes in caſes relating to the king, the ſanhedrim, the general of the army or ſome other great perſonage.

URINAL, in medicine, a veſſel fit to receive and hold urine, and uſed accordingly for the convenience of ſick perſons. It is uſually of glaſs, and crooked; and ſometimes it is filled with milk, to aſſuage the pain of the gravel.

URINAL, in chemiſtry, is an oblong glaſs veſſel, cloſed for making ſolutions, and ſo called from its reſemblance to the glaſſes in which urine is ſet to ſettle for the inſpection of the phyſicians.

URINE, a ſerous and ſaline fluid, ſeparated from the blood, and carried by the emulgent arteries to the kidneys, from whence it deſcends to the bladder by the ureters, and is from time to time emitted thence by the canal of the urethra. See ANATOMY, n° 107. For the analyſis of urine, ſee CHEMISTRY.

URN, a kind of vaſe, of a roundiſh form, but biggeſt in the middle, like the common pitchers, now ſeldom uſed but in the way of ornament over chimney-pieces, in buffets, &c. The great uſe of urns among the ancients, was to preſerve the aſhes of the dead after they were burnt; for which reaſon they were called *cineraria*, and *urnæ cinerariæ*, and were placed ſometimes under the tomb-ſtone whereon the epitaph was cut; and ſometimes in vaults in their own houſes. Urns were alſo uſed at their ſacrifices to put liquid things in.

UROGALLUS, in ornithology. See TETRAO.

URSA, in aſtronomy, the name of two conſtellations in the northern hemiſphere.

URSULINES, in church hiſtory, an order of nuns, founded originally by St Angela of Breſcia, in the year 1537; and ſo called from St Urſula, to whom they were dedicated.

URSUS, the BEAR; a genus of quadrupeds belonging to the order of *feræ*. There are ſix fore-teeth in the upper jaw, alternately hollow in the inſide, and ſix in the under jaw, the two lateral ones being lobated. The dog-teeth are ſolitary and conical; the eyes are furniſhed with a nictitating membrane; the noſe is prominent; and there is a crooked bone in the penis. There are eight ſpecies; the principal of which are,

1. *Arctos*, the black bear, has ſtrong, thick, and clumſy limbs; very ſhort tail; large feet; body covered with very long and ſhaggy hair, various in its colour: the largeſt are of a ruſty brown; the ſmalleſt of a deep black: ſome from the confines of Ruſſia black, mixed with white hairs, called by the Germans, *ſilver bear*; and ſome (but rarely) are found in Tartary of a pure white. It inhabits the north parts of Europe and Aſia; the Alps of Switzerland, and Dauphine; Japan and Ceylon; North America and Peru. The brown bears are ſometimes carnivorous, and will deſtroy cattle, and eat carrion; but their general food is roots, fruits, and vegetables: they will rob the fields of peaſe; and when they are ripe, pluck great quantities up, beat the peaſe out of the huſks on ſome hard place, eat them, and carry off the ſtraw: they will alſo, during winter, break into the farmer's yard, and make great havock among his ſtock of oats; they are alſo particularly fond of honey. The fleſh of a bear in autumn, when they are exceſſively fat, by feeding on acorns, and other maſt, is delicate food; and that of the cubs ſtill finer; but the paws of the old bears are reckoned the moſt exquiſite morſel; the fat white, and very ſweet; the oil excellent for ſtrains and old pains. The latter end of autumn, after they have fattened themſelves to the greateſt degree, the bears withdraw to their dens, where they continue for a great number of days in total inactivity and abſtinence from food, having no other nouriſhment than what they get by ſucking their feet, where the fat lodges in great abundance; their retreats are either in cliffs of rocks, in the deepeſt receſſes of the thickeſt woods, or in the hollows of ancient trees, which they aſcend and deſcend with ſurpriſing agility: as they lay in no winter-proviſions, they are in a certain ſpace of time forced from their retreats by hunger, and come out extremely lean: multitudes are killed annually in America, for the ſake of their fleſh or ſkin; which laſt makes a conſiderable article of commerce.

2. *Maritimus*, the polar or white bear, has a long head and neck; ſhort round ears; great teeth; the hair long, ſoft, and white, tinged in ſome parts with yellow: growing to a vaſt ſize; the ſkins of ſome being 13 feet long. See Plate DX. fig. 3.

This animal is confined to the coldeſt part of the globe; it has been found as far as navigators have penetrated northwards, above lat. 80. The frigid climes only ſeem adapted to its nature; for we do not learn from any authority that it is met with farther ſouth than Newfoundland. Its bounds in reſpect to longitude are alſo very limited; being an animal unknown except on the ſhores of Hudſon's Bay, Greenland, and Spitzbergen, on one ſide, and thoſe of Nova Zembla on the other; for ſuch as have appeared in other parts have been brought there involuntarily on floating iſlands of ice; ſo that the intermediate countries of Norway and Iceland are acquainted with them but by accident. We cannot trace them farther eaſt than Nova Zembla; though the frozen ſea, that is continued from thence as far as the land of Tſchukſchi, that lies above Kamtſchatka, is equally ſuited to their nature. The late hiſtories of thoſe countries are ſilent in reſpect to them.

During ſummer, the white bears are either reſident on iſlands of ice, or paſſing from one to another: they ſwim admirably, and can continue that exerciſe ſix or ſeven leagues, and dive with great agility. They bring two young at a time: the affection between the parents and them is ſo ſtrong, that they would die rather than deſert one another. Their winter retreats are under the ſnow, in which they form deep dens, ſupported by pillars of the ſame. They feed on fiſh, ſeals, and the carcaſes of whales, and on human bodies, which they will greedily tear up: they ſeem very fond of human blood; and are ſo fearleſs as to attack companies of armed men, and even to board ſmall veſſels. When on land, they live on birds and their eggs; and allured by the ſcent of ſeals fleſh, often break into and plunder the houſes of the Greenlanders: their greateſt enemy in the brute creation is the morſe, with whom they have terrible conflicts, but are generally worſted, the vaſt teeth of the former giving it a ſuperiority. The fleſh is white, and ſaid to taſte like mutton: the fat is melted for train-oil, and that of the feet uſed in medicine: but the liver is very unwholeſome, as three of Barentz's ſailors experienced, who fell dangerouſly ill on eating ſome of it boiled. One of this ſpecies was brought over to England a few years ago; it was very furious, almoſt always in motion, roared loud, and ſeemed very uneaſy, except when cooled by having pailfulls of water poured on it.

3. The *luſcus*, or wolverene, has a black ſharp pointed viſage; ſhort rounded ears, almoſt hid in the hairs; the ſides of a yellowiſh brown, which paſſes in form of a band quite over the hind-part of the back, above the tail; the legs are very ſtrong, thick and ſhort, of a deep black: the whole body is covered with very long and thick hair, which varies in colour according to the ſeaſon. It inhabits Hudſon's Bay and Canada, as far as the ſtraits of Michilimackinac; is found under the name of the *glutton* in the north parts of Europe and Aſia, being a native of the moſt rigorous climates.

It is a moſt voracious animal, and ſlow of foot; ſo is obliged to take its prey by ſurpriſe. In America it is called the *beaver-eater*, watching thoſe animals as they come out of their houſes, and ſometimes breaking into their habitations, and devouring them. It often lurks on trees, and falls on the quadrupeds that paſs under; will faſten on the horſe, elk, or ſtag, and continue eating a hole in its body, till the animal falls down with the pain; or elſe will tear out its eyes: no force can diſengage it; yet ſometimes the deer in their agony have been known to deſtroy it, by running their head violently againſt a tree. It devours the iſatis, or white fox; ſearches for the traps laid for the ſables and other animals; and is often beforehand with the huntſmen, who ſuſtain great loſſes by the glutton: authors have pretended that it feeds ſo voraciouſly, that at length it is in danger of burſting; and that it is obliged to eaſe itſelf of its load, by ſqueezing it out between two trees.

In a wild ſtate, it is vaſtly fierce; a terror to both wolf and bear, which will not prey on it when they find it dead, perhaps on account of its being ſo very fetid, ſmelling like a pole-cat: it makes a ſtrong reſiſtance when attacked; will tear the ſtock from the gun, and pull the traps it is caught in to pieces. Notwithſtanding this, it is capable of being tamed, and of learning ſeveral tricks. It burrows, and has its den under ground. The ſkin is ſold in Siberia for 4s. or 6s.; at Jakutſk for 12s.: and ſtill dearer at Kamtſchatka, where the women dreſs their hair with its white paws, which they eſteem a great ornament. The fur is greatly eſteemed in Europe: that of the north of Europe and Aſia, whoſe ſkins are ſometimes to be ſeen in the furrier's ſhops, is much finer, blacker, and more gloſſy than that of the wolverene, or American kind. The glutton has by ſome authors been confounded with the hyæna.

4. The *lotor*, or raccoon, has the upper part of the body covered with hair, aſh-coloured at the root, whitiſh in the middle, and tipped with black; tail very buſhy, annulated with black; toes black, and quite divided.—It inhabits the warm and temperate parts of America; is found alſo in the mountains of Jamaica, and in the iſles of Maria, between the ſouth point of California and Cape Corientes, in the South Sea: is eaſily made tame, very good-natured, and ſportive; but as unlucky as a monkey. It is almoſt always in motion; and very inquiſitive, examining every thing with its paws. It makes uſe of them as hands; ſits up to eat; is extremely fond of ſweet things, and ſtrong liquors, and will get exceſſively drunk. It has all the cunning of a fox; and is very deſtructive to poultry; but will eat all ſorts of fruits, green corn, &c. At low water it feeds much on oyſters, and will watch their opening, and with its paw ſnatch out the fiſh; it ſometimes is caught in the ſhell, and kept there till drowned by the coming in of the tide: it is alſo fond of crabs. It climbs very nimbly up trees. It is hunted for its ſkin; the fur is next to that of the beaver for making hats.

5. The *meles*, or common badger, is an animal of a very clumſy make, with ſhort thick legs, long claws on the fore feet, and a fetid white matter exuding from the orifice below the tail. It inhabits moſt parts of Europe, as far north as Norway and Ruſſia, and the ſtep or deſert beyond Orenburgh, in the Ruſſian Aſiatic dominions, north of the Caſpian Sea: inhabits alſo China, and is often found in the butchers ſhops in Pekin, the Chineſe being fond of them; but a ſcarce animal in moſt countries. It ſeldom appears in the day; confines itſelf much to its hole; is indolent and ſleepy; generally very fat; feeds by night; eats roots, fruits, graſs, inſects, and frogs; but is not carnivorous: it runs ſlowly; when overtaken, it comes to bay, and defends itſelf vigorouſly; its bite is dangerous. It burrows under ground; makes ſeveral apartments, but forms only one entrance from the ſurface. It is hunted during night for the ſkin, which ſerves for piſtol furniture; the hairs for making bruſhes to ſoften the ſhades in painting. Its fleſh makes good bacon.

URTICA, in botany: A genus of plants of the claſs of *monœcia*, and order of *tetrandria*; and in the natural ſyſtem claſſed under the 53d order, *Scabridæ*. The ſmall flower has a calyx of four leaves; no corolla; a nectarium minute, central, urn-faſhioned. The female a bivalve calyx; and a ſingle, oval, gloſſy ſeed. There are 28 ſpecies; three of which are Britiſh plants.

1. The *pilulifera*, Roman nettle, has a ſtalk branched, two or three feet high. Leaves oppoſite, oval, ſerrated, ſtinging. Fruit globoſe.

2. The *urens*, leſs ſtinging nettle, has a ſtem a foot high. Leaves roundiſh, deeply ſerrated, oppoſite, burning. The ſtings are very curious microſcopic objects: they conſiſt of an exceedingly fine pointed, tapering, hollow ſubſtance, with a perforation at the point, and a bag at the baſe. When the ſpring is preſſed upon, it readily perforates the ſkin, and at the ſame time forces up ſome of the acrimonious liquor contained in the bag into the wound.

3. The *dioica*, common nettle, has a ſquare firm ſtem, three or four feet high. Leaves heart-ſhaped, long-pointed, ſerrated, beſet with ſtings. Flowers in long catkins. The aculei, or ſtings of the nettle, have a ſmall bladder at their baſe full of a burning corroſive liquor: when touched, they excite a bliſter, attended with a violent itching pain, though the ſting does not appear to be tubular, or perforated at the top, nor any viſible liquor to be infuſed into the puncture made by it in the fleſh. It ſeems certain, however, that ſome of this liquor is inſinuated into the wound, though inviſibly, ſince the ſtings of the dried plant excite no pain.

Nettle-tops in the ſpring are often boiled and eaten by the common people inſtead of cabbage-greens.

In Arran, and other iſlands, a rennet is made of a ſtrong decoction of nettles: a quart of ſalt is put to three pints of the decoction, and bottled up for uſe. A common ſpoonful of this liquor will coagulate a large bowl of milk very readily and agreeably. The ſtalks of nettles are ſo like in quality to hemp, that in ſome parts of Europe and Siberia they have been manufactured into cloth, and paper has been made of them. The whole plant, particularly the root, is eſteemed to be diuretic, and has been recommended in the jaundice and nephritic complaints. It is alſo reckoned aſtringent; and of ſervice in all kinds of hæmorrhagies, but is at preſent but little in practice. The roots boiled will dye yarn of a yellow colour. The larvæ, or caterpillars of many ſpecies of butterflies, feed on the green plant; and ſheep and oxen will readily eat the dried.

URTICA Marina. See *ANIMAL-Flower*.

USANCE, in commerce, is a determined time fixed for the payment of bills of exchange, reckoned either from the day of the bills being accepted, or from the day of their date; and thus called becauſe regulated by the uſage and cuſtom of the places whereon they are drawn.

USE, in law, the profit or benefit of lands and tenements; or a truſt and confidence repoſed in a perſon for the holding of lands, &c. that he to whoſe uſe the truſt is made ſhall receive the profits.

USHANT, an iſland of France, 15 miles weſt of the coaſt of Britanny, at the entrance of the Britiſh Channel.

USHER (James), archbiſhop of Armagh, one of the moſt illuſtrious prelates in the 17th century, as well with reſpect to his piety and other virtues, as his uncommon erudition, was born in Dublin in 1580, and it is ſaid that two of his aunts taught him to read, though they were both born blind. Dublin college being finiſhed in 1593, he was one of the three firſt ſtudents admitted into it. He made ſo ſwift a progreſs in his ſtudies, that at 18 years of age he was able to diſpute with Henry Fitz-Simon, a famous Jeſuit, who challenged all the Proteſtant clergy; and defended his cauſe ſo well in the caſtle of Dublin, that he made him repent his challenge. He was ordained prieſt in 1601, and ſoon after was appointed to preach conſtantly before the court at Chriſt-church in Dublin, on Sundays in the afternoon. In 1603, he was ſent over to England with Dr Luke

Challoner, in order to purchaſe books for the library of Dublin. In 1607, he took the degree of bachelor of divinity; ſoon after, he was made chancellor of St Patrick's cathedral, and the ſame year was choſen profeſſor of divinity, when he made choice of Bellarmine's controverſies for the ſubject of his lectures. Some years after, he made it a conſtant cuſtom to come over to England once in three years, ſpending one month of the ſummer at Oxford, another at Cambridge, and the reſt of the time at London. In 1612, he took the degree of doctor of divinity; at the latter end of the year 1620, he was promoted to the biſhopric of Meath, and in 1625 was made archbiſhop of Armagh. In the adminiſtration of his archbiſhopric he acted in a very exemplary manner, and endeavoured to reform the clergy and officers in the eccleſiaſtical courts. In 1640, he came over to England with his family, with an intention ſoon to return to Ireland; but was prevented by the rebellion which broke out there in 1641; and in that rebellion he was plundered of every thing, except his library, which was in England, and ſome furniture in his houſe at Drogheda. His majeſty, therefore, conferred on him the biſhopric of Carliſle, to be held *in commendam;* the revenues of which were greatly leſſened by the Scots and Iriſh armies quartering upon it; but when all the lands belonging to the biſhoprics in England were ſeized by the parliament, they voted him a penſion of 400l. *per annum,* though he never received it above once or twice. He afterwards removed to Oxford; and, in 1643, was nominated one of the aſſembly of divines at Weſtminſter, but refuſed to ſit amongſt them; which, together with ſome of his ſermons at Oxford giving offence to the parliament, they ordered his ſtudy of books, of conſiderable value, to be ſeized; but by the care of Dr Featly, one of the aſſembly, they were ſecured for the primate's uſe. The king's affairs declined; and Oxford being threatened with a ſiege, he left that city, and retired to Cardiff in Wales, to the houſe of Sir Timothy Tyrrel, who had married his only daughter, and was then governor and general of the ordnance. He was afterwards invited to London by the counteſs of Peterborough. In 1647, he was choſen preacher in Lincoln's-Inn; and during the treaty in the Iſle of Wight, he was ſent for by the king, who conſulted him about the government of the church. The death of his majeſty ſtruck him with great horror. The counteſs of Peterborough's houſe, where the primate then lived, being juſt over againſt Charing Croſs, ſeveral of her gentlemen and ſervants went up to the leads of the houſe, whence they could plainly ſee what was acting before Whitehall. As ſoon as his majeſty came upon the ſcaffold, ſome of the houſehold told the primate of it; and aſked him, whether he would ſee the king once more before he was put to death. He was at firſt unwilling, but at laſt went up: where, as the ceremonial advanced, the primate grew more and more affected; and, when the executioners in vizards began to put up the king's hair, he ſwooned away. He died of a pleuriſy in 1655; and was ſolemnly buried at Weſtminſter, in St Eraſmus's chapel. He publiſhed 1. *Britannicarum Eccleſiarum Antiquitates.* 2. *Polycarpi et Ignatii Epiſtolæ, Græce Latine,* &c. 3. Annals of the Old and New Teſtament, in Latin. 4. *De Græce Septuaginta interpretum Verſione Syntagma;* and many other books which are eſteemed. A conſiderable number of his works ſtill remain in manuſcript.

Usher, an officer or ſervant who has the care and direction of the door of a court, hall, chamber, or the like.

Usher of the Black Rod, the eldeſt of the gentlemen uſhers, daily waiters at court, whoſe duty is to bear the rod before the king at the feaſt of St George, and other ſolemnities.

USK, a river of Wales, which riſes on the weſt of Brecknockſhire, and runs ſouth-eaſt through that county and Monmouthſhire, falling into the mouth of the Severn.

USQUEBAUGH, a ſtrong compound liquor, chiefly taken by way of dram.

There are ſeveral different methods of making this liquor; but the following is eſteemed one of the beſt: To two gallons of brandy, or other ſpirits, put a pound of Spaniſh liquorice, half a pound of raiſins of the ſun, four ounces of currants, and three of ſliced dates; the tops of baum, mint, ſavory, thyme, and the tops of the flowers of roſemary, of each two ounces; cinnamon and mace, well bruiſed, nutmegs, aniſeeds, and coriander ſeeds, bruiſed likewiſe, of each four ounces; of citron or lemon, and orange peel, ſcraped, of each an ounce: let all theſe infuſe 48 hours in a warm place, often ſhaking them together: then let them ſtand in a cool place for a week: after which the clear liquor is to be decanted off, and to it is to be put an equal quantity of neat white port, and a gallon of canary; after which it is to be ſweetened with a ſufficient quantity of double-refined ſugar.

USTION, in pharmacy, the preparing of certain ſubſtances by burning them.

USUFRUIT, in the civil law, the uſe or enjoyment of any lands or tenements; or the right of receiving the fruits and profits of an inheritance, or other thing, without a power of alienating or changing the property thereof.

USURER, a perſon charged with a habit or act of uſury.

USURIOUS contract, is any bargain or contract whereby a man is obliged to pay more intereſt for money than the ſtatute allows.

USURPATION, in law, is an injurious uſing or enjoyment of a thing for continuance of time, that belongs of right to another.

USURY, an unlawful contract upon the loan of money, to receive the ſame again with exorbitant increaſe. Under the article Interest, it was obſerved, that by ſtatute 37 Hen. VIII. c. 9. the rate of intereſt was fixed at 10 l. *per cent. per annum:* which the ſtatute 13 Eliz. c. 8. confirms, and ordains, that all brokers ſhall be guilty of a *præmunire* that tranſact any contracts for more, and the ſecurities themſelves ſhall be void. The ſtatute 21 Jac. I. c. 17. reduced intereſt to 8 l. *per cent.*; and it having been lowered in 1650, during the uſurpation, to 6 *per cent.* the ſame reduction was re-enacted after the Reſtoration by ſtatute 12 Car. II. c. 13. and, laſtly, the ſtatute 12 Annæ, ſt. 2. c. 16. has reduced it to 5 *per cent.* Wherefore not only all contracts for taking more are in themſelves totally void, but alſo the lender ſhall forfeit treble the money borrowed. Alſo if any ſcrivener or broker takes more than 5 s. *per cent.* procuration-money, or more than 12 d. for making a bond, he ſhall forfeit 20 l. with coſts, and ſhall ſuffer impriſonment for half a year.

UTERUS, in anatomy. See there, nº 108.

UTICA (anc. geog.), a town of Africa Propria, on the Mediterranean: a Tyrian colony, and older than Carthage, (Sil. Italicus); its name, according to Bochart, denoting *old:* reckoned ſecond to it; but after the deſtruction of Carthage, became the capital and centre of all the Roman tranſactions in Africa, according to Strabo; who adds, that it ſtood on the ſame bay with Carthage, at one of the promontories called *Apollonium,* bounding the bay on the weſt ſide, the other to the eaſt called *Hermeia,* being at Carthage. It became famous by the death of Cato, who thence was called *Uticenſis.*

UTRECHT, one of the ſeven United Provinces, or States of Holland, wholly ſurrounded by Holland and Guelderland, excepting a ſmall part of it that borders on the

Zuyder-Zee. Its greateſt length is about 32 miles, and breadth about 22. It enjoys a good air; and in moſt places the ſoil is fruitful, but in ſome ſandy, or what is called *turf-ground*, and in others over-run with wood. It is watered by the Leck, Rhine, Vecht, and other ſmall rivers, beſides ſeveral canals; of which that extending from the village of Vreeſwyk to Utrecht is one of the chief.

UTRECHT, or, Latin, *Ultrajectum*, *Trajectum vetus* or *inferius*, or, *Trajectum Rheni*, capital of a province of the ſame name, ſo called from its ancient ferry or paſſage here over the Rhine; the word being compounded of *trecht*, which in Dutch ſignifies "a ferry," and *oud* or *olt*, i. e. "old." It is a fair, large, and populous city, ſituated 19 miles from Amſterdam, 25 from Rotterdam, and 27 from Leyden. Here is a ſtately town-houſe, with a commandery of the Teutonic order, and a celebrated univerſity, which was founded in 1630, ſince which it hath flouriſhed greatly, though it has not all the privileges of moſt other univerſities; being wholly ſubject to the magiſtrates of the city. The mall without the town, having five rows of lofty limes on each ſide, is very pleaſant, and the phyſic-garden belonging to the univerſity is extremely curious. There are five churches here that have chapters; but the members of theſe purchaſe the places, of which ſome coſt 6000 or 7000 guilders. The ſtreams which run through ſeveral of the ſtreets, contribute much to the beauty and cleanlineſs of the town; and the canal that is cut from the Leck, and paſſes through it to Amſterdam, will carry ſhips of any burden. Pope Adrian VI. was a native of this city. Here in 1579, the memorable union was formed between the ſeven provinces; and, in 1713, the celebrated peace concluded between France on the one part, and the allies on the other. The Papiſts have a nominal archbiſhop of this city; and there is a ſilk manufactory carried on in it, which employs a number of hands. The inhabitants are ſuppoſed to amount to 30,000. E. Long. 5. 8. N. Lat. 52. 7.

UTRICULARIA, in botany: A genus of plants of the claſs of *diandria*, and order of *monogynia*; and in the natural ſyſtem arranged under the 24th order, *Corydales*. The calyx is ringent, with a nectarium reſembling a ſpur; the corolla diphyllous and equal; the capſule unilocular. There are nine ſpecies; two of which are natives of Britain. They have been applied to no particular uſe.

UVA URSI. See ARBUTUS.

VULCAN, in Pagan worſhip, the god of ſubterraneous fire and metals, was the ſon of Jupiter and Juno; and was ſaid to be ſo remarkably deformed, that his father threw him down from heaven to the iſle of Lemnos, in which fall he broke his leg, and there he ſet up his forge, and taught men how to ſoften and poliſh braſs and iron. Thence he removed to the Liparian iſles near Sicily, where, by the aſſiſtance of the Cyclops, he made Jupiter's thunderbolts, and armour for the other gods. Notwithſtanding the deformity of his perſon, he had a paſſion for Minerva, and by Jupiter's conſent made his addreſſes to her, but without ſucceſs. He was, however, more fortunate in his ſuit to Venus; who, after her marriage, choſe Mars for her gallant; when Vulcan expoſed them to the ridicule of the other gods, by taking them in a net.

VULGATE, a very ancient Latin tranſlation of the Bible, and the only one acknowledged by the Church of Rome to be authentic. See BIBLE.

VULNERARY, in medicine, an epithet formerly given to remedies ſuppoſed to poſſeſs virtues for the cure of wounds and ulcers.

VULTUR, a genus of birds belonging to the order of *Accipitres*. The beak is ſtraight and crooked at the point; the head has no feathers; on the forepart being only naked ſkin; and the tongue is generally bifid. There are 21 ſpecies.

1. *Gryphus*, the condor, which is not only the largeſt of this genus, but perhaps of all others which are able to fly. The accounts of authors in regard to its extent of wing are various, viz. from 9 to 18 feet from the tip of one wing to that of the other. One gives it ſtrength enough to carry off ſheep and boys of ten years old; while another ventures to affirm, that it can lift an elephant from the ground high enough to kill it by the fall! M. de Salerne ſays, that one of this kind was ſhot in France in the year 1719, which weighed 18 lib. and whoſe extent of wing was 18 feet. But to come nearer the truth, perhaps it is better to abide by deſcriptions which bear a moderate proportion. In Hawkeſworth's Voyages, mention is made of one of theſe birds ſhot at Port Deſire, off Penguin Iſlands, of which he gives the following deſcription: "The head of this bird reſembled that of an eagle, except that it had a large comb upon it. Round the neck it had a white ruff, exactly reſembling a lady's tippet; the feathers on the back were as black as jet, and as bright as the fineſt poliſh could render that mineral; the legs were remarkably ſtrong and large, and the talons like thoſe of an eagle, except that they were not ſo ſharp; and the wings when they were extended, meaſured from point to point, no leſs than 12 feet." This laſt account ſeems by no means to exceed the natural ſize, ſince we have an account in the Philoſophical Tranſactions of one of the quill-feathers of this bird, brought from Chili, which meaſured 12 feet 4 inches; the diameter of the quill half an inch; and the extent of wing 16 feet. This bird was met in latitude 33 ſouth, not far from the iſland Mocha, in the South Sea, in the year 1691. The ſeamen ſhot it on a cliff by the ſea-ſide; and taking it for a kind of turkey, made a meal of it. In this account we are told that the colour was black and white, like a magpie, and the creſt or comb ſharp like a razor.

It ſeems now certain, that the account given by the editor of Cook's Voyage is very nearly, if not preciſely the truth, as two birds of this kind are now in the muſeum of Mr Parkinſon, and are probably male and female. The firſt of theſe has an extent of wing ſomewhat under 11 feet. The bill is ſtrong, moderately hooked, and blunt at the tip, which is white, the reſt of it being of a duſky colour. On the top of the head runs a kind of carunculated ſubſtance, ſtanding up like the comb of a cock. The head and neck are ſlightly covered with brown down, in ſome parts nearly bare, and here and there a carunculated part, as in the neck of a turkey. The lower part of the neck is ſurrounded with a ruff of a pure white and hairy kind of feathers. The upper parts of the body, wing, and garl, are black, except that the middle wing coverts have whitiſh ends, and the greater coverts half black half white. The nine or ten firſt quills are black, the reſt white with the tips only black: and when the wings are cloſed, producing the appearance of the bird having the back white; giving occaſion to Molruc in his Hiſtory of Chili to ſay, that the back was white. The under parts of the body are rather ſlightly covered with feathers; but thoſe of the thighs are pretty long. The legs are ſtout and brown; claws black and blunt.

The ſecond bird in Mr Parkinſon's collection, chiefly differs from the firſt, in having not the leaſt appearance of a comb or creſt, but ſmooth for the moſt part, except where the head and neck are covered with down. The ruff on the lower part of the neck is not ſo full and conſpicuous; but as to the colour of the plumage, the difference is not worth noticing. It is not impoſſible but this laſt may prove to be

Vultur.

Vultur ‖ Uz.

a young male, for Molruc expreſsly ſays, that the female is ſmaller than the male, of a brown colour, and has no ruff about the neck, only a ſmall tuft at the back part.

Theſe birds are ſaid to make the neſt among the inacceſſible rocks, and to lay two white eggs, larger than thoſe of a turkey; are very deſtructive to ſheep, and will in troops often attempt calves; in which caſe, ſome of them firſt pick out the eyes, whilſt others attack the poor animal on all ſides, and ſoon tear him to pieces. This gives riſe to the following ſtratagem, uſed by the peaſants of Chili: One of them wraps himſelf up in the hide of a freſh killed ſheep or ox, and lies ſtill on the ground; the condor ſuppoſing it to be lawful prey, flies down to ſecure it, when the perſon concealed, lays hold of the legs of the bird, his hands being well covered with gloves; and immediately his comrades, who are concealed at a diſtance, run in, and aſſiſt to ſecure the depredator, by falling on him with ſticks till they have killed him. See Plate DX. fig. 4.

2. The *Percnopterus*, or Egyptian vultur. The appearance of this bird is as horrid as can well be imagined, viz. the face is naked and wrinkled; the eyes are large and black; the beak black and hooked; the talons large, and extending ready for prey; and the whole body polluted with filth: theſe are qualities enough to make the beholder ſhudder with horror. Notwithſtanding this, the inhabitants of Egypt cannot be enough thankful to Providence for this bird. All the places round Cairo are filled with the dead bodies of aſſes and camels; and thouſands of theſe birds fly about, and devour the carcaſes before they putrify and fill the air with noxious exhalations. The inhabitants of Egypt, and after them Maillet in his deſcription of Egypt, ſay, that they yearly follow the caravan to Mecca, and devour the filth of the ſlaughtered beaſts, and the carcaſes of the camels which die on the journey. They do not fly high, nor are they afraid of men. If one is killed, all the reſt ſurround him in the ſame manner as do the royſton crows; they do not quit the places they frequent, though frightened by the exploſion of a gun, but immediately return thither. Maillet imagines this bird to be the ibis of the ancients: but it is ſcarcely to be imagined, that a wiſe nation ſhould pay ſuch honours to an unclean, impure, and rapacious bird, which was not perhaps ſo common before the Egyptians filled the ſtreets with carcaſes. If the ibis is to be found, it muſt certainly be looked for in the ordo of grallæ of Linnæus; and we imagine it to be the white ſtork (*Ardea cicona*), which is ſo common in Egypt. The Arabians call it *rochæme*; the French living in Egypt, give it the name of *chapon de Pharaon*, or *de Mahometh*.

3. The *aura*, or carrion vultur, according to Mr Latham, is about the ſize of a turkey, though it varies in ſize in different parts. The bill is white; the end black; irides bluiſh ſaffron-colour. The head, and part of the neck, are bare of feathers: and of a red, or rather rufous colour. The ſides of the head warted, not unlike that of a turkey. The whole plumage is brown black, with a purple and green gloſs in different reflections; but in ſome birds, eſpecially young ones, greatly verging to dirty brown. The feathers of the quills and tail are blacker than the reſt of the body. The legs are fleſh-colour; the claws black.

This bird is very common in the Weſt Indies, and both in North and South America. It feeds on dead carcaſes, ſnakes, &c. like moſt of this genus; which makes the ſmell of it very offenſive. In general, it is very tame in its wild ſtate, but particularly ſo when trained up from being young. This our author experienced in two birds ſent home from Jamaica. They were ſuffered to run wild about the garden, and were alert and briſk during the ſummer months; but impatient of the leaſt cold; for a rainy day, with the ſlighteſt degree of cold obliged them to creep for ſhelter. In the Weſt Indies, they rooſt together of nights, in vaſt numbers, like rooks in Great Britain. They are reckoned a moſt uſeful animal in the places where they reſort; which ſecures their ſafety, added to a penalty for killing one, which is in force in Jamaica, and other iſlands of the Weſt Indies.

4. The *ſagittarius*, or ſecretary, is a moſt ſingular ſpecies, being particularly remarkable for the great length of its legs; which at firſt ſight would induce one to think it belonged to waders: but the characters of the vultur are ſo ſtrongly marked throughout, as to leave no doubt to which claſs it belongs.

The bird, when ſtanding erect, is full three feet from the top of the head to the ground. The bill is black, ſharp, and crooked, like that of an eagle: the head, neck, breaſt, and upper parts of the body, are of a bluiſh aſh colour: the legs are very long, ſtouter than thoſe of a heron, and of a brown colour; claws ſhortiſh, but crooked, not very ſharp, and of a black colour; from the hind-head ſprings a number of long feathers, which hang looſe behind like a pendent creſt; theſe feathers ariſe by pairs, and are longer as they are lower down on the neck; this creſt the bird can erect or depreſs at pleaſure: it is of a dark colour, almoſt black; the webs are equal on both ſides, and rather curled; and the feathers, when erected, ſomewhat incline towards the neck: the two middle feathers of the tail twice as long as any of the reſt.

This ſingular ſpecies inhabits the internal parts of Africa, and is frequently ſeen at the Cape of Good Hope. It is alſo met with in the Philippine iſlands.

The deſcription was taken by Mr Latham from three that were alike, which he ſaw in England alive ſome years ſince; two of which are now in the Leverian muſeum. From confinement they had loſt their two long tail feathers; but this want was ſupplied by ſome accurate drawings by Sir Joſeph Banks, taken from the life at the Cape.

As to the manners of this bird, it is on all hands allowed that it principally feeds on rats, lizards, ſnakes, and the like; and that it will become familiar: whence Sonnerat is of opinion, that it might be made uſeful in ſome of our colonies, if encouraged, towards the deſtruction of theſe peſts. They call it at the Cape of Good Hope *ſlangeater*, i. e. ſnake-eater. A great peculiarity belongs to it, perhaps obſerved in no other; which is, the faculty of ſtriking forwards with its legs, never backwards. Dr Solander has ſeen one of theſe birds take up a ſnake, ſmall tortoiſe, or ſuch like, in its claws; when daſhing it from thence againſt the ground with great violence, if the victim was not killed at firſt, it repeated the operation till that end was anſwered; after which it ate it up quietly. Dr J. R. Forſter mentioned a further circumſtance, which he ſays was ſuppoſed to be peculiar to this bird; that ſhould it by any accident break the leg, the bone would never unite again.

VULVA, in anatomy. See there, n° 132.

UVULA, in anatomy. See there, n° 102.

UZ, or Utz, the country and place of reſidence of Job. In the genealogy of the patriarchs there are three perſons called *Uz*, either of which might give this diſtrict its name. The firſt was the grandſon of Sem, by his ſon Aram (Gen. xxii. 23.), who, according to Joſephus, occupied the Trachonitis, and Damaſcus, to the north of Paleſtine: but Job was among the ſons of the Eaſt. Another *Uz* was the ſon of Nahor, Abraham's brother (Gen. x. 21.), who appears to have removed, after paſſing the Euphrates, from Haran of Meſopotamia to Arabia Deſerta. The third *Uz* was a Horite, from mount Seir (Gen. xxxvi. 28.), and thus not of Eber's poſterity. Now the queſtion is, from which of theſe

Uz.

Job's country, Uz took its name? Not from the firſt, as is already ſhown; nor from the ſecond, becauſe his country is always called *Seir*, or *Edom*, never *Uz*; and then called a *ſouth* or an *eaſt*, country, in Scripture. It therefore remains, that we look for the country and place of reſidence of Job in Arabia Deſerta; for which there were very probable reaſons. The plunderers of Job are called *Chaldeans* and *Sabeans*, next neighbours to him. Theſe Sabeans came not from Arabia Felix, but from a nearer Sabe in Arabia Deſerta (Ptolemy); and his friends, except Eliphaz the Themanite were of Arabia Deſerta.

UZBECK Tartary. See Tartary.

Uz, Uzbeck.

W.

Waag ‖ Waggon.

W, or w, is the 21ſt letter of our alphabet; and is compoſed, as its name implies, of two v's. It was not in uſe among the Hebrews, Greeks, or Romans; but chiefly peculiar to the northern nations, the Teutones, Saxons, Britons, &c. But ſtill it is not uſed by the French, Italians, Spaniards, or Portugueſe, except in proper names, and other terms borrowed from languages in which it is originally uſed, and even then it is ſounded like the ſingle v. This letter is of an ambiguous nature; being a conſonant at the beginning of words, and a vowel at the end. It may ſtand before all the vowels except *u*; as *water*, *wedge*, *winter*, *wonder*: it may alſo follow the vowels *a*, *e*, *o*, and unites with them into a kind of double vowel, or diphthong; as in *ſaw*, *few*, *cow*, &c. It alſo goes before *r*, and follows *ſ* and *th*; as in *wrath*, *ſwear*, *thwart*: it goes before *h* alſo, though in reality it is ſounded after it; as in *when*, *what*, &c. In ſome words it is obſcure, as in *ſhadow*, *widow*, &c.

WAAG, a river of Hungary, which riſes in the Carpathian mountains, and falls into the Danube oppoſite to the iſland of Schut.

WAAL, a river of the United Netherlands, being one of the branches of the Rhine, which runs from eaſt to weſt, thro' Guelderland, paſſing by Nimeguen, Tiel, Bommel and Gorcum: and, uniting with the Maes, falls into the German Sea below the Briel.

WACHENDORFIA, in botany: A genus of plants of the claſs of *triandria*, and order of *monogynia*; and arranged in Linnæus's Natural Method of Claſſification under the 6th order, *Inſatæ*. The corolla is hexapetalous, unequal, and ſituated below the germen; the capſule trilocular and ſuperior. There are four ſpecies; none of which are natives of Britain.

WADD, or Wadding, is a ſtopple of paper, hay, ſtraw, or the like, forced into a gun upon the powder, to keep it cloſe in the chamber; or to put up cloſe to the ſhot, to keep it from rolling out.

WADSET, in Scots law. See Law, n° clxix. 1.

WAFERS, or *Sealing Wafers*, are made thus: Take very fine flour, mix it with glair of eggs, iſinglaſs, and a little yeaſt; mingle the materials; beat them well together; ſpread the batter, being made thin with gum-water, on even tin plates, and dry them in a ſtove; then cut them out for uſe.

You may make them of what colour you pleaſe, by tinging the paſte with braſil or vermilion for red; indigo or verditer, &c. for blue; ſaffron, turmerics, or gamboge, &c. for yellow.

WAGER *of Law*. See *(Wager of)* Law.

Wager of Battel. See *(Wager of)* Battel.

WAGGON, a wheel carriage, of which there are various forms, accommodated to the different uſes they are intended for. The common waggon conſiſts of the ſhafts or rods, being the two pieces which the hind horſe bears up; the welds; the ſlotes, or croſs pieces, which hold the ſhafts together; the bolſter, being that part on which the forewheels and the axle-tree turn in wheeling the waggon acroſs the road; the cheſt or body of the waggon having the ſtaves or rails fixed thereon; the bales, or hoops which compoſe the top; the tilt, the place covered with cloth, at the end of the waggon. See Mechanics, Sect. iv.

Wagtail ‖ Wake.

WAGTAIL, in ornithology. See Motacilla.

WAIFS, bona waviata, are goods ſtolen, and waived or thrown away by the thief in his flight, for fear of being apprehended. Theſe are given to the king by the law, as a puniſhment upon the owner for not himſelf purſuing the felon, and taking away his goods from him. And therefore if the party robbed do his diligence immediately to follow and apprehend the thief (which is called *making freſh ſuit*), or do convict him afterwards, or procure evidence to convict him, he ſhall have his goods again. Waived goods do alſo not belong to the king till ſeized by ſomebody for his uſe; for if the party robbed can ſeize them firſt, though at the diſtance of 20 years, the king ſhall never have them. If the goods are hid by the thief, or left any where by him, ſo that he had them not about him when he fled, and therefore did not throw them away in his flight; theſe alſo are not *bona waviata*, but the owner may have them again when he pleaſes. The goods of a foreign merchant, though ſtolen and thrown away in flight, ſhall never be waifs: the reaſon whereof may be, not only for the encouragement of trade, but alſo becauſe there is no wilful default in the foreign merchant's not purſuing the thief, he being generally a ſtranger to our laws, our uſages, and our language.

WAIGATS straits, ſituated between Nova Zembla and Ruſſia, through which the Dutch ſailed to the north, as high as 75°, in order to diſcover a north-eaſt paſſage to China and the Eaſt Indies.

WAINSCOT, in building, the timber-work that ſerves to line the walls of a room, being uſually made in pannels, and painted, to ſerve inſtead of hangings.

WAIVE, in law, a woman that is put out of the protection of the law. She is called *waive*, as being forſaken of the law; and not *outlaw* as a man is; by reaſon women cannot be of the decenna, and are not ſworn in leets to the king, nor to the law, as men are; who are therefore within the law; whereas women are not, and ſo cannot be outlawed, ſince they never were within it.

WAKE, the print or track impreſſed by the courſe of a ſhip on the ſurface of the water. It is formed by the reunion of the body of water which was ſeparated by the ſhip's bottom whilſt moving through it; and may be ſeen to a conſiderable diſtance behind the ſtern, as ſmoother than the reſt of the ſea. Hence it is uſually obſerved by the compaſs, to diſcover the angle of lee-way.

A ſhip is ſaid to be in the wake of another when ſhe follows her on the ſame track, or a line ſuppoſed to be formed on the continuation of her keel.

Two diſtant objects obſerved at ſea are called in the wake of each other, when the view of the fartheſt is intercepted by the neareſt; ſo that the obſerver's eye and the two objects are all placed upon the ſame right line.

Wake is the eve-feaſt of the dedication of churches, which is kept with feaſting and rural diverſions.

The learned Mr Whitaker, in his Hiſtory of Mancheſter, hath given a particular account of the origin of wakes and fairs. He obſerves, that every church at its conſecration received the name of ſome particular ſaint: this cuſtom was practiſed among the Roman Britons, and continued among the Saxons; and in the council of Cealchythe, in 816, the name of the denominating ſaint was expreſsly required to be inſcribed on the altars, and alſo on the walls of the church, or a tablet within it. The feaſt of this ſaint became of courſe the feſtival of the church. Thus Chriſtian feſtivals were ſubſtituted in the room of the idolatrous anniverſaries of heatheniſm: accordingly, at the firſt introduction of Chriſtianity among the Jutes of Kent, pope Gregory the Great adviſed what had been previouſly done among the Britons, viz. Chriſtian feſtivals to be inſtituted in the room of the idolatrous, and the ſuffering day of the martyr whoſe relics were repoſited in the church, or the day on which the building was actually dedicated, to be the eſtabliſhed feaſt of the pariſh. Both were appointed and obſerved; and they were clearly diſtinguiſhed at firſt among the Saxons, as appears from the laws of the Confeſſor, where the *dies dedicationis*, or *dedicatio*, is repeatedly diſcriminated from the *propria feſtivitas ſancti*, or *celebratio ſancti*. They remained equally diſtinct to the Reformation; the dedication-day in 1536 being ordered for the future to be kept on the firſt Sunday in October, and the feſtival of the patron ſaint to be celebrated no longer. The latter was, by way of pre-eminence, denominated the *church's holiday*, or its peculiar feſtival; and while this remains in many pariſhes at preſent, the other is ſo utterly annihilated in all, that biſhop Kennet (ſays Mr Whitaker) knew nothing of its diſtinct exiſtence, and has attributed to the day of dedication what is true only concerning the ſaint's day. Thus inſtituted at firſt, the day of the tutelar ſaint was obſerved, moſt probably by the Britons, and certainly by the Saxons, with great devotion. And the evening before every ſaint's day, in the Saxon Jewiſh method of reckoning the hours, being an actual hour of the day, and therefore like that appropriated to the duties of public religion, as they reckoned Sunday from the firſt to commence at the ſun-ſet of Saturday; the evening preceding the church's holiday would be obſerved with all the devotion of the feſtival. The people actually repaired to the church, and joined in the ſervices of it; and they thus ſpent the evening of their greater feſtivities in the monaſteries of the North, as early as the concluſion of the ſeventh century.

Theſe ſervices were naturally denominated from their late hours *wæccan* or *wakes*, and *vigils* or *eves*. That of the anniverſary at Rippon, as early as the commencement of the eighth century, is expreſsly denominated the *vigil*. But that of the church's holiday was named *cyric wæccan*, or church-wake, the church vigil, or church eve. And it was this commencement of both with a wake, which has now cauſed the days to be generally preceded with vigils, and the church-holiday particularly to be denominated the *church-wake*. So religiouſly was the eve and feſtival of the patron ſaint obſerved for many ages by the Saxons, even as late as the reign of Edgar, the former being ſpent in the church, and employed in prayer." And the wakes, and all the other holidays in the year, were put upon the ſame footing with the octaves of Chriſtmas, Eaſter, and of Pentecoſt. When Gregory recommended the feſtival of the patron ſaint, he adviſed the people to erect booths of branches about the church on the day of the feſtival, and to feaſt and be merry in them with innocence. Accordingly, in every pariſh, on the returning anniverſary of the ſaint, little pavilions were conſtructed of boughs, and the people indulged in them to hoſpitality and mirth. The feaſting of the ſaint's day, however, was ſoon abuſed; and even in the body of the church, when the people were aſſembled for devotion, they began to mind diverſions, and to introduce drinking. The growing intemperance gradually ſtained the ſervice of the vigil, till the feſtivity of it was converted, as it now is, into the rigour of a faſt. At length they too juſtly ſcandalized the Puritans of the laſt century, and numbers of the wakes were diſuſed entirely, eſpecially in the eaſt and ſome weſtern parts of England; but they are commonly obſerved in the north, and in the midland counties.

This cuſtom of celebrity in the neighbourhood of the church, on the days of particular ſaints, was introduced into England from the continent, and muſt have been familiar equally to the Britons and Saxons; being obſerved among the churches of Aſia in the ſixth century, and by thoſe of the weſt of Europe in the ſeventh. And equally in Aſia and Europe on the continent, and in the iſlands, theſe celebrities were the cauſes of thoſe commercial marts which we denominate *fairs*. The people reſorted in crowds to the feſtival, and a conſiderable proviſion would be wanted for their entertainment. The proſpect of intereſt invited the little traders of the country to come and offer their wares; and thus, among the many pavilions for hoſpitality in the neighbourhood of the church, various booths were erected for the ſale of different commodities. In larger towns, ſurrounded with populous diſtricts, the reſort of the people to the wakes would be great, and the attendance of traders numerous; and this reſort and attendance conſtitute a fair.—Baſil expreſsly mentions the numerous appearance of traders at theſe feſtivals in Aſia, and Gregory notes the ſame cuſtom to be common in Europe. And as the feſtival was obſerved on a feria or holiday, it naturally aſſumed to itſelf, and as naturally communicated to the mart, the appellation of *feria* or fair. Indeed ſeveral of our moſt ancient fairs appear to have been uſually held, and have been continued to our time, on the original church-holidays of the places: beſides, it is obſervable, that fairs were generally kept in church-yards, and even in the churches, and alſo on Sundays, till the indecency and ſcandal were ſo great as to need reformation.

Wake-Robin. See Arum.

WALACHIA, a province of Turkey in Europe, bounded on the north by Moldavia and Tranſylvania, on the eaſt and ſouth by the river Danube, and on the weſt by Tranſylvania. It is 225 miles in length, and 125 in breadth; and was ceded to the Turks by the treaty of Belgrade, in 1739. It abounds in good horſes and cattle; and there are mines of ſeveral kinds. The ſoil is ſo fertile, that it is capable of producing any thing; and there are good paſtures, with wine, oil, and all manner of European fruits. The inhabitants are chiefly of the Greek church.

WALCHEREN, an iſland of the Low Countries, and one of the principal of thoſe of Zealand; ſeparated from Dutch Flanders by the mouth of the Scheld. It is about nine miles in length, and eight in breadth; and though it lies low, has good arable and paſture land. The chief town of this iſland and the whole province is Middleburg.

WALDEN, a town of Eſſex, commonly called *Saffron Walden*, with a market on Saturdays, and two fairs on Midlent Saturday for horſes, and November 1ſt for cows. It is remarkable for the plenty of ſaffron that grows about it. This town was incorporated by Edward VI. and is governed by a mayor and 24 aldermen. It is 27 miles north-weſt-by-north of Chelmſford, and 43 north-eaſt of London. E. Long. 0. 20. N. Lat. 52. 4.

WALDENSES. See WALDO.

WALDO, a merchant of Lyons in the latter part of the 12th century, who applying himſelf to the ſtudy of the Scriptures, and finding no warrant there for ſeveral of the Romiſh doctrines, particularly that of tranſubſtantiation, publicly oppoſed them. His followers, who from him were called *Waldenſes*, being chaſed from Lyons, ſpread over Dauphine and Provence; upon which Philip II. is ſaid to have razed 300 gentlemens ſeats, and deſtroyed ſeveral walled towns to ſtop their growth: but this, inſtead of ſuppreſſing, ſpread them over a great part of Europe. The articles of their faith, which they drew up and dedicated to the king of France, agreed in moſt points with thoſe of the preſent Proteſtants. In the year 1200, thoſe of them who dwelt in the province of Albigeois in Languedoc, from whence they were called *Albigenſes*, ſtood upon their defence; upon which Philip drove them into Bohemia, Savoy, and England. The cruſade againſt them is ſaid to have conſiſted of 500,000 men, who wore their croſſes on their breaſts, to diſtinguiſh themſelves from thoſe who went to the Holy Land, and wore them on their ſhoulders.

WALES, a country ſituated in the ſouth-weſt part of Britain, into which the ancient Britons retired from the perſecution of the Saxons. Anciently it was of greater extent than it is at preſent, and comprehended all the country beyond the Severn, that is, beſides the 12 counties included in it at preſent, thoſe of Herefordſhire and Monmouthſhire, which now are reckoned a part of England, were then inhabited by three different tribes of the Britons, namely, the Silures, the Dimetæ, and the Ordovices. The Romans were never able to ſubdue them, till the reign of Veſpaſian, when they were reduced by Julius Frontinus, who placed garriſons in their country to keep them in awe. Though the Saxons made themſelves maſters of all England, they never could get poſſeſſion of Wales, except the counties of Monmouthſhire and Herefordſhire, formerly a part of Wales. About the year 870, Roderic king of Wales divided it among his three ſons; and the names of theſe diviſions were, *Demetia*, or *South-Wales*; *Poveſia*, or *Powis-Land*; and *Venedotio*, or *North-Wales*. Another diviſion is mentioned afterwards in the records, viz. North Wales, South Wales, and Weſt Wales; the laſt comprehending the counties of Monmouth and Hereford. The country derived the name of *Wales*, and the inhabitants that of *Welſh*, from the Saxons, who by thoſe terms denote a country and people to which they are ſtrangers; for the Welſh, in their own language, call their country *Cymry*, and their language *Cymraeg*. They continued under their own princes and laws from the above mentioned period, and were never entirely ſubjected to the crown of England till the reign of Edward I. when Llewellin ap Gryffith, prince of Wales, loſt both his life and dominions. Edward, the better to ſecure his conqueſt, and to reconcile the Welſh to a foreign yoke, ſent his queen to lie in at Caernarvon, where ſhe was delivered of a prince; to whom the Welſh, on that account, the more readily ſubmitted. Ever ſince that time, the eldeſt ſons of the kings of England have commonly been created princes of Wales, and as ſuch enjoy certain revenues from that country.

As to the character of the Welſh, they are ſaid to be a brave, hoſpitable people; and though very jealous of affronts, paſſionate, and haſty, yet are eaſily reconciled. The common people look with a ſuſpicious eye on ſtrangers, and bear an hereditary grudge to the Engliſh nation, by whom their anceſtors were expelled from the fineſt parts of the iſland. The gentlemen are apt to value themſelves upon the antiquity of their families; and with ſome reaſon, as they can generally trace them much higher than the inhabitants of moſt other countries.

All the better ſort, both in town and country, can ſpeak Engliſh, eſpecially in the counties bordering upon England. The common people, in general, only ſpeak their own language, which is the ancient Britiſh; and not only differs entirely from the Engliſh, but has very little affinity with any of the weſtern tongues, unleſs we ſhould except the Gaelic, Erſe, or Iriſh. It is ſaid to be a dialect of the ancient Celtic, and in many reſpects to reſemble the Hebrew. Moſt of the clergy are natives of the country, and underſtand Engliſh ſo well, that they could exerciſe their functions in any part of Britain. The public worſhip however, is as often performed in Welſh as in Engliſh, excepting in the towns, where the latter is the prevailing language. The inhabitants are computed at about 300,000.

The country, though mountainous, eſpecially in North Wales, is far from being barren or unfruitful; the hills, beſides the metals and minerals they contain, feeding vaſt herds of ſmall black cattle, deer, ſheep, and goats, and their valleys abounding in corn, as their ſeas and rivers do in fiſh. Here are alſo wood, coal, and turf for fuel, in abundance.

Wales is bounded on all ſides by the ſea and the Severn: except on the eaſt, where it joins to the counties of Cheſter, Salop, Hereford, and Monmouth. Its length, from the ſouthernmoſt part of Glamorganſhire to the extremity of Flintſhire north, is computed at about 113 miles; and its greateſt breadth, from the river Way eaſt to St David's in Pembrokeſhire weſt, is nearly of the ſame dimenſions, being about 90 miles.

After the conqueſt of Wales by Edward I. very material alterations were made in their laws, ſo as to reduce them nearer to the Engliſh ſtandard, eſpecially in the forms of their judicial proceedings: but they ſtill retained very much of their original polity, particularly their rule of inheritance, viz. that their lands were divided equally among all the iſſue male, and did not deſcend to the eldeſt ſon alone. By other ſubſequent ſtatutes their provincial immunities were ſtill farther abridged: but the finiſhing ſtroke to their independency was given by the ſtatute 27 Hen. VIII. c. 26. which at the ſame time gave the utmoſt advancement to their civil proſperity, by admitting them to a thorough communication of laws with the ſubjects of England.—Thus were this brave people gradually conquered into the enjoyment of true liberty; being inſenſibly put upon the ſame footing, and made fellow-citizens, with their conquerors.

It is enacted by the 27 Hen. VIII. 1. That the dominion of Wales ſhall be for ever united to the kingdom of England. 2. That all Welſhmen born ſhall have the ſame liberties as other king's ſubjects. 3. That lands in Wales ſhall be inheritable according to the Engliſh tenures and rules of deſcent. 4. That the laws of England, and no other, ſhall be uſed in Wales: beſides many other regulations of the police of this principality. And the 34 and 35 Hen. VIII. c. 26. confirms the ſame, adds farther regulations, divides it into twelve ſhires, and, in ſhort, reduces it into the ſame order in which it ſtands at this day; differing from the kingdom of England in only a few particulars, and thoſe too of the nature of privileges (ſuch as having courts within itſelf, independent of the proceſs of Weſtminſter-hall), and ſome other immaterial peculiarities hardly more than are to be found in many counties of England itſelf.

New Wales. See *New Britain.*

New South-Wales. See *New Holland.*

Prince of Wales. See *Royal Family.*

Walking Leaf. See *Mantis Sycifolia.*

WALL, in architecture, the principal part of a building, as ſerving both to incloſe it, and to ſupport the roof, floors, &c.—Walls are diſtinguiſhed into various kinds, from the matter whereof they conſiſt; as plaſtered or mud-walls, brick-walls, ſtone-walls, flint or boulder-walls, and boarded-walls. See Architecture.

Cob or *Mud-Wall.* In thoſe parts of England where ſtone is ſcarce, it is uſual to make walls and houſes of mud, or, as it is called in Devonſhire, *cob;* which is a compoſition of earth and ſtraw, wet up ſomewhat like mortar, but well beat and trod together. When a wall is making, after being raiſed to a certain height, it is allowed time to pitch or ſettle before the work is reſumed. Some value themſelves on their ſkill in building with this compoſition; the price, when materials are found, is generally in Devonſhire 3s. per perch of 16½ feet; but a ſtone foundation coſts more. Houſes built with this, being covered with thatch, are very dry and warm; a cob wall, if in a good ſituation, will laſt 50 or 60 years or more. When pulled down, they are uſed as manure, and new earth employed to rebuild with.

WALLACE (Sir William), a gallant general of the Scots, who endeavoured to reſcue his country from the Engliſh yoke; but being taken priſoner, he was unjuſtly tried by the Engliſh laws, condemned, and executed as a traitor to Edward I. in 1304. See Scotland, n° 103, *et ſeq.*

WALLACHIA. See Walachia.

WALLER (Edmund) a celebrated Engliſh poet, was the ſon of Robert Waller, Eſq; of Agmondeſham in Buckinghamſhire, by Anne, the ſiſter of the great Hamden who diſtinguiſhed himſelf ſo much in the beginning of the civil wars. He was born in 1605; and his father dying when he was very young, the care of his education fell to his mother, who ſent him to Eton ſchool. He was afterwards ſent to King's college in Cambridge, where he muſt have been very aſſiduous in his ſtudies, ſince, at ſixteen or ſeventeen years of age, he was choſen into the laſt parliament of King James I. and ſerved as burgeſs for Agmondeſham. He began to exerciſe his poetical talent ſo early as the year 1623; as appears from his verſes "upon the danger his majeſty (being prince) eſcaped in the road of St Andero;" for there Prince Charles, returning from Spain that year, had like to have been caſt away. It was not, however, Mr Waller's wit, his fine parts, or his poetry, that ſo much occaſioned him to be firſt publicly known, as his carrying off the daughter and ſole heireſs of a rich citizen, againſt a rival whoſe intereſt was eſpouſed by the court. It is not known at what time he married his firſt lady; but he was a widower before he was 25, when he began to have a paſſion for Sachariſſa, which was a fictitious name for the lady Dorothy Sidney, daughter to the earl of Leiceſter, and afterwards wife to the earl of Sunderland. He was now known at court, careſſed by all who had any reliſh for wit and polite literature; and was one of the famous club of which Lord Falkland, Mr Chillingworth, and other eminent men, were members. He was returned burgeſs for Agmondeſham in the parliament which met in April 1640. An intermiſſion of parliaments having diſguſted the nation, and raiſed jealouſies againſt the deſigns of the court, which would be ſure to diſcover themſelves whenever the king came to aſk for a ſupply, Mr Waller was one of the firſt who condemned the preceding meaſures. He ſhowed himſelf in oppoſition to the court, and made a ſpeech in the houſe on this occaſion; from which we may gather ſome notion of his general principles in government; wherein, however, he afterwards proved very variable and inconſtant. He oppoſed the court alſo in the long parliament which met in November following, and was choſen to impeach Judge Crawley, which he did in a warm and eloquent ſpeech, July 16th 1641. This ſpeech was ſo highly applauded, that 20,000 copies of it were ſold in one day. In 1642, he was one of the commiſſioners appointed by the parliament to preſent their propoſitions of peace to the king at Oxford. In 1643, he was deeply engaged in a deſign to reduce the city of London and the tower to the ſervice of the king; for which he was tried and condemned, together with Mr Tomkins his brother-in-law, and Mr Challoner. The two latter ſuffered death; but Mr Waller obtained a reprieve: he was, however, ſentenced to ſuffer a year's impriſonment, and to pay a fine of 10,000 l. After this, he became particularly attached to Oliver Cromwell, upon whom he wrote a very handſome panegyric. He alſo wrote a noble poem on the death of that great man.

At the Reſtoration, he was treated with great civility by Charles II. who always made him one of the party in his diverſions at the duke of Buckingham's and other places. He wrote a panegyric upon his majeſty's return; which being thought to fall much ſhort of that he had before written on Oliver Cromwell, the king one day aſked him in raillery, "How is it, Waller, that you wrote a better encomium on Cromwell than on me?" "May it pleaſe your majeſty," anſwered he, "we poets generally ſucceed beſt in fiction." He ſat in ſeveral parliaments after the Reſtoration, and continued in the full vigour of his genius to the end of his life, his natural vivacity bearing him up, and making his company agreeable to the laſt. He died of a dropſy in 1687, and was interred in the church-yard of Beaconsfield, where a monument is erected to his memory. Mr Waller has been honoured as the moſt elegant and harmonious verſifier of his time, and a great refiner of the Engliſh language. The beſt edition of his works, containing poems, ſpeeches, letters, &c. is that publiſhed in quarto by Mr Fenton, in 1730.

WALLIS (Dr John), a celebrated mathematician, was educated at Cambridge; where he became fellow of Queen's college, and continued ſo till, by his marriage, he vacated his fellowſhip. In 1640, he received holy orders, and became chaplain to the lady Vere. While he lived in this family, he cultivated the art of deciphering, and it is ſaid, that the elector of Brandenburg, for whom he explained ſeveral letters written in ciphers, ſent him a gold chain and medal. In 1643 he publiſhed, "Truth tried; or, Animadverſions on the lord Brooke's treatiſe, called *The Nature of Truth,* &c." The next year he was choſen one of the ſcribes or ſecretaries to the aſſembly of divines at Weſtminſter. Dr Peter Turner, Savilian profeſſor of geometry in Oxford, being ejected by the parliament-viſitors in 1649, Mr Wallis was appointed to ſucceed him in that place. In 1653 he publiſhed at Oxford a Grammar of the Engliſh Tongue in Latin. In 1655 he entered the liſts with Mr Hobbes; and their controverſy laſted a conſiderable time. In 1657 the Doctor publiſhed his Mathematical Works. Upon the death of Dr Langbaine, he was choſen cuſtos archivorum of the univerſity. After the Reſtoration he met with great reſpect, the king himſelf entertaining a favourable opinion of him on account of ſome ſervices he had done both to his royal father and himſelf. He was therefore confirmed in his places, admitted one of the king's chaplains in ordinary, and appointed one of the divines empowered to review the book of common prayer. He complied with the terms of the act of uniformity, and continued a ſteady conformiſt till his death. He was one of the firſt members of the Royal Society, and correſponded with many learned men. In 1697, the curators of the univerſity preſs at Oxford thought it for the honour of the univerſity to collect the mathematical works of the Doctor, which had been printed ſeparately, ſome in Latin, ſome in Engliſh, and publiſhed them all together in the Latin tongue, in 3 vols folio. He died in 1703. He ſpeaks of himſelf thus: "It hath been my endeavour all along to act by moderate principles, being willing, whatever ſide was uppermoſt, to promote any good deſign for the true intereſt of religion, of learning, and of the public good." Beſides the works above-mentioned, he publiſhed many others.

WALLOONS, a name for the inhabitants of a conſiderable part of the Netherlands, viz. Artois, Hainault, Namur, Luxemburgh, and part of Flanders and Brabant.

WALNUT-TREE, in botany. See JUGLANS.

WALPOLE (Sir Robert), earl of Orford, was born at Houghton in Norfolk, September 6th, 1674, and educated on the foundation at Eton ſchool. Thence he was elected to King's College in Cambridge; but, ſucceeding to the family eſtate by the death of his elder brother, he reſigned his fellowſhip. In 1700, he was choſen member of parliament for King's Lynn, and repreſented that borough in ſeveral ſucceeding parliaments. In 1705, he was nominated one of the council to prince George of Denmark, lord high admiral of England; in 1707, appointed ſecretary at war; and, in 1709, treaſurer of the navy. In 1710, upon the change of the miniſtry, he was removed from all his poſts, and held no place afterwards during the queen's reign. In 1711 he was expelled from the houſe of commons for what they called notorious corruption in his office as ſecretary at war. The borough of Lynn, however, re-elected him; and, though the houſe declared the election void, yet they perſiſted in the choice. In the well-known debate relating to Steele for publiſhing the Criſis, he greatly diſtinguiſhed himſelf in behalf of liberty, and added to the popularity he had before acquired.

On the death of the queen, a revolution of politics took place, and the Whig party prevailed both at court and in the ſenate. Walpole had before recommended himſelf to the houſe of Hanover by his zeal for its cauſe, when the commons conſidered the ſtate of the nation with regard to the Proteſtant ſucceſſion: and he had now the honour to procure the aſſurance of the houſe to the new king (which attended the addreſs of condolence and congratulation), "That the commons would make good all parliamentary funds." It is therefore not to be wondered at, that his promotion ſoon took place after the king's arrival; and that in a few days he was appointed receiver and paymaſter general of all the guards and garriſons, and of all other the land forces in Great Britain, paymaſter of the royal hoſpital at Chelſea, and likewiſe a privy counſellor. On the opening of a new parliament, a committee of ſecrecy was choſen to enquire into the conduct of the late miniſtry, of which Walpole was appointed chairman; and, by his management, articles of impeachment were read againſt the earl of Oxford, lord Bolingbroke, the duke of Ormond, and the earl of Strafford. The eminent ſervice he was thought to have done the crown, by the vigorous proſecution of thoſe miniſters who were deemed the chief inſtruments of the peace, was ſoon rewarded by the extraordinary promotions to the offices of firſt commiſſioner of the treaſury, and chancellor and under treaſurer of the exchequer.

In two years time he reſigned all his offices on account of a miſunderſtanding which took place between him and the reſt of the miniſtry about certain ſupplies demanded for the ſupport of his majeſty's German dominions. On the day of his reſignation he brought in the famous ſinking fund-bill, which he preſented as a country-gentleman, ſaying, that he hoped it would not fare the worſe for having two fathers; and that his ſucceſſor Mr Stanhope would bring it to perfection. His calling himſelf the father of a project, which hath ſince been ſo often employed to other purpoſes than were at firſt declared, gave his enemies frequent opportunity for ſatire and ridicule; and it hath been ſarcaſtically obſerved, that the father of this fund appeared in very bad light when viewed in the capacity of a nurſe. In the next ſeſſion of parliament, Walpole oppoſed the miniſtry in every thing: and even Wyndham or Shippen did not exceed him in patriotiſm. Upon a motion in the houſe for continuing the army, he made a ſpeech of above an hour long, and diſplayed the danger of a ſtanding army in a free country, with all the powers of eloquence. Early in 1720 the rigour of the patriot began to ſoften, and the complaiſance of the courtier to appear; and he was again appointed paymaſter of the forces, and ſeveral of his friends were found ſoon after in the liſt of promotions. No doubt now remained of his entire converſion to court meaſures; for, before the end of the year, we find him pleading as ſtrongly for the forces required by the war-office as he had before declaimed againſt them, even though at this time the ſame pretences for keeping them on foot did not exiſt.

It was not long before he acquired full miniſterial power, being appointed firſt lord commiſſioner of the treaſury, and chancellor of the exchequer; and, when the king went abroad in 1723, he was nominated one of the lords juſtices for the adminiſtration of government, and was ſworn ſole ſecretary of ſtate. About this time he received another diſtinguiſhed mark of the royal favour; his eldeſt ſon then on his travels being created a peer, by the title of baron Walpole of Walpole. In 1725 he was made knight of the Bath, and the year after knight of the Garter. The meaſures of his adminiſtration, during the long time he remained prime or rather ſole miniſter, have been often canvaſſed with all the ſeverity of critical inquiry. It is difficult to diſcern the truth through the exaggerations and miſrepreſentations of party. He has indeed been accuſed of employing the ſinking fund for the purpoſes of corruption, of which it was long the faſhion to call him the father; but the man who reflects on the tranſactions of Charles II. and his infamous cabal, will acquit him of the latter part of this charge. He was an enemy to war, and the friend of commerce; and becauſe he did not reſent ſome petty inſults of the court of Spain ſo ſuddenly as the fiery part of the nation thought he ſhould have done, a formidable oppoſition was formed againſt him in the houſe, which had influence enough to employ in its cauſe almoſt all the wit of the nation. Pulteney and Pitt were the great leaders of the party in the houſe of commons; while Bolingbroke and Pope and Johnſon, and almoſt every man of genius, exerted themſelves without doors to enlighten, by pamphlets in proſe and verſe, the minds of the people, and ſhow the neceſſity of a Spaniſh war. This he ſtrenuouſly oppoſed, becauſe he knew that the foreign ſettlements of that power are very remote, and in a climate deſtructive to Engliſhmen; and that ſuch of them as we might be able to take, we could not poſſibly retain. The oppoſition however prevailed. The nation was indulged in a war, of which it ſurely had no cauſe to boaſt of the ſucceſs; and it is now univerſally known, that the greater part of thoſe who with honeſt intentions had, either in parliament or out of it, been engaged to run down the miniſter, lived to repent of their conduct, and do juſtice to the man whom they had ſo pertinaciouſly vilified.

In order to encourage commerce and improve the revenue, Sir Robert projected a ſcheme for an extenſion of the exciſe, as the only means of putting a ſtop to the frauds of merchants and illicit traders. This was another ground of clamour to the orators within, and the wits without, doors; and while the oppoſition repreſented it as a meaſure big with public miſchief, Swift and Pope occaſionally alluded to it as an oppreſſion calculated to deprive private life of all its comforts. The miniſter was therefore obliged to abandon the ſcheme; but in a ſucceeding adminiſtration it was partly carried into execution, at the expreſs ſolicitation of the principal perſons concerned in that article of trade which it was ſuggeſted would be moſt affected by it; and afterwards the moſt popular miniſter that ever directed the councils of this country declared in full ſenate, that if a time ſhould ever arrive which was likely to render the project feaſible, he would himſelf recommend an extenſion of the exciſe laws as a meaſure of the greateſt advantage to commerce, to the revenue, and to the general intereſts of the kingdom.

In 1742 the oppoſition prevailed; and Sir Robert being no longer able to carry a majority in the houſe of commons, reſigned all his places, and fled for ſhelter behind the throne. He was ſoon afterwards created earl of Orford; and the king, in conſideration of his long and faithful ſervices, granted him a penſion of 4000 l. *per annum*. The remainder of his life he ſpent in tranquillity and retirement, and died, 1745, in the 71ſt year of his age.

He has been ſeverely, and not unjuſtly, cenſured for that ſyſtem of corruption by which he almoſt avowed that he governed the nation; but the objects which he had in view are now acknowledged to have been in a high degree praiſeworthy. Johnſon, who in the earlier part of his life had joined the other wits in writing againſt his meaſures, afterwards honoured his memory for the placability of his temper, and for keeping this country in peace for ſo many years; and Mr Burke has lately * declared, that his only defect as a miniſter was the want of ſufficient firmneſs to treat with contempt that popular clamour, which, by his yielding to it, hurried the nation into an expenſive and unjuſt war. But his rancorous proſecution of Atterbury biſhop of Rocheſter (ſee ATTERBURY), by a bill of pains and penalties, may be conſidered as ſomething worſe than a defect: it was a fault for which no apology can be made; becauſe, whether that prelate was innocent or guilty, of his guilt no legal proof ever appeared. In that inſtance the conduct of the miniſter was the more extraordinary, that on other occaſions he choſe to gain over the diſaffected by mildneſs and beneficence, even when he had ſufficient proofs of their guilt. Of this the following anecdote, communicated by lord North to Dr Johnſon, is a ſufficient proof. Sir Robert having got into his hands ſome treaſonable papers of his inveterate enemy Shippen, ſent for him, and burnt them before his eyes. Some time afterwards, while Shippen was taking the oaths to the government in the houſe of commons, Sir Robert, who ſtood next to him, and knew his principles to be the ſame as ever, ſmiled; upon which Shippen, who had obſerved him, ſaid "Egad, Robin, that's hardly fair."

To whatever objections his miniſterial conduct may be liable, in his private character he is univerſally allowed to have had amiable and benevolent qualities. That he was a tender parent, a kind maſter, a beneficent patron, a firm friend, an agreeable companion, are points that have been ſeldom diſputed; and ſo calm and equal was his temper, that Pulteney, his great rival and opponent, ſaid, he was ſure that Sir Robert Walpole never felt the bittereſt invectives againſt him for half an hour.

About the end of queen Anne's reign, and the beginning of George I.'s, he wrote the following pamphlets. 1. The Sovereign's Anſwer to the Glouceſterſhire Addreſs. The Sovereign meant Charles duke of Somerſet, ſo nicknamed by the Whigs. 2. Anſwer to the Repreſentation of the Houſe of Lords on the State of the Navy, 1709. 3. The Debts of the Nation ſtated and conſidered, in four Papers, 1710. 4. The Thirty-five Millions accounted for, 1710. 5. A Letter from a foreign Miniſter in England to Monſieur Pettecum, 1710. 6. Four Letters to a Friend in Scotland upon Sacheverell's Trial; falſely attributed in the General Dictionary to Mr Maynwaring. 7. A ſhort Hiſtory of the Parliament. It is an account of the laſt Seſſion of the queen. 8. The South-Sea Scheme conſidered. 9. A Pamphlet againſt the Peerage Bill, 1719. 10. The Report of the Secret Committee, June 9th, 1715.

WALRUS, in zoology. See TRICHECUS.

WALSH (William), an Engliſh critic and poet, the ſon of Joſeph Walſh, Eſq; of Abberley in Worceſterſhire, was born about the year 1660. He became a gentleman-commoner of Wadham college, Oxford, but left the univerſity without taking a degree. His writings are printed among the works of the Minor Poets, printed in 1749. He was made gentleman of the horſe in queen Anne's reign; and died in 1708. He was the friend of Mr Dryden and of Mr Pope; the former of whom eſteemed him the beſt critic then living; and Mr Pope has celebrated his character in the Eſſay on Criticiſm.

WALSINGHAM, a town of Norfolk, with a market on Fridays, and a fair on Whit-Monday, for horſes and pedlar's ware. It is ſeated not far from the ſea; and in former times was famous for its college of canons, and was greatly frequented by pilgrims who went to pay their devotions to the image of the Virgin Mary at the chapel, where there are two fine ſprings, called the *Virgin Mary's wells*. Not many years ago there were found here 100 urns full of aſhes by a huſbandman, which were ſuppoſed to be thoſe which the Romans filled with the aſhes of the dead. It is 22 miles north-weſt of Norwich, and 117 north-north-eaſt of London. E. Long. 0. 53. N. Lat. 52. 56.

WALSINGHAM (Thomas), an Engliſh Benedictine monk of the monaſtery of St Alban's, about the year 1440. He applied himſelf to the hiſtory and antiquity of his country, in quality of hiſtoriographer to the king; and compoſed the Hiſtory of King Henry VI. with other works.

WALSINGHAM (Sir Francis), miniſter and ſecretary of ſtate during the reign of queen Elizabeth, and one of the greateſt politicians of his time, was deſcended from a noble and ancient family at Chiſlehurſt. After having made great progreſs in his ſtudies at Cambridge, he was twice ſent ambaſſador to France, and at his return to England was employed in the moſt important affairs; became ſecretary of ſtate, and was one of the commiſſioners for the trial of Mary queen of Scotland. Sir Francis was undoubtedly one of the moſt refined politicians and moſt penetrating ſtateſman that any age ever produced. He had an admirable talent, both in diſcovering and managing the ſecret receſſes of the heart. He had his ſpies in moſt courts in Chriſtendom, and allowed them a liberal maintenance; for it was his maxim, That knowledge cannot be bought too dear. In 1587 the king of Spain having made vaſt preparations, which ſurpriſed, and kept all Europe in ſuſpence, Walſingham employed his utmoſt endeavours for the diſcovery of that important ſecret; and accordingly procured intelligence from Madrid, that the

* Letters on a Regicide Peace.

king had informed his council of his having diſpatched an expreſs to Rome, with a letter written with his own hand to the pope, acquainting him with the true deſign of his preparations, and begging his bleſſings upon him; which for ſome reaſons he could not diſcloſe till the return of the courier. The ſecret being thus lodged with the pope, Walſingham, by means of a Venetian prieſt, whom he retained at Rome as a ſpy, got a copy of the original letter, which was ſtolen out of the pope's cabinet by a gentleman of the bed-chamber, who took the key out of the pope's pocket while he ſlept. After this, by his dexterous management, he cauſed the Spaniards bills to be proteſted at Genoa, which ſhould have ſupplied them with money for their extraordinary preparations; and by this means he happily retarded this formidable invaſion for a whole year. In ſhort, he ſpent his whole time and faculties in the ſervice of queen Elizabeth; on which account her majeſty was heard to ſay, "That in diligence and ſagacity he exceeded her expectations." However, after all his eminent ſervices to his country, this great man gave a remarkable proof at his death, which happened on the 6th of April, 1590, how far he preferred the public intereſt to his own, he being ſo poor, that excepting his library, which was a very fine one, he had ſcarcely effects enough to defray the expence of his funeral. His principal works are, 1. Memoirs and Inſtructions for the uſe of Ambaſſadors, with his Letters and Negociations. 2. Political Memoirs.

WALTHERIA, in botany; a genus of plants in the claſs *monodelphia*, and order *triandria*; and in the natural ſyſtem arranged under the 37th order, *Columniferæ*. There is only one piſtillum, and the capſule is unilocular, bivalved, and monoſpermous. There are three ſpecies, none of which are natives of Britain.

WALTON (Bryan), biſhop of Cheſter, a learned Engliſh divine, who gained great reputation by his edition of the Polyglot bible, with his Prolegomena in the beginning; which is more exact, ſays Father Simon, than any other which had been publiſhed on that ſubject. He died in 1661.

WAMPUM, the money uſed by the North-American Indians. It is much uſed in all their treaties as a ſymbol of friendſhip. It is made of a ſhell of a particular ſpecies of VENUS.

WAPENTAKE, in England what is called a *hundred*; eſpecially uſed in the north countries beyond the river Trent. The word ſeems to be of Daniſh original, and to be ſo called for this reaſon: When firſt this kingdom, or part thereof, was divided into wapentakes, he who was the chief of the wapentake or hundred, and who is now called a *high conſtable*, as ſoon as he entered upon his office, appeared in a field on a certain day on horſeback with a pike in his hand, and all the chief men of the hundred met him there with their lances, and touched his pike; which was a ſign that they were firmly united to each other by the touching their weapons. But Sir Thomas Smith ſays, that anciently muſters were made of the armour and weapons of the ſeveral inhabitants of every wapentake; and from thoſe that could not find ſufficient pledges for their good abearing, their weapons were taken away and given to others; from whence he derives the word.

WAR.

WAR is a great evil; but it is inevitable, and oftentimes neceſſary. If he who firſt reduced to rules the art of deſtroying his fellow-creatures, had no end in view but to gratify the paſſions of princes, he was a monſter, whom it would have been a duty to ſmother at his birth: but if his intention was the defence of perſecuted virtue, or the puniſhment of ſucceſsful wickedneſs, to curb ambition, or to oppoſe the unjuſt claims of ſuperior power, mankind ought to erect altars to his memory.

War, in the laſt caſe, is the moſt neceſſary and uſeful of all the ſciences: the various kinds of knowledge which ought to furniſh the mind of a ſoldier are not without great difficulty to be attained. Of moſt other ſciences the principles are fixed, or at leaſt they may be aſcertained by the aſſiſtance of experience; there needs nothing but diligence to learn them, or a particular turn of mind to practiſe them. Philoſophy, mathematics, architecture, and many others, are all founded upon invariable combinations. Every man, even of a narrow underſtanding, may remember rules, apply them properly, and ſometimes draw juſt conſequences from them: but the ſcience of war branches out into ſo many particulars; it takes in ſo many different parts; there are ſo many reflections neceſſary to be made, ſo many circumſtances and caſes to be brought together; that it is only by a continual application, grounded upon the love of his duty, and an inclination to his profeſſion, that any man can attain it.

To march an army in every ſort of country, whether open, woody, or mountainous; to know how to form a camp in all thoſe countries, with which the general muſt be thoroughly acquainted in order to do it with ſecurity; to make a proper diſpoſition for a battle, whether with a view to the poſture of the enemy, or to the ſituation of the country; to foreſee events which depend in a manner upon chance; to be capable of making a good retreat on proper occaſions; to direct the forages without fatiguing or expoſing the troops; to ſend out detachments with precaution; to conduct the convoys in ſafety; to know how to canton an army; to eſtabliſh magazines in places, both ſafe and within reach of the army, ſo that it ſhall never be in want of ſubſiſtence—theſe are the great ends of the military ſcience.

It is commonly thought ſufficient for a military man to know how to obey; and it is alſo ſuppoſed that the ſucceſs of a day cannot be dubious, if a general joins the confidence of the ſoldiers to perſonal courage, a cool head, and a knowledge of the country.

It is true that, in caſes of perplexity, many generals have in a great meaſure owed to their own capacity, and the confidence their ſoldiers have repoſed in them, the advantages they have gained over the enemy; and confidence will always be repoſed by the ſoldiers in that general in whom they perceive coolneſs united with courage. At the battle of Cannæ, when Giſco ſeemed to be much aſtoniſhed at the ſuperiority of the enemy's number, Hannibal anſwered him coolly, "There is, Giſco, a thing ſtill more ſurpriſing, of which you take no notice." Giſco aſking him what it was, "It is (replied Hannibal) that in all that great crowd there is not one man whoſe name is *Giſco*." Plutarch obſerves, that this coolneſs of Hannibal greatly animated the Carthaginians, who could not imagine that their general would joke at ſo important a time, without being certain of overcoming his enemies.

Although bravery and courage are the moſt eſſential qualifications of a ſubordinate officer, yet he ſhould not be deficient in thoſe which are required in a general, and which have been already mentioned; obedience to the orders delivered to him is no longer a virtue than whilſt he comprehends and knows the intention of them. War, ſays a celebrated author, is a buſineſs which, like all others, muſt be learned; it ſuppoſes ſome qualities to be born with us, and demands others which are to be acquired: but ſince all theſe qualities muſt have the original ſource in genius, a man who propoſes war for his profeſſion, ſhould never engage in it without having conſulted his natural bent, or without knowing the particular turn and power of his mind. Ability, whether in a general or an officer, is the effect of his genius, quickened by a natural liking to his buſineſs.

A quick eye, which is of great importance to a ſoldier, is natural to ſome, and in them it is the effect of genius; others acquire it by ſtudy or experience; he who knows how to command himſelf, and has courage enough to keep himſelf cool on the moſt urgent occaſions, has the readieſt and quickeſt eye. A quick, hot-headed man, however brave, ſees nothing; or if he does, it is confuſedly, and generally too late.

It is this quick eye which enables a general to judge of an advantageous poſt, of a manœuvre to be made, and of a good diſpoſition for the troops, whether with reſpect to that of the enemy, or to the ſituation and nature of the country.

The quick eye is no other than that penetrating genius which lets nothing eſcape it. A general who knows how to unite this quality with perpetual coolneſs, never is in want of expedients; he will ſee how thoſe events, which to any other would be the preſage of his own defeat, may end in the overthrow of his enemies.

The choice of the general officers depends upon this genius, which diſcovers every thing; they ought to be the right-hand of the general, and as capable of commanding the army as himſelf. Whatever good diſpoſitions a general may make, they muſt prove ineffectual if not ſeconded by the general officers under his command; he cannot be everywhere, neither can he foreſee all exigencies that may ariſe. He is obliged to give only general orders; it is therefore the buſineſs of thoſe who command under him to know how to take the advantage of a wrong movement of the enemy; to take upon them to attack, or ſuſtain the troops which are engaged; and, as circumſtances vary, to make them advance towards the enemy, either to keep him back or to attack him.

But the qualities already mentioned would be uſeleſs, if order and diſcipline were not ſeverely obſerved: the moſt numerous and beſt compoſed army would ſoon become little elſe than a body of rangers, who being only united by the hope of booty, would ſeparate as ſoon as that motive ceaſed; and truſting each to his own head, or indulging his own humour, would be cut in pieces party by party: ſo that if the general does not keep up ſubordination (the ſoul and ſtrength of diſcipline), his army will be nothing more than a troop of Tartars acting more from the hope of plunder than the deſire of glory. What art and what genius is there not requiſite to maintain this ſubordination? Too much ſeverity diſguſts the ſoldier, and renders him mutinous; too much indulgence ſinks him into indolence, and makes him neglect his duty; licentiouſneſs cauſes that ſubordination to ſeem burdenſome, which ſhould never in any degree be given up: he loſes that reſpect, and often that confidence, which he ſhould have with regard to his officer; and indulgence often makes a well-diſciplined body become a ſet of ſluggards, who march againſt their will, and who, on the moſt preſſing emergencies, think only on their own ſafety.

Beſides theſe qualities, which are eſſential to a general, and which all who would attain that rank ought of courſe to have, there are ſtill many others neceſſary to make a great man. A general who would merit the title of a hero, ought to unite in himſelf all civil, military, and political excellence. It is by this that he will eaſily attain to make war with ſucceſs: nothing will eſcape him; he will know without difficulty the genius of every country, and of the nations which compoſe the enemy's army, the abilities of the generals who command, and the nature of the troops under them; he knows that he may venture a motion with ſome troops that he would not dare to attempt with others that are equally brave. One nation is vehement, fiery, and formidable in the firſt onſet; another is not ſo haſty, but of more perſeverance: with the former, a ſingle inſtant determines ſucceſs; with the latter, the action is not ſo rapid, but the event is leſs doubtful.

No man is born a general, although he brings into the world with him the ſeeds of thoſe virtues which make a great man: Cæſar, Spinola, Turenne, the great Conde, and ſome others, ſhowed, even in their earlieſt years, ſuch qualities as ranked them above other men; they carried within them the principles of thoſe great virtues which they drew forth to action by profound ſtudy, and which they brought to perfection by the help of practice: thoſe who came after them, with perhaps fewer natural talents, have by ſtudy rendered themſelves worthy of being compared to them. Cæſar and all conquerors had this advantage, that they were able to make their own opportunities, and always acted by their own choice. A man may be a good general without being a Marlborough or a Turenne: ſuch geniuſes are ſcarcely ſeen once in an age; but the more they are raiſed above the reſt of mankind, the more they ought to excite emulation. It is by endeavouring to ſurpaſs the intellects of the ſecond rate; it is by ſtriving to equal the moſt ſublime, that the imitation of them is to be attained. This paſſion in a ſoldier is neither pride nor preſumption; it is virtue: and it is by this only that he can hope to be ſerviceable to the ſtate, and add to the glory of his king and country.

How much ſoever the honour of commanding armies may be ſought after, it degrades him who is not worthy of it; this rank, ſo much deſired, borders on the two extremes of glory and ignominy. A military man who labours to make himſelf capable of commanding, is not to be blamed; his ambition is noble: by ſtudying the art of commanding, he learns that of obeying and of executing. But it is aſtoniſhing in the higheſt degree to ſee ſoldiers thinking only on preferment, and neglecting the ſtudy of their buſineſs. It is perhaps leſs ſurpriſing if we ſee others, without having been tried, propoſing to themſelves to command in chief; becauſe ſuch attempts ſuppoſe in the projector an abſurd temerity, founded on a profound ignorance of the talents he ought to have, and the virtues which he has not. Such boldneſs is the character of a man whoſe mind is too narrow to perceive his danger: We ſhould rather approve the timidity that ſuffers itſelf to be dejected by terror, ſince it ſhows at leaſt that he knows to what hazards he is expoſed; both one and the other are blameable: modeſty is the only proper quality of a ſoldier; it gives ſplendour to virtue, it argues diffidence of himſelf, and deſire of arriving at perfection.

The title of general would be leſs tempting, if proper attention was paid to the qualities it requires, and the duties it impoſes; it would then appear a very honourable, but painful burden. The moſt firm and intrepid genius might be diſcouraged, merely by thinking that on the conduct of a general depends the fate of the ſtate, the glory of his prince's arms, and his own reputation.

But yet the reward that follows ſuch irkſome labours ought to animate men to undertake them. Obſtacles, however numerous they may be, are not inſurmountable, ſince ſo many great men have got the better of them: difficulties ſhould ſtir up a ſoldier's emulation, but ſhould never terrify him: he ſhould endeavour to copy ſuch great originals, though he ſhould not be able to equal them.

This treatiſe is divided into four parts.

In the firſt are mentioned all the greater operations of a campaign; and the means of executing thoſe operations, in any kind of country, are endeavoured to be laid down.

In the ſecond, the precautions that are to be taken to attack the enemy in all the forementioned operations, are conſidered.

The third treats of the *Petite Guerre*, or the operations of detached parties, and the war of poſts.

The fourth, of ſieges, both with regard to attack and defence.

PART I. Of the GREATER OPERATIONS in DEFENSIVE WAR.

SECT. I. *Of the Knowledge of a Country.*

A Campaign of which the plan is well formed, and the diſpoſitions well concerted, may nevertheleſs prove unſucceſsful, if the general, to whoſe direction the operations are intruſted, hath not a thorough knowledge of the country in which they are to be carried into execution.

There is one knowledge of a country, which for an officer to be without ſhould be conſidered as a reproach; that of the ſituation of cities, towns, villages, foreſts, ſtreams, rivers, which is to be acquired by ſtudying of geographical maps. There is another branch of knowledge yet more particular, ſuch as, of the paſſes, or the boundaries of the country, the ſituation, the nature of the ground, whether it is plain, or divided by hollows, rivulets, hills, &c. which is to be acquired by the aſſiſtance of topographical maps. In the ſtudy of theſe laſt, care muſt be taken, not blindly to follow the marks they lay down. It very ſeldom happens, that topographical maps are perfectly exact: for, beſides the many circumſtances which may ſometimes in a year alter a large extent of country, they ſeldom take notice of fords, bridges over the ſmall rivulets, ſmall hills, and hollows of little importance; neither can they mark whatever may be occaſioned by recent inundations and diſruptions of the earth: whereas any of theſe unforeſeen circumſtances may prove an obſtruction to a great deſign, either by retarding the march of an army, preventing a column of troops from advancing, or leaving the enemy in poſſeſſion of ſome paſſes from which he might have been driven.

In order to avoid the errors into which a general may be drawn by the maps, the ſafeſt method is to apply to the inhabitants of the country, go over it with the moſt intelligent of them, and remark every obſtacle, however trifling it may appear.

For marching with greater ſecurity, a general ought to form a company of guides of the peaſants, be aſſured of their fidelity, and attach them to him by all poſſible methods, particularly by unbounded liberality. It is by money only that truſty ſpies and faithful guides can be ſecured; the latter are leſs expenſive, but full as neceſſary as the former. Parſimony ſhould be avoided in war; for, as Vigetius obſerves, money ſhould never be ſpared when expence is neceſſary to ſecure poſſeſſion. In proportion as an army advances into a country, great care muſt be taken to change the guides.

The general ſhould ſend out detachments along with ſome of theſe guides to examine the ſtreams which croſs the country, whether or no their mouths are at a diſtance, into what river they empty themſelves, from whence they take their ſource, whether they may be eaſily forded, if their banks are ſteep or ſloping, marſhy or covered with buſhes; other detachments ſhould be employed in examining the woods, in order to find out whether troops can paſs through them or not.

A general ought himſelf to examine into the truth of the reports made to him by theſe ſmall detachments, or ſend out others more conſiderable under the command of general officers: however certain a general may be of the fidelity of his ſpies and guides, yet he ſhould not always rely upon their reports: miſtruſt, which in general is accounted a vice, may almoſt be eſteemed a virtue in the buſineſs of war.

Furniſhed with theſe lights, a general can allot the eaſieſt road to the artillery and baggage, the ſhorteſt to the infantry, and longeſt to the cavalry: he can at once judge, from the nature of the ground, into how many columns the army can be divided in order to expedite the march, and what diſpoſitions will be neceſſary for the columns with regard to the enemy's poſition.

By the knowledge of the country, a general is informed of what camps the enemy doth or can occupy, and of thoſe neceſſary to be taken to oppoſe his deſigns; whether the enemy's detachments can eaſily approach, or how he can himſelf advance towards him, without being diſcovered; if there is forage in the neighbourhood of the enemy's camp, or whether he is obliged to draw it from a diſtance; where he hath fixed his magazines, and whether an attempt to carry them off is practicable or not; in what manner his quarters are diſpoſed, and which of them is moſt expoſed; what diſtance there is between himſelf and the enemy; where the enemy hath eſtabliſhed poſts, and which thoſe are that himſelf ought to occupy with regard to the ſituation of his own camp and quarters, and thoſe belonging to the enemy; which is the propereſt road for the detachments and the patrols to keep, in order to gain intelligence; and laſtly, with what degree of eaſe the enemy can attack the army on its march, and whether in front or flank. This knowledge is eſſential to a general in every kind of country; but in a woody or mountainous country it would become more particularly dangerous, and even impoſſible for him to march an army, if unacquainted with it.

In 1702, the duke of Burgundy, being deſirous to attack the enemy who were behind Cleves, but not being perfectly acquainted with the foreſt in his front, he detached the marquis d'Alegre with 500 grenadiers, and 800 horſe, to ſee if it was not poſſible to find ſome paſſage thro' it. M. d'Alegre met with a defile which was occupied by the enemy: he attacked and forced it; but being advanced beyond it, found it was not poſſible to proceed farther, by reaſon of the great number of defiles that ſucceeded to each other: he thereupon turned back, ſent, and had another paſſage ſurveyed, where there were found ſtill greater obſtacles. He gave an account of this to the duke of Burgundy, who, not chooſing to miſs the opportunity of attacking the enemy, ſent him out again with a larger detachment, that he might examine whether, by keeping along the ſide of the foreſt, it would not be practicable for him to march up to them by way of the heaths of Mook, on the ſide of Grave and Nimeguen. The marquis d'Alegre diſcovered a defile which led to theſe heaths; he took poſſeſſion of it, and ſent notice thereof to the duke of Burgundy; who ordered the army to advance, obliged the enemy to ſend their infantry into Nimeguen, and cannonaded their cavalry which had taken poſt on the glacis, but were unable to maintain it; and the conſequence was, that the enemy ſuſtained a great loſs in men, artillery, waggons, and baggage.

This example tends to prove that maps are not always to be relied on. There can be no reaſon to doubt that the duke of Burgundy was furniſhed with the moſt exact: but yet it is probable that he might not have ſucceeded in this enterpriſe, if he had neglected ſending M. d'Alegre to ſurvey the paſſes, and examine two before he proceeeded to that through which he marched.

The following is a general rule: That it is upon the ground, and not upon maps, that the roads through which an army is to march muſt be examined, as well as the ſituation of places where camps are to be fixed, and fields of battle choſen. An army ſhould never move before ways are opened for every column: with regard to a detachment it is different, as there may ariſe circumſtances which will prevent the general from foreſeeing what road it may take. The command of a detachment ſhould always be given to an intelligent officer, and one who has made his buſineſs his only ſtudy; who hath been particularly careful to acquire a knowledge of the country, and of whoſe genius the general ſhould entertain no doubt. A particular choice ſtirs up emulation in young men, and induces them to exert their utmoſt endeavours to deſerve ſo diſtinguiſhing a mark of approbation.

Into how many miſtakes have even the greateſt generals fallen, by not being thoroughly acquainted with a country, and by ſuffering themſelves to be guided by general notions? M. de Feuquieres cites many examples of great enterpriſes which have miſcarried by it.

Toward the end of the year 1673, when a conſiderable body of infantry, with only few cavalry, was on its return from Holland, under the conduct of M. de Luxemburg, the prince of Orange having aſſembled the whole force of the Dutch and the Spaniards (under his command), came upon the Maeſe, with an intention to fight M. de Luxemburg between Maeſtricht and Charleroy. This march made it neceſſary for the court to ſend an order to M. de Schomberg to aſſemble all the cavalry that were in Hainault and Flanders, and immediately join M. de Luxemburg, who was greatly inferior to the prince of Orange in cavalry. The prince's aim then ſhould have been to prevent the two generals from joining, and to have fought one or other of them before their junction. The prince's being unacquinted with the country, made him miſtake for real the feints made by M. de Luxemburg, whilſt he was upon the river Ourte; as if his intention was to march by way of the Condros and the Ardennes, in order to gain Sedan and the Mezuris. The prince of Orange drew near Huy and Namur; and by that means was at ſuch a diſtance from the high-road, that M. de Schomberg had an opportunity of advancing with his cavalry to Tongres; at the ſame time that M. de Luxemburg, by a forced march, paſſed the Maeſe at Maeſtricht, and arrived at Tongres, where the junction of the two armies was effected without any accident.

If the prince of Orange had made only two reflections upon the nature of the country, he would have avoided the miſtake he fell into; the firſt of which is, that ſcarcely any body can be ignorant that the Condros and the Ardennes are ſterile and mountainous countries; from whence it is evident, that M. de Luxemburg could not have ſubſiſted his army, eſpecially in the month of December: the roads in thoſe parts, very bad in the ſummer, are almoſt impaſſable during the winter; conſequently the carriages could not have paſſed but with the utmoſt difficulty.

The ſecond reflection is, that if M. de Luxemburg had actually deſigned to paſs through the Ardennes, why did M. de Schomberg advance towards Tongres, and ſo expoſe himſelf to the danger of being beaten, without a poſſibility of receiving help from M. de Luxemburg, who was on the other ſide of the Maeſe? If the prince of Orange had had a thorough knowledge of the country through which M. de Luxemburg pretended he would paſs, he would ſoon have perceived that it was only to throw him into a perplexing uncertainty with regard to the road which the enemy's general ſhould naturally take: in a word, he would not have remained a moment in doubt on the part he had to act.

By this, then, it appears, that the prince ought to have continued on the ſide of Liege; by which poſition he would have ſtopped M. de Schomberg, who would have ſcarcely dared to advance to Tongres, nor would M. de Luxemburg have attempted the paſſage of the Maeſe at Maeſtricht: by this means, the junction would have been prevented; or, if either of the two armies had advanced, the prince could have attacked and beaten it; neither would it have been in the power of the other to have aſſiſted it.

It hath frequently happened, and will continue to do ſo, that a general who knows how to take advantage of the knowledge of the country, although inferior in point of force, may change a defenſive into an offenſive war. In 1671, M. de Créqui, who began the campaign on the defenſive, ended it with obliging the duke of Lorrain to paſs the Rhine: that prince diſperſed his army, and then M. de Créqui formed the ſiege of Fribourg.

The knowledge of a country is ſtill more eſſential in retreats: there is more art and more precaution required in a retreat than in any other action; that operation is the concluſion of all preceding ones. If a general, obliged to retreat precipitately, hath but a ſuperficial knowledge of the country, how will he be able to re-aſſemble his troops, re-eſtabliſh order, or march with any degree of ſecurity?

Xenophon's retreat with the ten thouſand Greeks is one of the moſt uſeful leſſons a commander can ſtudy: in that undertaking were united the virtues of a conſummate general, and the moſt intrepid courage of a ſoldier; and in particular it exhibits the moſt profound knowledge of the country.

The knowledge of a country is as neceſſary for a private officer as for the commander chief, becauſe he is to execute with part what the general performs with all the troops. When an officer, to whoſe conduct an expedition is intruſted, joins this knowledge, one of the chief branches of military ſcience, to practice and experience, he will with ſo much the greater eaſe comprehend and execute the general's intention and plan; and he will be alſo enabled to take the propereſt meaſures for ſucceſs: if, on the contrary, he begins a march, without being acquainted with the country, his mind miſgiving him, will increaſe the danger, by the very means he takes to avoid it: he will ſuppoſe it in places where there is nothing to be feared, and often fall into it where he was leaſt apprehenſive of it.

The general who commands in the cantonments and winter-quarters, and each officer who commands a particular quarter, will never be able to take proper meaſures if they are unacquainted with the country: they will be unable to preſerve a proper ſtrength when ſeparated, or to aſſemble without difficulty on the firſt order; and for want of knowing

ing the poſts which it is proper to guard, they will occupy ſuch as are unneceſſary, and leave thoſe defenceleſs that are moſt liable to be attacked; the troops will be greatly fatigued by increaſing the number of poſts without occaſion, by ſuperfluous or too numerous detachments or patroles. In a word, whatever precautions are taken within, the quarters will never be in ſecurity, if the country round about them is not perfectly known, and every important paſs between them and the enemy occupied.

SECT. II. *Of the Preparations before taking the Field, and the March of an Army on leaving its Quarters to go into Cantonments.*

THE time for an army to come out of winter-quarters, is always regulated by the plan which the general has formed for the enſuing campaign. But whether by the ſituation of the quarters the army is enabled to enter immediately on the campaign, or whether it muſt be firſt of all cantoned, the magazines ſhould be ſo ſituated as to be always within reach, eſpecially in that early ſeaſon of the year, when there can be no forage upon the ground, and conſequently the cavalry muſt be ſubſiſted out of the magazines. The magazines ought to be diſtributed about in different parts, that the troops may have leſs way to go for their forage. And this diſtribution ſhould be regulated by the movements which the general foreſees the army will make on leaving its quarters, ſuppoſing it leaves them when there is only dry forage; but if the army is in an enemy's country, and there is forage upon the ground, it is certainly better to reſerve the magazines entire, by which not only great trouble will be avoided in tranſporting the forage, but alſo a great expence ſaved to the government.

Of what nature ſoever the country may be (an enemy's country is ſuppoſed), it ſhould be foraged in front as much as poſſible, in order to reſerve that which is in the rear, that, when the campaign is over, it may be found laid up in the barns: if this precaution is not attended to, the army will be deſtitute of forage at its return, and will of courſe be obliged to draw it from home, and conſume thoſe magazines which were before ſpared; conſequently there will be nothing ſaved, the expence will only have been deferred, but it will be increaſed by tranſporting the forage from the magazines to the army.

The forming of the magazines ſhould never be delayed till the time for opening the campaign approaches. The intendant, purſuant to the general's order, ſhould lay in the proviſions during the winter, and diſtribute them in the frontier towns, by which means they can eaſily be tranſported to whatever place the general ſhall order. By theſe precautions, the general will not only avoid the inconvenience of being obliged to wait till there is forage upon the ground, but he will alſo be enabled to be firſt in the field. The ſame precautions ſhould alſo be taken with reſpect to the artillery. It ſhould be aſſembled upon the glacis of the frontier towns, or rather upon that of the conquered places: the more it is within reach of readily joining, the ſooner the operations will be commenced.

From prudence in the execution of theſe diſpoſitions, as well for the magazines and for the artillery, as for every thing that is neceſſary to an army, it follows, that a general hath often formed a ſiege, or at leaſt inveſted a place, and completed his lines of circumvallation, before the enemy could be in a condition of coming out of his quarters: he may likewiſe have made many marches, and will poſſeſs himſelf of advantageous poſts, without the enemy having it in his power to oppoſe him.

A general ſhould obſerve, that, in order to cauſe his army to be cantoned within a march of the country where he deſigns to commence the operations he muſt make all the troops leave their quarters together; aſſemble them in many bodies in different frontier towns; proportion the marching days to the diſtance of the quarters and the rendezvous that ſhall have been appointed for them, that they may arrive on the day appointed, and that from thence they may march in a body to the place where they are to canton.

All the bodies march, either in the number of columns that the ſituation of the country will allow, and arrive at the cantonment together; or elſe they march ſeparately, and arrive on different days: but, in either of theſe caſes, the cantonments for each regiment ought to have been marked out; and, if poſſible, forage for at leaſt three or four days diſtributed to each quarter.

In the marching orders which are ſent to each commander, the ſituation and name of the place where each regiment is to canton, ſhould be carefully expreſſed; whether on the right, the left, or in the centre: the diſcipline to be there obſerved, the place where to go and receive orders, and that where to receive forage, ſhould alſo be particularly ſpecified.

Troops, when upon a march, ſhould always obſerve the moſt exact diſcipline; and never be ſuffered to advance, but in the ſame order, and with the ſame precaution, as if they were in danger of being moleſted or attacked.

Whenever an army is cantoned, it is generally in an enemy's country; therefore, for the greater ſecurity of the cantonments, there ſhould at leaſt be one place that may ſerve for a ſupport. If no place of this ſort can be found, the army muſt then march out together and encamp, inſtead of going into cantonments.

As the cantonments are properly nothing more than a halting place where the troops are to remain till the ſeaſon permits them to take the field, till the proper quantity of forage is collected, or till the neceſſary preparations for the intended operations are completed, they ſhould be more connected than the winter-quarters. But as ſoon as the weather permits, and all the neceſſary preparations which ſhould have been forwarded during the winter are finiſhed, there is then no time to be loſt; for an army will always find its advantage in encamping early, getting the ſtart of the enemy as much as it poſſibly can, and beginning the campaign, no matter by what operations, before the enemy can have time to aſſemble.

If any particular column, upon the march, preſents its flank to any of the enemy's towns, although it is indiſpenſably neceſſary for every column to obſerve all poſſible order and diſcipline on the march, yet this column is more particularly obliged to it; neceſſity makes it become a duty. But that it ſhould not be too much expoſed, ſome huſſars ought to be appointed to march upon its flank, who ſhould alſo be ordered to advance till they come within ſight of thoſe towns. This column, whether conſiſting of infantry or cavalry, muſt detach ſome troops to ſuſtain the huſſars, in caſe they ſhould be attacked and repulſed. By poſting theſe detachments upon the flank, the enemy will be kept at a diſtance from the column, and the huſſars will be alſo ſuſtained.

SECT. III. *The March of an Army in an open Country.*

To direct the march of armies is not the leaſt difficult part of a general's duty, and it is only by a thorough knowledge of the country that he can perform this duty; that he can concert the meaſures for conducting them in ſafety; and that he will be enabled to foreſee the enemy's motions.

There are but three ſorts of countries which may become the theatre of war; an open country divided by rivers, a woody, or a mountainous one.

When an army is in an open country, the general may take whatever road he thinks moſt convenient, without being under a neceſſity of keeping the beaten road. If he chooſes to march acroſs the country, it may be done by cutting down the hedges, filling up the ditches, levelling the ridges, filling up the hollow ways, thereby rendering their aſcent or deſcent eaſy, and by building bridges over the ſtreams and rivulets which divide the country. But nevertheleſs it is very imprudent for a general to ſuppoſe himſelf entirely free from danger upon a march; for the conſequences of ſelf-ſecurity are generally fatal. The effects of negligence in any military operation are pernicious, but more particularly ſo upon a march; and although a general ſhould never fear his enemy when in preſence of him, he ſhould nevertheleſs always apprehend the worſt from him when he is out of his ſight.

The number of columns in which an army can march in an open country is arbitrary, whilſt it is advancing, and the enemy at too great a diſtance to attack or annoy it upon its march. But if, on the contrary, the enemy is near at hand, and there is a poſſibility of his attacking the army, it ſhould then be diſpoſed after ſuch a manner as to form in order of battle in a very ſhort time, and to be able to take a favourable poſition for action upon the firſt ſignal.

If the army preſents its flank to the enemy, the diſpoſitions, without conſidering the probability of its being attacked, ſhould be changed; for an army upon a march ought to be always prepared againſt any accident that may happen.

A general ſhould never cauſe an army to move without having previouſly conſidered and examined the intended march of it, nor without a thorough knowledge of the enemy's poſition, and where he is, or without knowing particularly the ground intended to encamp on. An army ought never to move but with ſome deſign, either to ſeize on ſome advantageous poſt, to prevent an intended march of the enemy's, to draw him into a diſadvantageous ſituation, to deprive him of ſubſiſtence, or to procure ſome for itſelf.

This maxim being eſtabliſhed, let it be ſuppoſed, that a general would cauſe his army to march, and the enemy's diſtance to be alſo ſuch as to ſecure him from any danger of attacks; he hath it in his power to open four, ſix, or eight roads, in proportion to the number of the troops under his command: for the greater the number of columns, the leſs is the body of troops contained in each; conſequently there will be leſs confuſion, and the ſooner will the army arrive at its deſtined camp.

Before the march is planned, and the number of columns determined upon in which the army is to march, notwithſtanding the general is acquainted with the country, he ſhould ſend out a detachment ſome days before, to reconnoitre the intended route of the army, as well as the camp it is to occupy. This detachment is to be commanded by the officers of the day appointed for its ſetting out: they muſt have ſtaff officers and guides with them, to conduct and to inform them of the nature of whatever may prove an obſtacle, of the places where the roads begin, and thoſe where they terminate: they ſhould alſo have labourers with them, to mend the ways, enlarge the roads, and make new ones, if neceſſary; to cut down the hedges, fill up the ditches, level the ridges of the hollows, and build or repair bridges.

When the general commanding this detachment is ready to enter the different ways through which the army is to follow, he will divide his detachment into as many ſeparate bodies as the army is to be divided into upon its march; and diſtribute ſtaff-officers, guides, and labourers, to each detachment, with orders to meet again at the ſame place from whence they ſeparated.

Each of theſe detachments ſhould advance to the extremities of the woods, if they meet with any, and of the roads leading to the camp, intended to be occupied: the commanding and ſtaff-officers will then advance with an eſcort to reconnoitre its ſituation, and will leave part of their men in ambuſcade in the woods, or concealed behind ſome heights, or in ſome hollows. The knowledge of the ſituation of the camp being attained, each detachment will return by the road it came; but firſt, the commanding officer of each detachment will make a report to the general of the roads they have paſſed, what diſcoveries they have made, and, in ſhort, will give him a particular detail of every thing they have met with on their way, whether woods, villages, hollows, bridges, and of every thing they have done to render the road eaſy for the column that is to paſs through it. This detachment being aſſembled at the place appointed for meeting, will take the road to the camp, where being arrived, the lieutenant-general will make his report to the commander in chief of the army.

With theſe precautions the army may not only advance in ſafety, but the roads alſo for every column having been reconnoitred and repaired, no accident can happen to retard the march of the army.

The general muſt take care to have detachments of huſſars or dragoons always in the front and upon the flanks, to obſerve and clear the march of the army; neither ſhould a general ſuppoſe himſelf to be in abſolute ſecurity from the diſtance of the enemy: but whilſt he ſees all clear before him, it would ſhow great weakneſs for him to be apprehenſive of a ſurpriſe, eſpecially when every neceſſary precaution for avoiding it hath been taken. It is certainly a mark of prudence to take precautions: but multiplying them without cauſe is an undoubted ſign of fear and anxiety.

It is proper to make the army march as near as poſſible, in the ſame order in which it is to encamp; by which means the troops may enter the camp without confuſion. The army being ſuppoſed to march in ſix columns, the infantry will form three, the artillery and baggage the fourth; the cavalry, with the remainder of the corps of huſſars that are not detached, and the dragoons, the two laſt upon the flanks; ſo that the army, on its march, will be in the following diſpoſition: The column upon the right will conſiſt of cavalry, the one adjoining to it of infantry, and that which comes next will be formed by the artillery and baggage; then two columns of infantry, and the ſixth cloſing the left, will be compoſed of cavalry. It is to be obſerved, that, if the baggage-waggons belonging to the army form too long a row, ſome of them may be ſent into the rear of the columns of infantry, with expreſs orders to the officers to make them march in the column.

There ſhould be an advanced and a rear guard to each column, formed from the troops of which the column is compoſed; there ſhould be alſo detachments of light horſe upon the flanks of the cavalry, in order to keep off any of the enemy's parties that might advance to annoy the army upon its march. The rear guard to the column of baggage ſhould conſiſt of infantry, cavalry, or dragoons, beſides the eſcort always appointed for it. The general officers who are at the head of the two columns of cavalry ſhould not march too faſt, leſt they ſhould get too far advanced before the infantry; a matter always to be avoided. The march of an army being diſpoſed after this manner, every column will enter the camp at the ſame time, and find itſelf oppoſite to its ground. See Plate DXIV, where *a* is the army formed in order of battle, ready to march. *b*, The park of artillery, where the baggage belonging to the army, and their eſcorts, alſo are aſſembled. *c*, March of the cavalry, to form the column on the right. *d*, March of the cavalry to form the column on the left. *e*, March of the infantry, to form in three columns. *f*, March of the artillery and baggage, to form in a column. *g*, Parties of huſſars, covering the flanks of the army, and forming the rear-guards of the column, when the army hath paſſed. *h*, Bridges and fords, diſcovered by the advanced detachments, who have marked the route of the army. *i*, Bridges built by the ſame detachments. *k* Front and rear-guards of the columns drawn from the troops of which the columns are formed. *l*, Parties of huſſars, marching upon the flanks of the army. *m*, Parties of huſſars marching at the head of the army, to ſcour the country through which the army is to paſs, and alſo to examine the routes marked by the advanced detachments.

If, by the enemy's poſition, although at a diſtance, the army ſhould, on its march, preſent a flank to the enemy, without fearing its being attacked; yet as the enemy may have ſtolen one or two marches, as hath happened on many occaſions, there muſt be only two columns of infantry placed in the centre. The third muſt be placed upon that flank which the army preſents to the enemy; ſo that the army will find itſelf diſpoſed upon its march after the following manner: Suppoſing it is the right which preſents the flank to the enemy, the firſt column will conſiſt of infantry, the ſecond of cavalry, the third of artillery, the fourth and fifth of infantry, and the ſixth of cavalry. The baggage will then be diſtributed to the three columns upon the left; ſo that neither the two columns upon the right, or the artillery, will have the leaſt embarraſſment, in caſe an action enſues. The ſame diſpoſition muſt be made upon the left, if it is that which preſents the flank. Particular care muſt be taken that the artillery have orders, ſuppoſing the enemy advancing in full force to attack, to tranſport itſelf to the column of infantry, and to divide itſelf along the front, when it ſhall be in order of battle, and to keep up a conſtant fire, in order to give the general time to make ſuch diſpoſitions as he ſhall find neceſſary.

The column of cavalry ſhould be divided into two, and be poſted upon the flanks of the infantry that is drawn up in the face of the enemy; the other columns muſt follow the orders which have been delivered to them, and execute them with the utmoſt diſpatch.

If it appears, either from the proximity or poſition of the enemy, that the army is liable to be attacked in front, the diſpoſition for the march ſhould be in the ſame order as the army is to form in for action: the artillery muſt then be diſtributed among the columns of infantry; ſo that, following the diviſions where it is placed, the brigades will find themſelves ſpread over the front of the firſt line. In this caſe, the infantry will form four columns, which will march in the centre of the two columns of cavalry upon their flanks; ſo that the head of each column, as far as the centre, when placing itſelf in order of battle, ſhall make the firſt line, and the remainder, from the centre downward, the ſecond; and the reſerve which follows ſhall form itſelf behind the other two lines.

It is neceſſary that an army diſpoſed after this manner ſhould have orders to draw itſelf into order of battle on the very firſt ſignal, which ſhould be a diſcharge of two or three pieces of cannon. The ſignal being given, the firſt and ſecond lines, and the reſerve, will find themſelves formed in a very ſhort time. If, from the proximity and poſition of the enemy, and the facility with which he can attack, the general hath reaſon to imagine he will do it, the heavy baggage, with a good guard and eſcort, ought to be removed into the rear.

On this occaſion the *campement* (A) ſhould not be far before the army, the eſcort ſhould be increaſed, and ſome detachments of light horſe ſhould march in front to cover it, and alſo to make obſervation at a diſtance. The remainder of the body of light horſe ſhall continue upon the flanks of the army ſuſtained by dragoons, who, on the ſignal being given, ſhall immediately go and form themſelves in the place aſſigned to them during the action.

On the firſt ſight of the enemy the campement ſhould retire; for when fighting becomes neceſſary, all thought of encamping muſt be laid aſide; but the eſcort ſhall put itſelf in order of battle, and the light horſe ſhall approach the enemy as near as poſſible, in order to reconnoitre his diſpoſition and ſtrength. The officer commanding them will immediately ſend a report of the diſcoveries he hath made to the commander in chief, who on every occaſion ſhould be in the front, and even a little advanced, to ſurvey the nature of the ground; it being very certain, that in theſe caſes a man can much better rely upon his own than upon the judgment of others. This was marſhal Saxe's method; particularly when he was apprehenſive of being attacked upon a march, or had himſelf an intention of attacking. In proportion as the enemy ſhall advance, the eſcort of the campement muſt retire in good order, at the ſame time not neglecting the opportunity, if it offers, of haraſſing the enemy's advanced guard, ſo as to retard his march, and give more time for the army to form in order of battle, and to the general to make ſuch diſpoſitions as he ſhall judge neceſſary: after which, the eſcort having amuſed the enemy, or cauſed him to ſlacken the briſkneſs of his march, muſt retire in good order; and when it ſhall be near the body of the army, each body ſhall return to its own brigade.

If, from his knowledge of the country, although an open one, the general knows there are any thickets, hollows, or heights, either on the right or the left, and that this ſpot may prove favourable to the enemy, he ſhould try to poſſeſs himſelf of it. If that attempt is not practicable, as the enemy will undoubtedly take advantage of it, and poſt infantry either at theſe thickets or heights, the general muſt place a brigade of infantry at the head of each column of cavalry, which ſhall mix by platoons with that line of cavalry when formed in order of battle. This diſpoſition was made by M. de Turenne at the action of Sinzheim, and at the battle of Enzheim.

If, by the ſituation of the country, the flanks cannot be ſheltered

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(A) This is a French term, for which we have not a ſynonyme equally expreſſive in the Engliſh language. It is uſed to denote a certain number of troops, who proportion their time of ſetting out before the army, by the diſtance or proximity of the enemy, in order to trace or mark out the camp. For this purpoſe, a quarter-maſter and a trooper is draughted from every troop of every regiment of horſe; and a ſerjeant and a corporal, in like manner, from every regiment of infantry, furniſhed with ropes and pickets, to lay out the ground for the tents and the intervals; ſo that every regiment will, on its arrival find its ground properly marked out. A field-officer of every regiment alſo marches with the campement, beſides the officers of each corps, who command the detachment.

ſheltered either by an hollow, a moraſs, a river, a town, or a village, the huſſars and dragoons muſt be poſted upon the wings, but ſidewiſe, ſo as to be able to take the enemy in flank when he ſhall come down to charge the firſt line, or at leaſt to keep back his ſecond; theſe huſſars and dragoons ſhould be ſuſtained by the infantry of the light troops belonging to the army. If the right can be formed next a village, and the leſt next an hollow, ſome infantry and artillery muſt be poſted there: if there is only the right or the leſt that can be ſheltered, that which cannot muſt be properly ſuſtained; and the ſame diſpoſition muſt be obſerved that hath been juſt now mentioned, with regard to an army whoſe flanks cannot be covered.

If, on leaving the camp, the army preſents a flank to the enemy, who may have it in his power to attack it on the march, it muſt then march but in two or three columns at moſt. Each column ſhould be diſpoſed after ſuch a manner, that by a motion to the right or to the leſt, according to the wing that is liable to be attacked, each battalion and ſquadron may find itſelf formed in order of battle before the enemy.

The advanced guard ſhould be compoſed of light horſe, ſuſtained by dragoons: the rear-guard of cavalry ſuſtained by infantry: there ſhould be alſo ſome light horſe upon the flanks of the cavalry, and ſome pieces of cannon with the infantry. The artillery ſhould be diſtributed by brigades in the column of infantry neareſt to the enemy; ſo that, performing the ſame movement as the troops, it may find itſelf placed in the front of the firſt line, ready to fire on the firſt order. The number of three columns is given to the army, in order that the firſt and ſecond lines and the reſerve ſhall be formed at the ſame time, which cannot be done if the army marches only in two columns: for troops muſt then be taken from theſe two lines in order to form the reſerve, which would require a conſiderable time, and conſequently retard the diſpoſitions; whereas this reſerve, forming the third column, is ſeparated from the main body, and in a condition to act with readineſs, according to the orders it ſhall have received. As the baggage, in this manner of marching, muſt neceſſarily be an embarraſſment, it muſt be ſent into the rear under a good eſcort, with orders to join the next day at the new camp.

Sect. IV. *The March of an Army in a mountainous and woody Country.*

If the ſituation of the places in a mountainous country furniſhes a general with a greater variety of expedients to conceal his diſpoſitions, it alſo renders more precautions, and a greater degree of knowledge, neceſſary to avoid being ſurpriſed. If theſe kinds of countries, on the one hand, preſent greater advantages for the concealment of marches, they alſo, on the other, offer many difficulties in the tranſporting of the proviſions and the artillery, and require a greater degree of vigilance for the ſafety of the magazines and the preſervation of the communications with the frontier towns.

It is to be feared, that in mountainous countries, in roads that cannot be enlarged, the troops preſſed too cloſe together will not be able to move but with great difficulty; and as they will embarraſs each other, the front, the rear-guard, and the flanks, muſt be equally ſecured; the columns muſt be unbroken and cloſe, that there be no diſtance left between them; and halting ſhould be particularly avoided, as that is a circumſtance by which an army is moſt fatigued.

It is again dangerous, as the commentator upon Onoſander obſerves, when troops find themſelves ſtraitened of room in a narrow road, for the general, in order to enable them to move with greater eaſe, to lengthen the columns too much: from whence would ariſe two inconveniences; the firſt of which is, that the columns would be weakened, and that in caſe of a ſurpriſe it would not be difficult for the enemy to ſeparate them entirely, and it would alſo be impoſſible for them to rally; in the ſecond place, theſe columns thus lengthened, in going round a mountain and deſcending into a valley, would take up a prodigious extent; from whence it hath often happened, that the windings of the road hiding the middle of the column, thoſe who march in the front rank can ſee only thoſe who are in the laſt, and retard their march, becauſe that, being deceived by diſtance, they will be ſcarcely able to diſtinguiſh whether they advance or whether they are halted.

In order to avoid theſe inconveniences, it is not barely ſufficient for a general to have a thorough knowledge of the country: he ought immediately to inform himſelf of every particular, however minute, relating to it; he ſhould take the ſame precautions which have been pointed out as neceſſary for a march in an open country, and ſend out a detachment, ſuch as hath been ſuppoſed in the foregoing ſection. This detachment will examine the narrow paſſes, ſurvey and ſound the fords, run round the windings of the mountains; and if there are many roads, it will find out which is the moſt practicable, and that through which the army, the artillery, and baggage, can paſs with the greateſt eaſe; what ſtreams croſs it, and whether there are bridges over them: it will examine whether they are ſufficiently ſtrong, and repair them, or build new ones. It often happens in a mountainous country, that the road which would be very ſhort and commodious proves to be divided, either by the ſeparation of two rocks or by hollows. As theſe breaches, however deep they may be, cannot be all of a certain breadth, therefore, in order to avoid marching over the unneceſſary ground that going round them would take up, bridges ſhould be thrown over, if poſſible, from one rock to another.

But as in a march, whether in an open or in a mountainous country, occaſions for throwing bridges very often preſent themſelves it is very neceſſary to ſay a word or two relative to the manner of their conſtruction.

Six or eight thick pieces of timber are laid acroſs a rivulet, or any other bad place neceſſary to be paſſed, at ſix feet diſtance from each other; theſe muſt be croſſed again by other pieces of timber not ſo thick, at the diſtance of three feet from each other; which muſt be fixed to one another by large pegs, and faggots well faſtened together muſt be laid over them. When the bridge ſhall be thus covered, ſome earth muſt be thrown over it, which ought to be well trampled, in order to fill up the vacancies of the faggots; and then, for the greater firmneſs, new earth ſhould be thrown over it, which ought to be well beaten down. The bridge thus made, the troops, the artillery, and the baggage, will paſs over it with great eaſe.

It muſt be obſerved, that the bridges ſhould be of the ſame breadth with the roads; they ſhould be broader rather than narrower, becauſe, excluſive of the danger the artillery and baggage would run if they were narrower, the ranks being obliged to be ſtraitened and the column to be lengthened, the march would of courſe be retarded, and it would be difficult to avoid confuſion. The labourers that accompany the detachment ought to be furniſhed with every ſort of tool neceſſary for the removing of earth, the felling of trees, and working and fitting them for uſe.

On the report of the commanding officer of this detachment to the general, he will order as many detachments as there are columns intended, to ſet out two or three hours before the time appointed for the march of the army. Theſe detachments will march carefully over the ways already examined and prepared: they will ſcour every thing, hedges, narrow paſſes, entrances of paſſes, woods, heights, villages, in ſhort all that may ſerve as ſhelter for troops in ambuſcade; and for greater ſecurity, they will poſt guards in the villages, which guards are not to retire till the rear-guard of the army comes up.

The commanding officer of each detachment ſhould poſſeſs himſelf of the heights on the right and left, and ſhould diſtribute platoons of infantry at proper diſtances from the rocks and narrow paſſes: he ſhould be careful of what may be done to oppoſe him, and be attentive even to the ſmalleſt paths. When the commanding officer of the detachment ſhall be advanced to the end of the paſſes, or to the ground intended for the camp, he will eſtabliſh his infantry in the moſt advantageous poſts; he will place his light horſe or dragoons in the front, but within reach of aſſiſtance; he will ſend out patroles of light horſe advanced before the infantry. If he receives any intelligence of the enemy, he will ſend immediate notice of it to the general; but if, from the report made to him, the enemy does not appear to be ſufficiently ſtrong to annoy the army on its march, or only ſome parties were willing to try if they could enter the paſſes, his detachment will be ſufficient to keep them at a diſtance, particularly as he is in poſſeſſion of the heights and the paſſes.

With ſuch precautions as theſe, if the enemy is at too great a diſtance to attack the army, the march will be performed without any trouble: there will be no obſtacle in the roads, or reaſon to fear that the waggons will be mired; and if the wheels or axle-trees of any of them ſhould break, they will be repaired from thoſe which have ſpare ones: if, on the contrary, the enemy ſhould be ſo near as to give cauſe to apprehend an attack, the neceſſary precautions are taken for forming the troops in order of battle, and for the neceſſary diſpoſitions during the action.

It has been already obſerved, that an army on a march ſhould be divided into as many columns as the detachments have found openings or roads leading to the camp the general intends to occupy; ſuppoſe two, the army will conſequently march in two columns. The diſpoſition of the troops in their march differs entirely from what it would be in an open country; the advanced-guard of each column muſt conſiſt of infantry, ſome muſt be diſtributed either in the narrow paſſes or on the heights, and there ſhould be ſome advanced detachments of light horſe to ſcour the narrow paſſes: the rear-guard ſhould conſiſt of infantry only. The remainder of the troops may be diſpoſed after the following manner:

Four or five brigades of infantry, according to the number which compoſes the army, ſhould be placed at the head of each column; the ſame partition ſhould be made with regard to the artillery, which muſt follow the infantry; the cavalry muſt march next, and the baggage of each column, well eſcorted by infantry, muſt follow the cavalry; then the remainder of the corps of light horſe which are not detached; and the dragoons are placed the laſt, in order to diſmount and ſuſtain the rear-guard in caſe it ſhall be attacked.

Each column ſhould conſiſt of the ſame number of troops as well infantry as cavalry. Platoons of infantry ſhould be detached to march on the heights, at proper diſtances, in order to cover the flanks on the right and left. Care muſt be taken to march very leiſurely in the front, otherwiſe the rear will not be able to keep up; then, in order to give the rear time to come up, the front will be forced to halt, by which the march will be much retarded and the troops fatigued.

Plate DXV. repreſents the march of an army through a mountainous country. A is the poſition of the army before it begins its march. P is the artillery and baggage, with their eſcorts in the front of the camp. B, Parties of huſſars forming the advanced-guard of the army on its march. C, Parties of infantry of the advanced-guards of the columns. D, The infantry of the army forming the head of the columns. E, The artillery, and waggons belonging to the artillery. F, Battalions of artillery. G, The cavalry. H, The baggage of the army. I, The eſcort of the baggage. K, Parties of huſſars. L, Parties of dragoons. M, the infantry of the reſerve, forming the rear-guard of the army. N, Platoons of infantry marching upon the heights, to cover the flanks of the columns. O, Villages in front of the camp the army is to occupy, and of which the light infantry have taken poſſeſſion.

Theſe diſpoſitions are neceſſary, becauſe, as the enemy in a mountainous country will be able to attack with infantry only, he muſt be oppoſed with troops of the ſame nature: the reaſon why the artillery is poſted behind the infantry is, that in caſe the enemy ſhould attack briſkly in front, and the road through which the columns paſs be broad enough ſome pieces of cannon may be ſent into the front, which firing with grape-ſhot will ſoon thin the enemy's ranks, and abate ſomething of his ardour: if the road be too narrow to permit the bringing forward of the artillery, reſolution muſt ſupply the want of that aſſiſtance which the cannon would give, and the enemy muſt be charged with bayonets. The cavalry does not follow immediately, becauſe, not being able to act in this ſort of country, it muſt be covered by infantry. The baggage which follows is ſufficiently defended by the columns that cover it, and the infantry that eſcorts it: this infantry ſhould nevertheleſs join as often as circumſtances will permit, without being fearful of expoſing itſelf, that upon the heights being to reinforce it in caſe the head of the army ſhould be attacked.

There are ſome mountainous countries ſo difficult of acceſs, that it is impoſſible for the cavalry to follow, becauſe ſome poſt muſt either be immediately ſeized, or the enemy, being in poſſeſſion of the hills, muſt be driven from them before it can advance; or becauſe it would be difficult for it to be ſubſiſted.

If the army can march in four columns, the diſpoſitions ſhould ſtill be the ſame; but as the head of the columns will be weaker in infantry, the heights ſhould be guarded accordingly, and the rear-guard ſufficiently ſtrong to reſiſt the enemy: the ſame diſpoſition ſhould be made for one column only.

If the march is to be made through a woody country, the precautions which have been already mentioned in regard to examining the ways through which the army is to paſs, and for the detachments which ſet out in order to be before the army, ſhould ſtill be obſerved: but the diſpoſition and order of the troops muſt be different. If by the ſituation of the country, the army is obliged to march continually through woods till it arrive at the camp, the cavalry and the baggage ſhould be in three columns in the centre; but ſome infantry ſhould be placed at their head and their rear-guard: the infantry ſhould march in two columns, one on the right the other on the left of the cavalry and baggage; ſome brigades of artillery ſhould be diſtributed to each column of infantry the remainder muſt march at the head of the columns of baggage; the flanks of the columns muſt be covered by platoons of infantry, placed about at proper diſtances, which are to follow the columns at 40 or 50 paces diſtance, without ever loſing ſight of them.

Plate DXVI. repreſents the march of an army through a woody country. A, Is the army formed in order of battle previous to the commencement of the march. B, The cavalry, which have marched ſome paces in advance, in order to make room for the infantry. C, The infantry, which, by facing to the right, forms the column upon the right. D, The infantry, which, by facing to the left, forms the column upon the left. E, Bodies of infantry, which are to march at the head of the columns of cavalry. F, The park of artillery, where the baggage belonging to the army, and the eſcorts, alſo are aſſembled. G, The march of the infantry, forming in columns. H, The march of the cavalry, forming in columns. I, The march of the artillery and baggage with their eſcorts, forming in column. K, The army in march. L, Huſſars of the advanced guard keeping the roads, marked out by the detachments ſent on before. M, Infantry, forming the advanced guard of the columns. N, Small parties of infantry, marching upon the flanks of the columns. O, Parties of huſſars, marching upon the flanks of the army. P, Infantry of the reſerve forming the rear-guard of the army.

If by the knowledge which the general has of the country, or rather from the report of the officers who commanded the detachment ſent out to view, open, and repair the roads, he knows that the country is interrupted by woods and little plains, the diſpoſition ought to be wholly changed; it will then be ſufficient that the ſecond detachment, which in other caſes ought to ſet out the evening before, ſets out only two hours before the campement. This detachment ſhould be compoſed of infantry, light horſe, and dragoons; the infantry to ſcour the villages and the woods, the light horſe to penetrate into the woods wherever they can enter, and clear the march of the Infantry, and the dragoons to ſuſtain the whole.

When the diſpoſition for the march of the army is ſuppoſed to be in five columns, the infantry ſhould form two, the cavalry two more, and the artillery and baggage the fifth. If it is thought there will be any occaſion for artillery, a brigade or two may be diſtributed to the columns of infantry; and the remainder may march at the head of the eſcort of the baggage, which is to be defended by the regiment of artillery; to which muſt be added a detachment of infantry, which will form the advanced guard. The cavalry and dragoons are to keep the open country as much as poſſible, and the infantry the incloſed; and the beſt and moſt acceſſible road ſhould always be given to the artillery and baggage. In order that the columns may preſerve the ſame length in marching, a brigade of infantry ſhould be placed at the heads of the columns of cavalry; if this precaution, which fixes the head of the columns of cavalry, is neglected, the cavalry will extend a great way before the columns of infantry, which ſhould be always avoided. The rear-guard ſhould conſiſt of infantry, cavalry, or dragoons: the light horſe ſhould always march on the flanks on the right and left, and before the army.

It is after this manner that the march of an army may be diſpoſed through a woody and a mountainous country; but an army muſt always ſuit its motions to circumſtances, and to the ſituation of the country where the war is carried on. If the general is inferior in point of number, he ſhould make choice of defiles; becauſe in them he can always preſent a front equal to the enemy's. Who can be ignorant that Leonidas with 8000 Greeks, at the ſtraits of Thermopylæ, ſtopped the almoſt innumerable army of Xerxes, who was unable to force him?

A mountainous and woody country, when thoroughly known, becomes a more favourable theatre for practiſing the wiles and ſtratagems of war than an open country; it is true that the knowledge of it is more difficult to attain, and that it requires more vigilance and readineſs in the general. Hannibal was even drawn into the ambuſcades by his own guides; an example worthy the notice of a general who takes guides that have either but little regard for him, or are unacquainted with the country: it is impoſſible to try them too much; and their ignorance is often more fatal than treachery itſelf.

The marches that require moſt precaution are thoſe made in the night, thoſe made in ſight of the enemy, and thoſe that ſhould be kept ſecret.

The firſt ſhould be avoided as much as poſſible; but if circumſtances require and force an army to march over a mountainous country in the night, care ſhould at leaſt have been taken to ſurvey the roads during the day; to make the guides march at the head of the army; to keep the ranks very cloſe together, that the men may not loſe ſight of each other; and that part of the troops do not miſtake one defile for another, which may eaſily happen in the dark, if the advanced guard has marched a little too faſt, and the officers haſtened too much. The Greeks, according to Xenophon, on like occaſions, gave the heavieſt arms to the troops that marched at the head, thereby to oblige them to proceed leiſurely.

In thoſe marches that are made in ſight of the enemy, beſide the precautions neceſſary to be taken for the ſafety of the troops, and which have already been mentioned, the general ſhould endeavour to deceive them by falſe appearances, and by an oſtentation, often in ſuch circumſtances, neceſſary: as extenſive a front as poſſible ſhould be given to the army; the intervals of the ranks and columns ſhould be widened, but not ſo as to weaken them; the general ſhould take advantage of an height, poſſeſs himſelf of it, and poſt ſome troops on it, in order to make the enemy ſuſpect there may be ſtill more behind; advantage ſhould be taken of a wood, and, by marches and countermarches, the ſame troops ſhould be made to paſs and repaſs, in order to make the enemy believe the army ſtronger than it really is. There have been inſtances of generals, who, on like occaſions, have made ſuch good uſe of their ground, that, by the arrangement of troops, they have ſeemed to multiply them in the enemy's eyes; and who, although inferior in ſtrength, appearing to have the advantage of numbers, have kept the enemy in awe.

But ſtill, unleſs it is to deceive the enemy, a general ſhould conceal his force and management: his force, becauſe, if ſuperior, he will not fail to profit by that advantage; and if inferior, he ſhould avoid a battle: he will conceal his management, becauſe he will prevent the deſigns of the enemy's general, who will receive as much information from his ſucceſſes as from his miſcarriages. Pyrrhus, who taught the art of war to the Romans, was in the end conquered by them. The Mexicans often turned the arts and wiles of Cortez and the Spaniards againſt them; and the Czar Peter I. never regretted a defeat when it became the means of inſtructing him how to conquer in his turn.

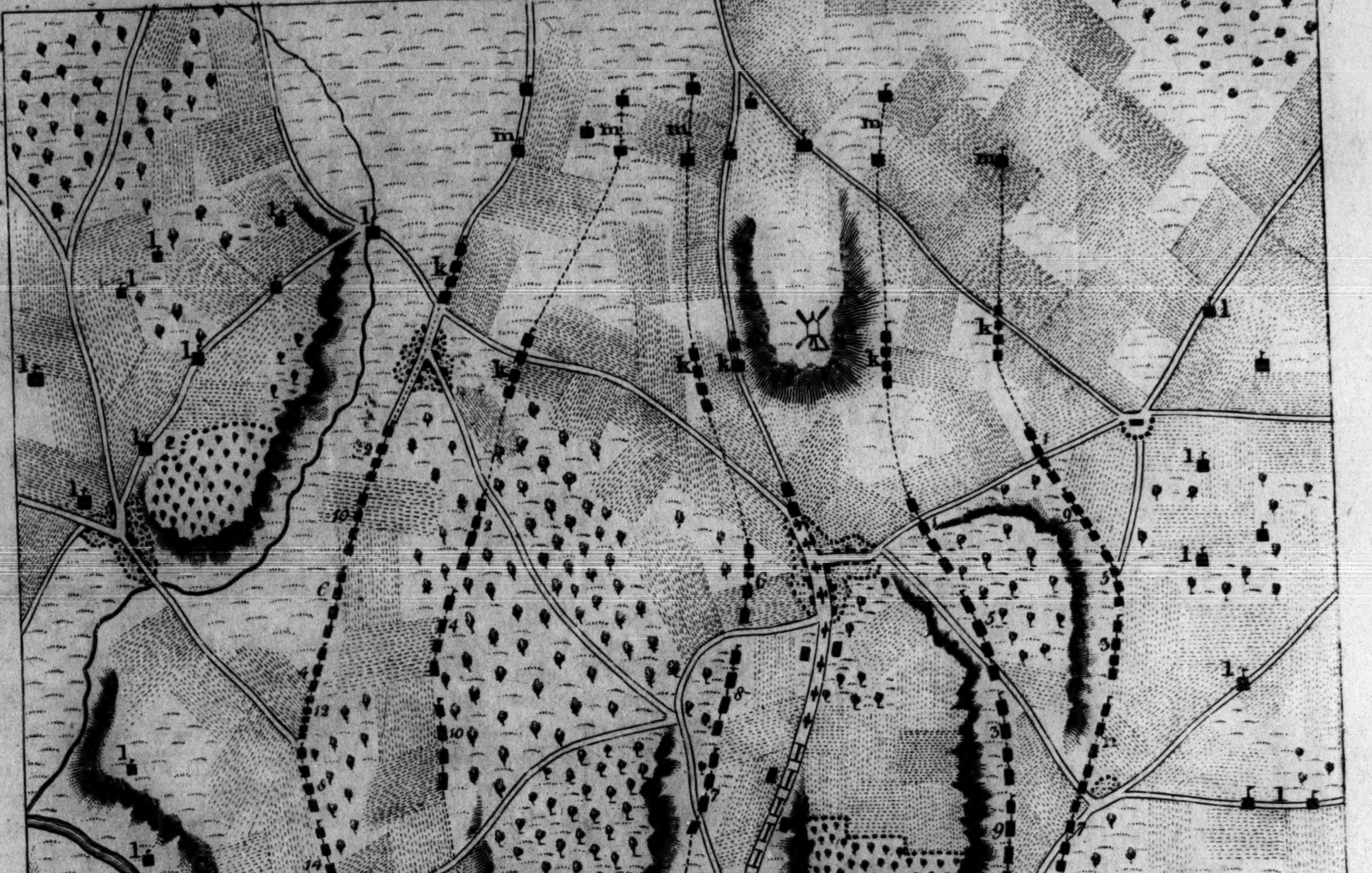
It is impoſſible to lay down fixed rules for ſecret marches: it is by his addreſs that a general will improve circumſtances: it is by art and contrivance that he will evade the enemy's vigilance, and deceive his ſpies.

General rules only can be given for the diſpoſitions to be made of troops upon a march; particular ones would be merely conjectural, becauſe the general of an army muſt always depend upon circumſtances: it is the ſituation and nature of the country, the number of troops, the nearneſs of the enemy, the facility of foraging, and the paſſes

WAR

Plan of the March of an Army in Six Columns

Plate DXIV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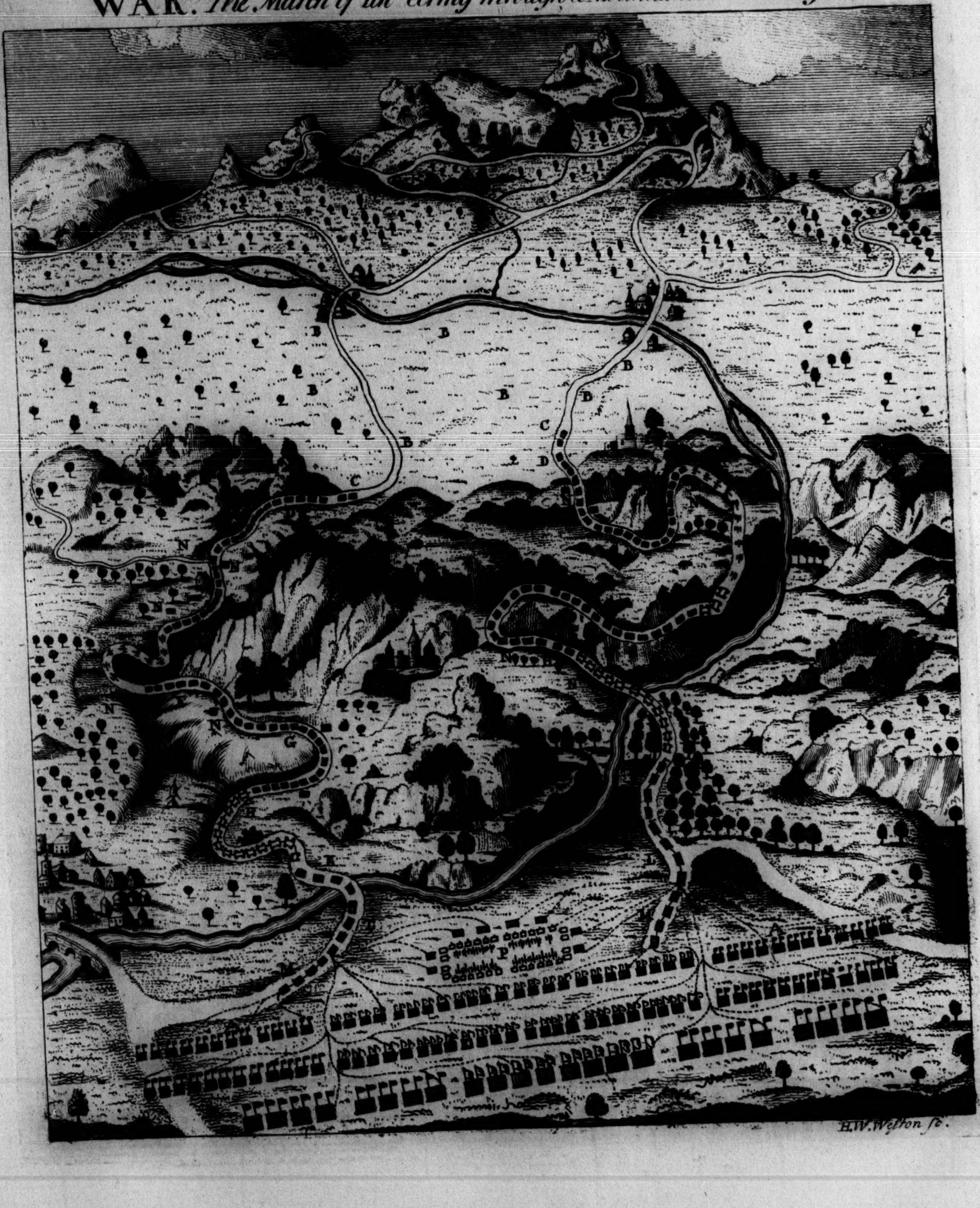
WAR. *The March of an Army through a Mountainous Country.*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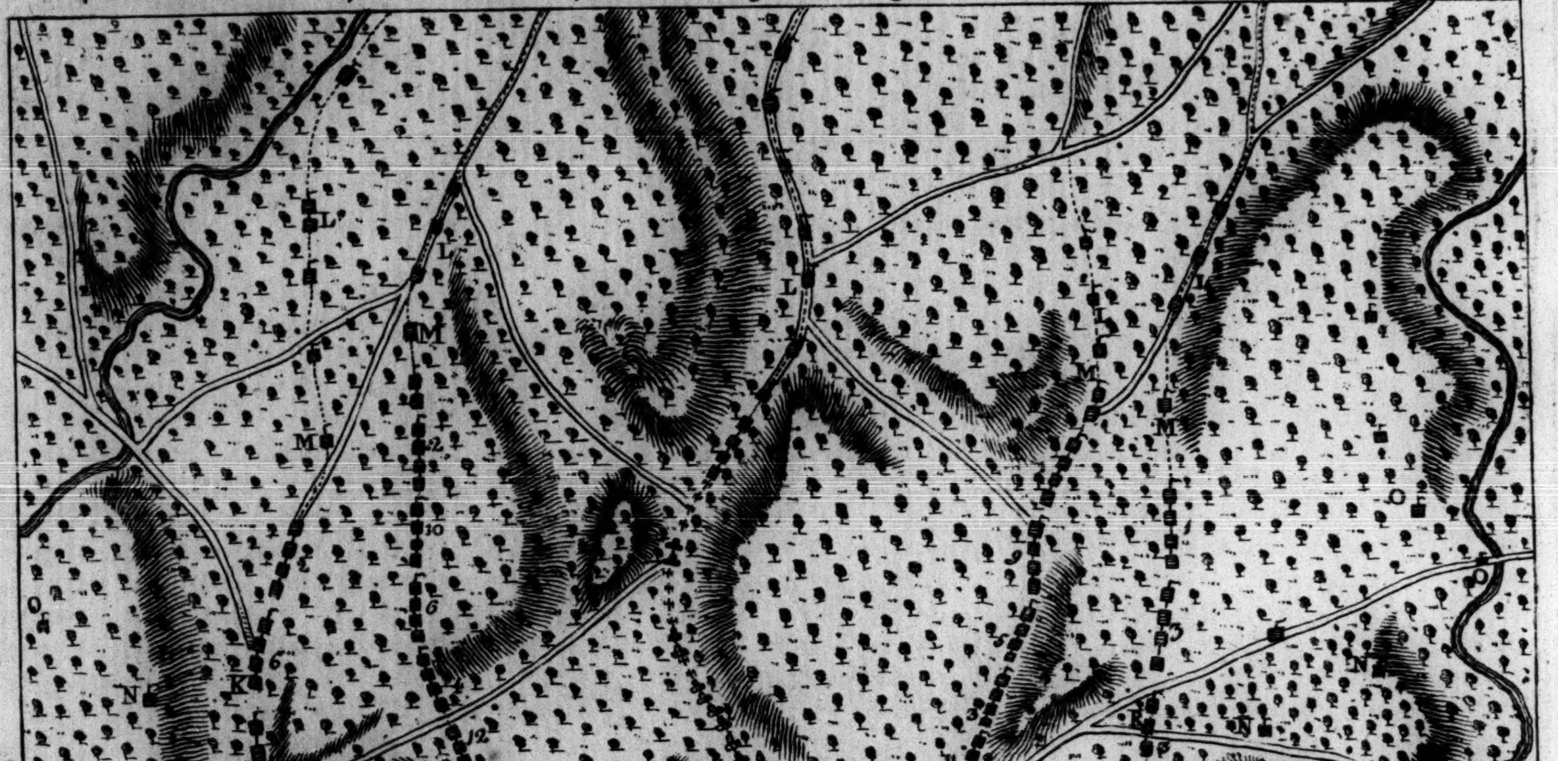
WAR. *Plan of the March of an Army through a Woody Country.*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of which the enemy is poſſeſſed, that ought to determine him.

In a word, whatever is the order and diſpoſition of the troops, it muſt be ſuch, that they ſhall always be able to ſuſtain each other; that the flanks ſhall be well guarded, and the fronts ſecured; the roads muſt have been ſurveyed and opened; and whatever the nature of the country is, all the columns ſhould arrive at and enter the camp at the ſame time.

Sect. VI. *Of Camps in defenſive War.*

It is in general more difficult to carry on a defenſive than an offenſive war, but more particularly ſo in an open than in a mountainous country. In the former, there is nothing to conceal the movements and diſpoſitions of the army from the enemy; whereas, in the latter, the nature of the places prevents the enemy from diſcovering them: but whatever may be the nature of the country, the choice of a camp, when on the defenſive, and the art of pitching upon an advantageous ſituation, is what proves the genius and talents of a great officer. Excluſive of a thorough knowledge of the country, this operation requires a quick and penetrating eye in a general, to enable him to ſeize the poſts which from their ſituation may prevent the enemy either from attacking him or penetrating into the country.

A general who acts on the offenſive, takes what ſtate or circumſtances he pleaſes; he may act as he chooſes, and is not under a neceſſity of regulating himſelf entirely by the enemy's motions: whereas a general that is not ſufficiently ſtrong to attack, is commonly obliged to continue quiet till the enemy hath acted, and then to regulate his motions according to thoſe made by the oppoſite army, unleſs his ſuperior abilities give him a particular advantage over the enemy's general.

Although it is always neceſſary for a general to have a thorough knowledge of the country, this knowledge will yet become more neceſſary to him when acting on the defenſive. He ought to prevent the enemy's entering his country, and forming any ſiege there (a plan which he cannot execute, unleſs he is poſſeſſed of the moſt advantageous poſts, and alſo of thoſe which cover the towns liable to be threatened), by proper diſpoſitions that ſecure his camp: by covering his fronts and rears, and keeping the communication between the camp and the places where the magazines are; by endeavouring to annoy the enemy in his convoys and foragings; by haraſſing him in his camp, and perplexing him with ſmall detachments, to which he will be obliged to oppoſe more conſiderable ones: theſe diſpoſitions, properly managed, may deſtroy any enterpriſes the enemy may have formed againſt the army.

Plate DXVII. repreſents an army properly encamped to ſerve theſe purpoſes. A, Is the camp of the main body of the army. B, An advanced camp, compoſed of dragoons and huſſars, in order to cover the right of the army, to guard the paſſes by which the enemy might make incurſions upon the flanks and rear of the army, moleſt the convoys, and cut off the communications. C, Villages and bridges, guarded by the light infantry. D, Poſts of diſmounted dragoons in the front of their camp. E, Poſts of dragoons on horſeback, to ſecure the communication between their camp and that of the main body of the army. F, Bridges built, to keep up the communication between the grand and the advanced camp. G, Bridges and villages guarded by detachments of infantry. H, Grand guards of horſe. I, Guards of infantry. K, Bridge, village, and mill, guarded by the infantry belonging to the army. L, Camp of dragoons and huſſars covering the left of the army, and ſupporting the light infantry. M, Villages and bridges guarded by the light infantry. N, Poſts of diſmounted dragoons in the front and on the flanks of their camp. O, Poſts of dragoons on horſeback. P, Poſts and detachments of huſſars, to patrole in the front and upon the flanks of the army, and their camp.

By the enemy's ſuperiority, the nature of the country, and the ſucceſs of campaigns, the general ſhould determine whether or not his camp ſhould be entrenched: the entrenching of camps requires much obſervation. It is eaſy (ſays Vigetius) to entrench a camp while at a diſtance from the enemy; but it becomes a very difficult operation when the enemy is near at hand. The Romans, according to him, uſed to keep all their cavalry and half their infantry drawn up in order of battle, in order to cover thoſe troops that were employed in working at the entrenchments. Cæſar, when in Spain, fortified himſelf after this manner under the eyes of Afranius and Petreius, without their having the leaſt knowledge of it.

Before a general fortifies a camp in a plain, he muſt obſerve the poſition in which the ground will permit him to form his camp; whether or no it will be liable to be ſurrounded; if it will entirely cover the country it is to protect, and the towns for which there is moſt reaſon to be apprehenſive; if the parts in the rear are open; if forage is in plenty; if proviſion can eaſily be brought; if there is wood and water; if it is impoſſible for the enemy to enter the country without forcing the camp; if all theſe circumſtances concur, it is certainly moſt advantageous to entrench the camp.

A general ſhould never be too ſecure by having a ſuperiority of numbers; he ought not on that account to neglect fortifying his camp: even when he acts on the offenſive, theſe entrenchments will not hinder him from marching out to the enemy whenever he judges it proper, and his army will by that means be ſheltered from the enemy's attempts.

There are many methods of entrenching a camp by lines beginning on the right, and covering the whole front of the camp to the left; theſe lines, in their extent, have redoubts and angles at proper diſtances; and the line being continued from one to the other, forms the curtains. In the front of them there is a large and alſo deep ditch; ſometimes a covered way is added, which is palliſadoed and ſtoccaded throughout the whole front of the lines. To render them yet ſtronger and more difficult to be forced, there are pits ſunk before the covered way. Theſe pits are ranged chequered-wiſe, about ſix feet deep and five broad, and are in form like a reverſed cone. Such were the pits which the duke of Berwick cauſed to be made in 1734 to the lines of circumvallation before Philipſburg; only with this differance, there was no covered way. Without doubt theſe lines are formidable, and even very difficult to attack; but a great deal of time is required for conſtructing them; and if there is not a ſufficient number of peaſants in the army to work at them, troops muſt be employed to expedite them; which will not only greatly fatigue them, but may alſo coſt the lives of many; becauſe the removing of earth often cauſes great diſorders, particularly where the ground is ſwampy or clayey.

The method practiſed by marſhal Saxe ſeems much ſuperior to theſe lines. It contained as large an extent of ground, without diminiſhing the labour; becauſe, inſtead of lines, it conſiſted of redoubts, which require as much work to form the four faces and the covered way as lines always continued. At the ſiege of Maeſtricht, in 1748, he uſed theſe redoubts inſtead of lines; their diſtance from each other was 48 yards; they were ſtoccaded, and the covered way palliſadoed. Theſe redoubts preſented an angle to the field, and conſequently were a mutual protection to each other; they were each of them capable of containing a battalion.

His deſign, ſuppoſing the enemy come to attack the army, was to cauſe all the redoubts to be occupied; to plant ten pieces of cannon between each, and to draw the army up in order of battle behind them: by this means the enemy would be obliged to force the redoubts before they could attack the army, which could not be done without great loſs. But ſuppoſing the redoubts to be forced, how would the enemy be able to enter the intervals without dividing? The army behind, in order of battle, would charge him, without giving him time to recover himſelf, and it is highly probable would beat him.

By following this method of entrenching a camp, if ſome of the enemy's battalions ſhould, for example, force three or four redoubts, they certainly would not dare to advance as long as the remainder ſhould hold out; ſo that a general might, by detaching ſome brigades, and cauſing them to march to the aſſiſtance of the battalions that have been forced, retake the redoubts; or, without diſordering the order of battle, drive away the troops which are in poſſeſſion of them with his cannon. In ſhort, this method ſeems to be excellent, becauſe it proves that all the redoubts may be forced, and yet the army not be beaten, becauſe it has not ſuffered in the action, but remained the whole time in order of battle with all its cannon; ſo that the enemy will be reduced to the neceſſity of beginning a ſecond battle.—Lines, on the contrary, have not the ſame advantage; all the troops, or the greateſt part of them, muſt line them; the cannon is planted at proper diſtances either on the angles of the redans, or thoſe of the redoubts. If one part only is forced, the army is beat, and the cannon taken, becauſe the enemy makes the attack with his whole front.

Lines are indeed never good, unleſs when there is a large extent of country to be guarded, and ſome frontier to be covered from the incurſions of the enemy; the front of an entrenched camp ſeldom exceeds ſix miles, more or leſs, whereas lines to cover a country have ſometimes extended 30 miles in front. By ſome it is thought, that, in order to cover a country, it is ſufficient to have certain holds, which ſhall be ſtrong and well entrenched, with patroles continually going from one end of the poſts to the other, and each poſt to be provided with ſignals both for day and night. It is unneceſſary that theſe patroles ſhould be ſtrong, provided they follow, and are continually croſſing each other; this will be ſufficient to prevent the enemy paſſing undiſcovered. It is certain that the enemy will not dare to paſs between theſe poſts, whether he be ſtrong or weak; if he paſs in a body, he will be cut off behind, and his convoys intercepted; if he paſs only in parties, they will be cut off with the greater eaſe. However, lines of this nature would require much labour, and alſo take up years to complete them.

Marſhal Saxe's method for entrenching a camp in a woody country interſperſed with ſmall plains, ſeems alſo to be a very good one. The redoubts are to be erected in the plain; and lines thrown up in the woods according to the uſual method, with redans placed on the ſide of each other, at 24 toiſes diſtance; there ſhould be a palliſadoed ditch in the front, and the lines as well as the half-moon ſhould be fraiſed with pointed ſtakes; behind theſe lines, which cannot be very extenſive, becauſe they only cover part of the front of the camp, muſt be placed the troops neceſſary for defending them; a conſiderable entrenchment of felled trees muſt be made behind, with the branches of the trees entangled with each other, and ſome openings muſt be left wide enough to permit the troops who guard the lines to paſs through, in caſe they ſhould be overpowered and obliged to retire; the cannon muſt be planted in the front of theſe openings; and the remainder of the army muſt be drawn up in order of battle, 100 paces at moſt behind the retrenchments of trees and the half moons. The retrenchments of trees are placed about 60 or 80 paces behind the lines, and not before them, becauſe it will be a new and unexpected obſtacle to the enemy. Theſe retrenchments, carefully made, and with large trees, can be deſtroyed by cannon only, which would take up a conſiderable time; if they were in the front of the lines there would certainly be a rampart more; but that might be uſeleſs, and perhaps hurtful, becauſe the fire of the enemy to make a paſſage would drive the ſplinters of the trees into the lines, which would do more harm than even the ſhot itſelf.

Plate DXVIII. repreſents an entrenched camp; in which A is the main body of the army encamped behind its entrenchments. B, The camp of the troops of the reſerve. C, Camp of the dragoons, to ſecure the rear of the army. D, Camp of huſſars, to cover the ground upon the right of the army. E, Villages and redoubts guarded by the light infantry, to ſecure the camp of the huſſars. F, Bridges built to ſecure the communication of the army with the ground upon the right, and to favour the retreat of the troops poſted on the oppoſite ſide. G, Brigades of artillery diſtributed upon the flanks, and along the whole front of the army. H, The park of artillery. I, A bridge entrenched, to ſecure the communication between the army and the ground upon the left. K, Villages and farm-houſes, guarded by detachments of huſſars and light infantry, to patrole in the front of the army.

In a mountainous country the diſpoſitions for entrenchments are different: it is impoſſible there to find plains ſufficiently large to draw up an army in order of battle, and place it beyond redoubts, as in an open country; the avenues and the paſſes only can be entrenched; the redoubts would not be ſufficient, becauſe not only the avenues muſt be guarded, but the heights alſo occupied. Now, as it will often happen among mountains that there is not a foot of earth, how can redoubts be erected there? A general muſt then make uſe of ſuch aſſiſtance as the country can furniſh him with, whether by heaping ſtones upon each other, or by retrenchments of trees well joined; and thus conſtruct lines ſufficiently ſtrong to ſhelter the ſoldiers from fire and all injury. In an open country, a general in a manner ſuits the ground to his diſpoſitions; in a mountainous country, he muſt apply his diſpoſitions to the ground; but in any country whatever, he muſt uſe all the aſſiſtance of art for entrenching of camps. In mountainous countries there are more inequalities of ground, which render the enemy's approach to the lines difficult; and altho' it is almoſt impoſſible for a camp in a mountainous country to be attacked in front, nothing ſhould be neglected for its ſafety: but all the avenues by which it may be ſurrounded muſt be entrenched with care, and all the heights which overlook it ſecured; becauſe the enemy, without intending to attack in front, will amuſe him during the time neceſſary for troops to take a long round, in order to penetrate to the camp on another ſide. If Leonidas, with his 8000 Greeks, had been poſſeſſed of all the avenues, ways, and heights, by which he could be cut off, in the ſame manner as he was of the paſs of Thermopylæ, Xerxes with his innumerable army could never have forced him in the defiles which he guarded.

The entrenchment ſhould never be more than 250 or 300 toiſes, which make from 500 to 600 paces, diſtant from the camp, and which ought to be divided into three parts. This diſtance ſhould be made, that the troops may be able to judge of the parts that can be carried with greateſt eaſe, and of thoſe which are moſt in need of aſſiſtance, that they may march there with greater order, diſpatch, and facility: whereas, if this diſtance is not obſerved, it will happen, as hath been ſometimes ſeen, that the troops not having ground ſufficient to range themſelves in order of battle, the diſpoſitions will be impeded by confuſion and diſorder, and the enemy will have forced the lines before the troops can be in a condition of oppoſing him.

But in a mountainous country, it is not ſufficient for a general that he cannot be turned; that he hath profited ſo well by the advantages of ground, as to render the enemy's approach to the camp difficult; that the aſſiſtance of art hath been joined to nature; and that the country to be guarded is entirely covered: he muſt alſo be careful that the communication with the neighbouring towns where the magazines of war and proviſion are eſtabliſhed, is ſafe and eaſy. If any one of theſe particulars is neglected, the camp is expoſed, neither can the general continue in it the time that would be neceſſary to retard the march and deſigns of the enemy. As it hath been already obſerved, that there is ſcarcely any poſt that is not liable to be turned or overlooked, the camp ſhould be entrenched only ſo far as the entrenchments may become an obſtacle to the enemy, and as they may be a means of giving the general time to retire to occupy another poſt.

When the enemy undertakes the ſiege of ſome town, and the general, although with an inferior army, is willing to ſuccour it, or cauſe the ſiege of it to be raiſed, he ſhould ſeek out a ſpot naturally ſtrong, and entrench it according to its ſituation: if an open country, according to the method above mentioned; if among mountains, according to the aſſiſtance that the nature of the country may give; and make uſe of theſe entrenchments as a ſure aſylum from whence to make ſallies upon the enemy, to attack his forages and his convoys, and to oblige him to raiſe the ſiege as well by the fatigues of it, when it hath been drawn out to a greater length of time than was deſigned by the enemy, as by the want to which he is reduced by the continual inquietudes that the entrenched army hath given him.

When an army is in an open country, it generally continues in the ſame camp for ſome ſpace of time; becauſe it is certain the enemy cannot conceal his deſigns ſo effectually from the general, but he may be able to circumvent them; but in a mountainous country, it is uncertain whether an army will continue in the ſame poſt till morning that it occupied over-night. A general muſt then encamp in ſuch a poſition, and after ſuch a manner, that in caſe the enemy comes to attack him in force and with advantage, he may be able, without danger, to proceed to another poſt, and evade the enemy's deſigns.

It requires great ſkill in a general to judge when it is proper or improper to make choice of places which have a great many avenues on one ſide; becauſe if he ſhould be attacked in a camp incloſed by rocks, or deep in a valley which hath but one or two paſſes open, it will be very difficult for him to diſengage himſelf from the enemy: on the contrary, if there are many ſmall paſſes or avenues to the ground of which he is poſſeſſed, and by which the enemy may eaſily inveſt his camp, it will require a great number of men to guard them. But on theſe occaſions a general ſhould be ever careful to make a good diſpoſition of his troops, to maintain ſtrict order and diſcipline in his camp, and to ſend out his patroles with the greateſt regularity; by which means he will free himſelf from all apprehenſions of being ſurpriſed.

There ought to be no difference between a well-governed town and a well-ordered camp; the exacteſt order ſhould be obſerved, and the ſtricteſt diſcipline kept up: if a ſoldier is at liberty to quit or enter it at pleaſure, the enemy's ſpies will not fail to make their advantages of it. If the camp is unhealthy, or diſtreſſed for proviſion, water, wood, or forage, and the ſoldier hath real cauſe of complaint, every method ſhould be tried to avoid the danger that will attend his being diſcouraged. It is often owing to the little order exiſting in the camp, that the ſoldiers are ſeized with a panic, occaſioned by the abſurd and groundleſs reports that are diffuſed throughout it; troops thus terrified, are in a manner vanquiſhed before they come to action.

In a mountainous country, ſuch places ſhould be avoided as are ſubject to be overflowed, either by the melting of the ſnow, or by torrents, which at ſome ſeaſons appear no more than trifling rivulets, but which, at others, ſwell and carry off every thing they meet with in their way: of this nature were thoſe mentioned by M. de Feuquieres, which he found near the rock that he attacked and took in 1690 from the Baduais. Situations in the neighbourhood of woods are generally to be feared, becauſe the enemy may ſet them on fire, and the flames be communicated to the camp. The general ought alſo to ſatisfy himſelf with regard to the nature of the ſprings, which may agree very well with the inhabitants, but prove very unwholeſome to ſtrangers: ſuch, according to the reports of the French, is the nature of the ſprings in many parts of Italy. The water belonging to certain ſtreams or rivers will be pernicious, while that belonging to the fountains and wells in the ſame country will be very wholeſome and ſalutary.

SECT. VII. *Of eſcorting Convoys.*

THE conducting of convoys is one of the moſt important and moſt difficult of all military operations. In the eſcort aſſigned them, and the number of horſe and foot of which this eſcort is compoſed, the general ought to be guided by the diſtance of the town from whence they ſet out; the dangers to which they are expoſed from the different parties they may meet; the diſtance and ſtrength of the enemy, and the extent and nature of the country they have to travel over, whether an open or a mountainous one; the number of waggons, and the quality of the convoys, whether they conſiſt of money, or ammunition for war or proviſion; and whether they are extraordinary or daily. When eſcorts are too numerous, the troops are fatigued, and no end anſwered; and when they are too weak, they are liable to be beaten. M. de Puyſegur obſerves, that it is as dangerous to give an eſcort of 2000 men to a convoy where only 1000 are requiſite, as to give but 500 to one where 1000 are abſolutely neceſſary; in the firſt, the troops are unneceſſarily fatigued, and in the ſecond, the convoy is expoſed to the danger of being carried off.

All theſe conſiderations ſuppoſe the general to be a man whoſe natural parts are matured by experience, and who is ſenſible that, without a thorough knowledge of the country, the foundation of all conduct, it will be impoſſible to make a proper diſpoſition of troops. If a general is ignorant of the places moſt proper to form ambuſcades; of thoſe where there are bridges and fords; of the paſſes which are moſt dangerous, and thoſe which will favour the enemy's approach in order to attack, and whether in head, flank, or rear—he acts but as chance directs, and his diſpoſitions will have no meaning, either with reſpect to the ſituation of places, or the nature of the ground; the orders will be ill executed, the evolutions performed without exactneſs, and the diſpoſition of the troops will be faulty; the ſeparate bodies being, conſequently, unable to ſuſtain and aſſiſt each other, will ſoon be beaten and diſperſed, and the convoy carried off.

The general officer commanding the convoy ought, for its ſecurity, to diſtribute his troops after ſuch a manner that they may be a mutual aſſiſtance to it. The choice of the troops to form the eſcort is undetermined, as it is by the nature of the country their quality ſhould be decided. In mountainous and woody countries, only infantry, huſſars, or dragoons, can be made uſe of; the huſſars or dragoons are to march in the front and on the flanks, to ſcour the woods, examine the avenues, and make ſure of the defiles; in an open country, the eſcort ſhould be compoſed of infantry, cavalry, huſſars, or dragoons. But whatever may be the nature of the country, the convoy ought never to advance without firſt ſending out detachments to reconnoitre at a diſtance.

If the convoy marches through a mountainous country, a large body of cavalry would not only be uſeleſs, but alſo an embarraſſment, as it would be unable to act, except with great difficulty; whereas, in an open country, cavalry is very ſerviceable. In any kind of country a convoy can be eſcorted with infantry, eſpecially when the enemy can only act with his; but as in an open country it is neceſſary for the infantry to be ſupported, the cavalry muſt be uſed for that purpoſe. In a mountainous country, infantry can carry on war alone.

In this laſt caſe the officer commanding the eſcort ought to place a body of infantry at the head, another in the centre, and a third at the rear-guard; to diſtribute ſmall bodies at proper diſtances on the right and left; and he ſhould be particularly careful to poſſeſs himſelf of the heights. The huſſars muſt be diſtributed to the advanced and rear-guards, and, in order to be more certain that every part hath been ſtrictly examined, as the convoy advances, notwithſtanding the huſſars of the advanced guard have already ſcoured the avenues, woods, valleys, villages, and hollows, the huſſars belonging to the rear-guard ſhould again look into thoſe places, to ſee whether any thing hath eſcaped the notice of the advanced guard. Theſe precautions are never without their uſe, and do not in the leaſt retard the march of the convoy.

The ſmall detachments ſhould advance as far as poſſible into the country, without expoſing themſelves to the danger of being cut off, the huſſars with piſtol or muſquetoon, and the dragoons with their carbine in hand, in order that, if they ſhould meet the enemy, they may, by firing, give the officer commanding the eſcort notice of it, ſo that he may have time to make his diſpoſitions for defending and preſerving the convoy. The convoy may continue marching on till the enemy is diſcovered: but on the firſt notice of him, it muſt ſtop, and the officers belonging to the convoy ſhould park their waggons; or, if the ground will not admit of that, they ſhould cauſe them to keep very cloſe together, and double them up with the diſtance of four paces, which ſhould be filled with infantry, between each waggon. By this movement the length of ground taken up by the waggons will be contracted, the troops will be brought cloſer together, and will form a ſtronger and heavier body, capable of aſſiſting each other with more eaſe.

In a mountainous country it is almoſt impoſſible for the enemy to attack the advanced and rear guards and the centre at the ſame time. Nevertheleſs, if he ſhould find an opportunity of forming theſe three attacks at once, by following the diſpoſitions above mentioned, he will find troops at every part to receive him: neither will he be able to make himſelf maſter of the heights without attacking them, and the troops already in poſſeſſion of the ground will eaſily repulſe him; and by the aſſiſtance which the officer commanding the eſcort ſhould endeavour to ſend them, they will be enabled to maintain themſelves in them, to protect the convoy, and the enemy will be unable to attack by more than one or two paſſes.

If the enemy forms but one attack, only a part of the troops muſt be oppoſed to him, becauſe it is to be ſuppoſed this attack may be made only with a deſign to draw the whole ſtrength of the detachment to that part, and which, by being altogether in that one place, will give the enemy concealed in ambuſh an opportunity of falling with eaſe upon that part of the convoy that is unprovided with troops, and which will of courſe be incapable of making any defence. The troops of the centre ſhould never march to the aſſiſtance of the advanced guard, if it is that which is attacked, nor thoſe of the rear-guard to the aſſiſtance of the centre; but a party from thoſe troops which cover the flanks of the convoy ſhould be collected in a body, and ſent to aſſiſt the part that is attacked. However narrow and confined the country may be, a convoy may be eaſily conducted by infantry, when it would be impoſſible to do it with cavalry.

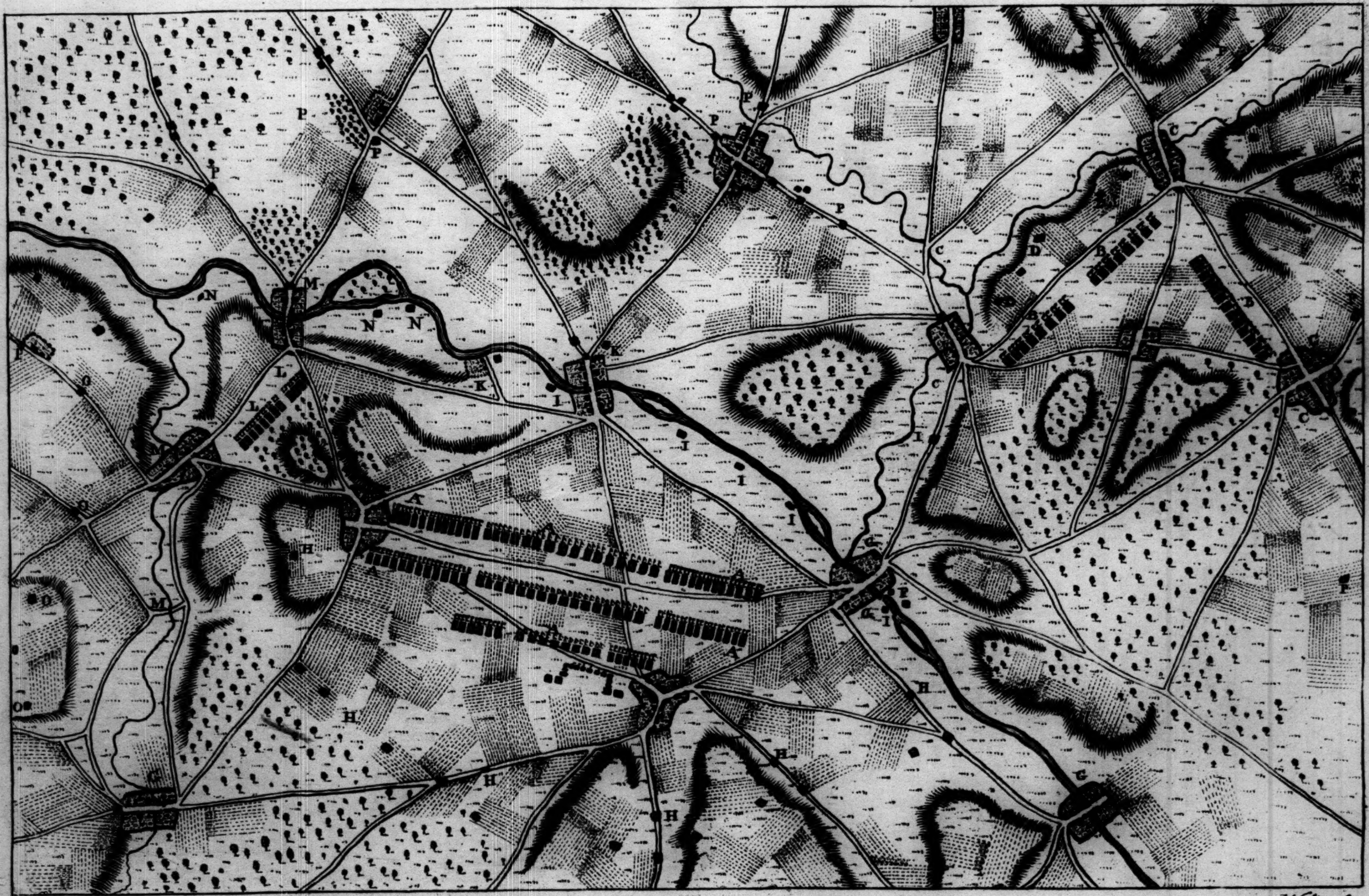
When any paſs or avenue croſſes the road on which the convoy marches, it ſhould be covered by a body of infantry, which will remain there till the rear-guard is come up; then it will fall into the poſt aſſigned it for conducting the convoy. It is always to be ſuppoſed, that this paſs hath been examined by the advanced detachments. If the eſcort is compoſed of infantry and dragoons, the latter ſhould be diſmounted, in order to give an additional ſtrength to the guards, and their horſes may be tied to the waggons. The huſſars, if the nature of the country renders them unſerviceable on horſeback, may alſo be diſmounted; by which means, inſtead of being an embarraſſment to the infantry, they will become uſeful to it. The nature of huſſars is ſuch as will admit of their being employed on every occaſion; and although the difference of their arms will not permit them to be as ſerviceable as dragoons, they may nevertheleſs amuſe a party of troops belonging to the enemy in ſuch a manner as to enable the infantry to beat them, or at leaſt to oblige them to retire.

Huſſars are more particularly neceſſary in the eſcorting of convoys, becauſe they ſcamper about on all ſides, and are very active and ready in ſcouring a country thoroughly; they leave no place till they have perfectly examined it, unleſs the thickneſs of the woods, or any other unavoidable obſtacle, ſhould prevent their penetrating as far as they would otherwiſe do; and even then they protect the infantry, who can with greater eaſe paſs into thoſe places where the huſſars cannot. Whatever country the convoy paſſes through, there ſhould always be huſſars with it; otherwiſe the officer commanding the eſcort cannot be certain that the country is thoroughly ſurveyed, becauſe for want of huſſars he muſt employ cavalry on that ſervice. Not that there can be any doubt of the cavalry's expoſing itſelf to danger with as much cheerfulneſs and courage as the huſſars; but as the horſes belonging to the cavalry are naturally heavier than thoſe of the huſſars, and often encumbered with forage, they cannot venture to a proper diſtance without running the danger of being taken, becauſe they cannot retire with that expedition which is requiſite: On the other hand, the huſſar being more active, and more accuſtomed to reconnoitre, knows how to go over a country with proper caution and care to himſelf: beſides, the trooper who is uſed always to march in a body, and to be under command, will have a very imperfect idea of the method of ſcouring a country. Although the diſpoſition of the troops ſhould always be regulated by the nature of the country through which the convoy marches, and by the nature and

WAR.

Plan of the Position of an Army in its Camp.

Plate DXVII.



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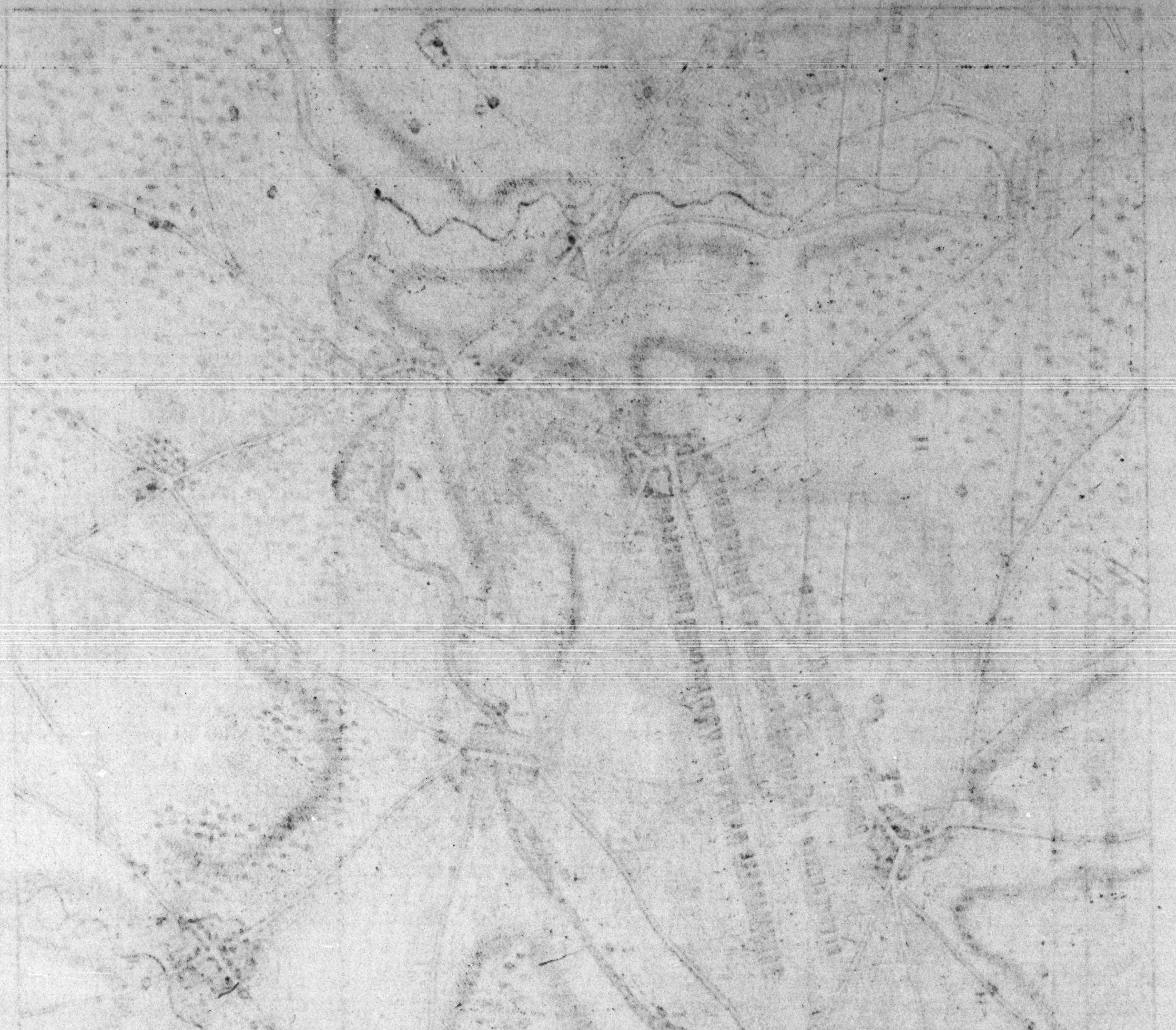

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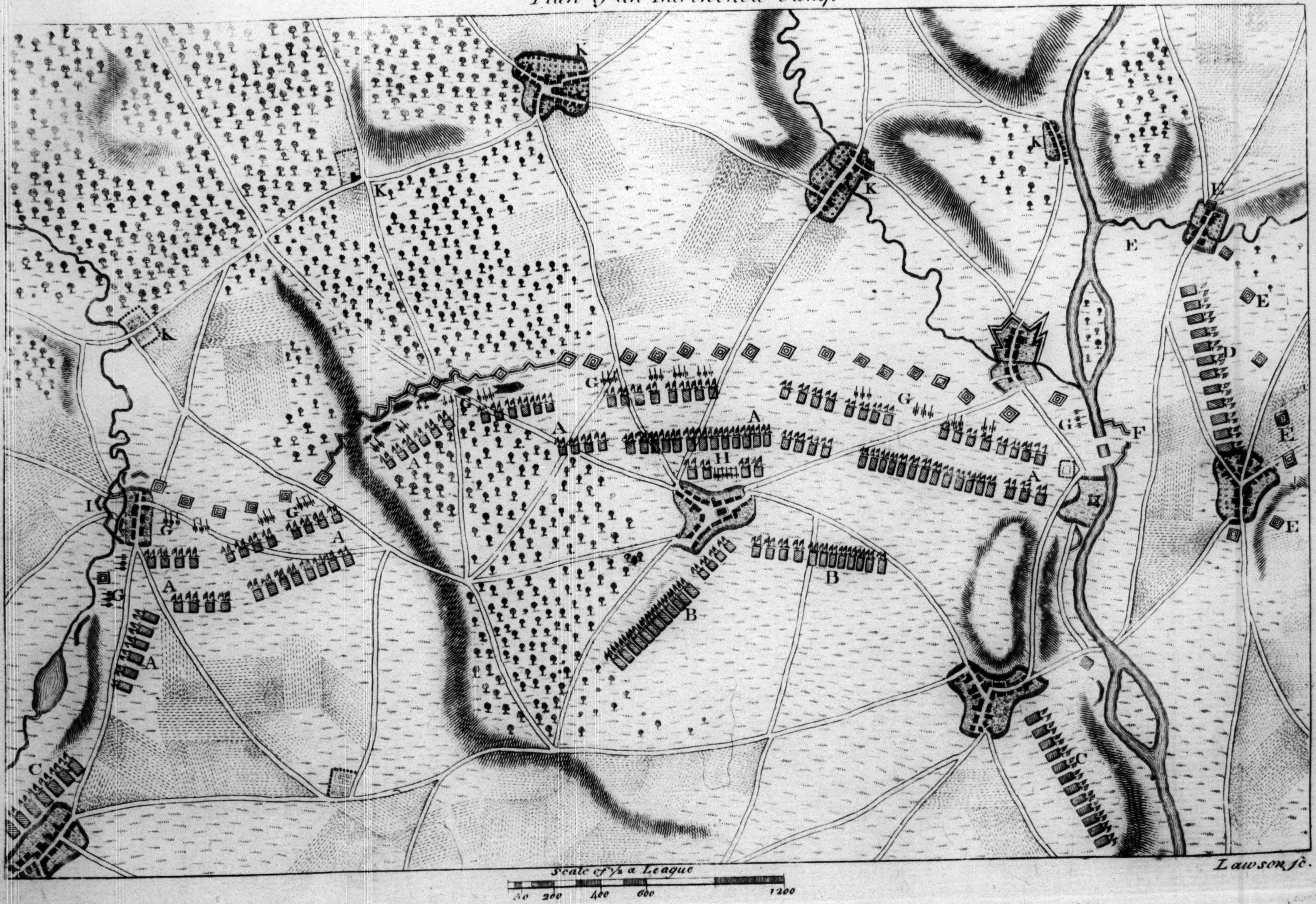
Plan of an Intrenched Camp

Plate DXVIII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number of the enemy by which it is liable to be attacked, yet the general ſhould never neglect, whatever his ſituation may be, to ſecure the head, centre, and rear. Before the convoy begins its march, the diſpoſition in caſe of an attack ſhould be ſettled; by which means the commanding officers of different corps will know where to poſt themſelves, and after what manner to act at the time the attack is made. By the knowledge which the commanding officer ought to have of the country, he will form a judgment of thoſe places where it is moſt probable he may be attacked, and of courſe make his diſpoſitions accordingly. In any diſpoſition that may happen, a general ſhould always foreſee in what manner the attack, defence, and retreat, will be conducted.

When a convoy marches through an open country, the advanced and rear guards ſhould conſiſt of cavalry ſuſtained by infantry; the infantry in the centre ſhould be continued on the right and left of the waggons, and the cavalry divided into troops ſhould be diſtributed on the flanks, at 100 or 150 paces from the infantry; ſquadrons of horſe, intermixed with platoons of infantry, ſhould be placed at proper diſtances on the flanks of the remaining part of the convoy. By this poſition, if the convoy ſhould be attacked in head, centre, or rear, theſe ſquadrons and platoons ſhould have orders to march immediately to the aſſiſtance of the party that is attacked.

The advanced detachments of huſſars, and thoſe upon the flanks, by giving notice that the enemy is at hand and coming to attack, will furniſh time for parking the waggons, and uniting the troops; in which caſe the infantry muſt form in the park, and the cavalry poſt itſelf on the flank of that front which expects to be attacked, and the huſſars place themſelves upon the flanks of the cavalry.

The attack of a convoy is always ſudden and rapid, and the ſucceſs of it is generally decided in the firſt onſet; and as the enemy, whether he ſucceeds in his attempt or not, muſt retire with great expedition, for fear of any ſuccour that may arrive, it is evident that it can be attacked only by cavalry, huſſars, or dragoons; there have indeed been ſome inſtances where the cavalry have brought infantry behind them. If the convoy has had time to park itſelf, the effort of the infantry can only be turned againſt that which it intrenched behind the waggons. The enemy's cavalry and that belonging to the eſcort attacking each other, will fight upon equal terms: but with regard to the infantry, it will be different; that which is ſheltered by the carriages having a great advantage over that which attacks it. On the contrary, if the enemy's infantry is ſuſtained by huſſars only, they will be briſkly attacked by the cavalry and huſſars belonging to the eſcort, who will take them in flank and rear. The enemy's huſſars being hemmed in, his infantry, for want of being ſuſtained, will be eaſily beaten: part of the cavalry and huſſars belonging to the eſcort ſhould be left in purſuit of the enemy's huſſars, and the remainder ought to take his infantry in flank. If the enemy is beaten, as it is probable he will, his retreat ſeems impracticable, or at beſt very difficult; becauſe, being deprived of his cavalry, he will be forced to make head againſt the infantry that attacks him in front, and to repulſe the cavalry that haraſſes him in flank.

If the enemy gives ground, the general ſhould be cautious of purſuing him too far, leſt, if he ſhould receive a reinforcement, the troops in purſuit of him, finding themſelves at too great a diſtance, will not only be beat, but alſo be deprived of every method of retreating.

There are ſome occaſions on which the enemy muſt not be purſued at all; ſuch as when the armies are very cloſe to each other, or the convoy draws near to ſome of the enemy's poſts; becauſe then, by the nearneſs of the army, the enemy's infantry can come to the attack without being under the neceſſity of mounting behind the cavalry. A general, to whoſe care a convoy is intruſted, ſhould never ſeek any other advantage than the conducting it in ſafety, even though he ſhould be ſure of beating and taking a detachment belonging to the enemy; a real advantage is often given up by endeavouring to follow an uncertain victory. There is leſs ſhame in being beat, when an officer hath done his utmoſt, and acted with propriety, than there is glory acquired in conquering when he hath exceeded the limits of his duty. An officer is no longer praiſe-worthy, than whilſt he acts up to the orders he hath received with exactneſs and diſcretion; whereas he who, depending too much on his own courage, raſhly ſuffers himſelf to be drawn on by the appearance of ſucceſs, is not only charged with, but ought to be anſwerable for, the conſequences.

There ſtill remains another diſpoſition to be made in an open country, whether the convoy marches on a cauſeway or in the high road, which is to divide the eſcort into many equal parts, with troops of every ſort belonging to each; the firſt body ſhould ſet out an hour before the convoy is to begin its march, the ſecond half an hour after, with orders to the commanding officers to ſcour the adjacent country with great exactneſs, and to be careful not to be cut off by any detachments the enemy may have in the country; for which reaſon theſe two bodies ſhould never be more than three quarters of a league diſtant from each other, by which means they will be within reach of aſſiſting each other. The body which ſets out laſt ſhould never be more than half a league before the advanced guard of the eſcort.

As the convoy is ſuppoſed to march through an open country, the above-mentioned diſtances are allotted between the firſt and ſecond bodies, and between the ſecond body and the advanced guard of the convoy; but if the country ſhould grow rough and unequal, theſe bodies ſhould draw cloſer together, and always keep ſight of each other, ſo as to be able to aſſiſt one another in caſe of an attack.

When theſe bodies are ſet out, the general muſt put the convoy in motion, and form the advanced guard of one of the divided detachments belonging to the eſcort; the infantry of which detachment will remain at the head of the waggons, the cavalry ſhall march by troops 300 paces in advance, and the rear-guard muſt be formed equal to the advanced; but beſides this rear-guard, there ſhould be a body of huſſars and dragoons reſerved, to march a quarter of a league or more, according to the nature of the country, in the rear of the convoy; the remainder of the infantry ſhall be diſtributed at proper diſtances on the ſides of the convoy, and the remainder of the cavalry ſhall be placed on the flanks of the convoy, about 300 paces diſtance.

When a convoy happens to be of ſuch importance that its being taken may influence the operations during the remainder of the campaign, the general ſhould not only aſſign a ſtronger or more numerous eſcort to it, but ſhould alſo ſend off detachments, which, without having orders to attack the enemy, ſhould keep between him and the road that the convoy keeps, in order to oppoſe and baffle any deſigns the enemy may have formed to carry it off. The following examples will ſhow both the ſecurity and neceſſity of this method.

During the campaign of 1746, marſhal Saxe, being encamped in the Orne, was in expectation of a conſiderable convoy from Judoigne. As its ſafe arrival in the camp was of great conſequence, he cauſed the marquis of d'Armentieres, then major-general, to ſet out with a large detachment in the night preceding the day on which the convoy was to begin its march, with orders to march on the ſide of Ramillies. At the ſame time he cauſed another detachment to ſet out from the camp of his ſerene highneſs the prince of Clermont, with orders to march on the ſide of the abbey of Rame: theſe two detachments, by amuſing the enemy on one ſide, and by entirely concealing the march of the convoy on the other, enabled it to proceed in ſecurity, and it arrived in the camp without having been at all moleſted.

In the beginning of the campaign in 1748, the ſame general having a deſign to lay ſiege to Maeſtricht, and conſequently having occaſion for all his troops, was willing to throw a ſupply of proviſions into Bergen-op-Zoom, as he was going to a diſtance from that place, and could no longer be in a ſituation of aſſiſting it. For that purpoſe he ordered a conſiderable convoy, which ſet out from Antwerp for that town under a good eſcort; but in order to prevent an attack, which circumſtance had often happened during the winter, and that with loſs, the allies at that time occupying a chain of quarters from Breda as far as Voude, he detached the count d'Eſtrees with a conſiderable body of cavalry to march on the ſide of Breda, with orders to puſh on detachments almoſt to Voude. This detachment had two objects in view; one of which was to keep the allies in ſuſpenſe with regard to the ſiege that was to be formed, and the other to cauſe them to remain near Breda. This large body of cavalry kept the allies, who were in the neighbourhood of that town, in ſuſpence; during which interval marſhal Saxe marched to Maeſtricht, the allies not daring to attack the convoy, becauſe they would have put themſelves between the eſcort and the troops under count d'Eſtrees. From theſe two examples may be concluded the neceſſity of covering convoys of importance by detachments, independent of the eſcort aſſigned them. In ſhort, a general ſhould do every thing that will contribute to the ſecurity of his diſpoſitions; and precautions ought never to be thought ſuperfluous when they are managed with prudence, and have for their end the ſucceſs of a well-concerted plan.

SECT. VIII. *Of Detachments for forming a chain of green Forage.*

It is very difficult to provide a large army with forage; and a general often expoſes it to inevitable danger, if he is not thoroughly experienced in this operation, or if he is deſtitute of that knowledge which at once preſents all the wants of an army, and the means of ſupplying them, to his view.

Foraging parties, like convoys, are attended with a greater or leſſer degree of danger, according as the country is more or leſs acceſſible, and the forage at a diſtance or near at hand. The diſpoſition for the chain in an open country is different from what it muſt be in a mountainous one. When forage is within reach of the camp, and the enemy at a diſtance, fewer troops and attendants are required; becauſe, in caſe of an attack, there is aſſiſtance near at hand: but in proportion as the forage is farther from the camp and nearer to the enemy, the precautions ſhould be increaſed, and more troops ſhould be allotted to the chain, which ſhould alſo ſometimes be furniſhed with cannon.

A general ſhould never forget that maxim which ſays, The enemy muſt always be oppoſed by troops of the ſame nature as thoſe with which he makes the attack; if the forage, therefore, is in an open country, the chain, as it is certain the enemy will be more numerous in cavalry than infantry, ſhould conſiſt chiefly of cavalry, and only have infantry ſufficient to occupy ſuch poſts as are neceſſary to be guarded: in a mountainous country the diſpoſitions will be quite different; becauſe as it is impoſſible for cavalry to move eaſily, the chain ſhould be ſtrongeſt in infantry. In ſhort, the number and quality of the troops for the chain ſhould be regulated in the ſame manner as in regard to the convoys; in proportion to the nearneſs or diſtance of the enemy; by the extent of ground to be foraged; and by the nature of the country: and as marſhal Puyſégur obſerves, before the ground to be foraged is examined, there ſhould be a calculation made of the number of horſes to be fed, and of the fertility of the ground that is to be foraged; for if it is a plentiful ſpot, a leſs extent will be ſufficient; if it is not plentiful, a larger muſt be taken; but in either caſe the chain muſt be always proportionable.

Before a forage is undertaken, the ground on which it is to be performed ſhould be always thoroughly known; in order for which the general ſhould ſend out in the evening, or the day before, the officer who is to command it, with a detachment, to ſurvey the ſituation of the country; the places where he muſt poſt his troops of cavalry and dragoons; the poſts which the infantry muſt occupy; the ground neceſſary for the forages; that where the corps of reſerve muſt be poſted; and what part in front of the chain it will be neceſſary for the huſſars to ſcour. After having examined all theſe particulars, the officer makes his report to the general, who, from the account given him, will order the troops neceſſary to ſecure the forage, and render the execution of it eaſy. The chain of forage ſhould be in proportion to the number of troops that are to forage, as well as to the quantity of ſown fields and the thickneſs of the grain. Beſides the horſe, dragoons, and infantry, there ſhould be huſſars to ſcour the country in the front of the chain: the number of them is undetermined, as it will be ſufficient for them to cover and protect the front, and give the commanding officer immediate notice of every thing that makes its appearance.

If the forage is to be made at a diſtance from the camp, the troops deſtined for the chain ſhould ſet out at day-break, or the evening of the foregoing night. The commanding officer muſt take care to eſtabliſh the chain before the foragers arrive, and alſo that the huſſars have ſcoured the country; firſt, becauſe the foragers ſhould not, by waiting, fatigue the horſes; and ſecondly, that no trooper or ſervant ſhall paſs; which will undoubtedly be the caſe if there is any vacancy where troops are not placed.

The whole of the troops ſhould be diſpoſed after ſuch a manner as to be able to ſee one another; and the vedets alſo, that are placed between the troops to prevent the foragers from paſſing, ſhould be within hearing. The infantry ſhould be poſted in hollows and villages and behind hedges, with horſe or dragoons to ſuſtain it and ſupport the flanks; and the diſpoſition of the chain will be ſtill better, if theſe troops can be mixed with it, provided the infantry can be ſheltered by any hollows, hedges, or buſhes.

Grenadiers, ſuſtained by horſe and cannon, if there are any, ſhould be poſted on thoſe ſides which, either from the ſituation of the country or the nearneſs of the enemy, are moſt liable to be attacked: but in reinforcing theſe poſts, the commanding officer muſt be careful not to weaken the chain too much in any particular part. When an enemy attacks a foraging party, he generally attempts to penetrate at different parts; but if he forms only one attack, the diſpoſition of the chain becomes uſeleſs, as all the troops muſt be brought to that part where the attack is made. But as it is naturally to be ſuppoſed the enemy will form many attacks, particularly if his general acts like a man underſtanding his buſineſs, he muſt be ſtrong in every part; the reſerve, which is in the centre, will, with expedition and ſpeed, ſend aſſiſtance to the parts which are attacked.

Before the commanding officer fixes the chain, he ſhould detach ſome huſſars to ſurvey and ſcour with great exactneſs the woods, villages, hollows, and all ſuch places, for at leaſt three quarters of a league or a league, in front, as may be capable of containing ambuſcades: and during the time of this ſurveying, the troops deſtined for the chain will remain in order of battle, in the front of the ground that is to be foraged, in order to cover it and protect the huſſars, in caſe they ſhould be attacked.

When this examination is finiſhed, the commanding officer may begin to eſtabliſh his chain, and the huſſars will remain in the front till the foraging is finiſhed; and will detach ſmall bodies to march round about the chain, croſſing each other, halting at times, and ſending ſome huſſars before them to patrole.

If the huſſars gain intelligence of the enemy's being either in march, or placed in ambuſcade, they will ſend immediate notice of it to the commanding officer of the chain, who ſhould always fix himſelf in a particular ſpot, that there may be no time ſpent in ſeeking him; his poſt ſhould be in the rear of that part of the chain that is neareſt to and moſt in front of the enemy, and he will regulate the diſpoſitions for his defence according to the report made to him. When an ambuſcade is diſcovered, and troops marching to attack, a general ſhould always ſuſpect there may be more ambuſcades, and more troops in march, to form different attacks; he muſt therefore, inſtead of weakening the chain in any part, ſtrengthen it as much as he can, by cauſing either the whole reſerve, or part of it, to march where circumſtances ſhall require.

The avenues and the heights in a mountainous country ſhould be occupied by infantry; the avenues, in order to prevent the enemy from penetrating into the valley or plain where the forage is made; the heights, in order to obſerve the enemy at a diſtance, and to prevent his getting poſſeſſion of them, and flanking the troops which guard the avenues. In this caſe there ſhould be a greater number of infantry than cavalry; no more of the latter being requiſite than what is neceſſary to ſuſtain and ſupport the infantry, in caſe it ſhould be attacked, repulſed, and obliged to retire through a valley or plain. Then, if it hath no cavalry to ſupport it, the wings will be entirely expoſed, and the enemy being ſuperior, can at the ſame time attack the front and the flanks; whereas, by the means of horſe, which can act with eaſe in a plain or a valley, this inconvenience will be prevented, and the infantry greatly aſſiſted.

If the forage is made at a diſtance from the camp, and in the neighbourhood of the enemy, the infantry guarding the avenues ſhould throw up ſome entrenchments in its front, which will be ſoon done; and it is then cannon becomes neceſſary, as there ſhould be two or three pieces planted at each avenue. The heights alſo muſt, on every occaſion, be occupied, which ſhould be conſtantly obſerved as a general rule, whether the enemy is at a diſtance or near at hand, in every diſpoſition that is to be executed in a mountainous country.

If the enemy forms one or more attacks, the ſmall eſcorts belonging to each regiment muſt join on the firſt order, and cover the foragers as much as poſſible, who ſhould at the ſame time aſſemble in the centre by regiments. The foragers ſhould always be provided with their carbine or ſword; and although they may not be very formidable againſt troops completely armed, yet there have been inſtances where they have charged with ſucceſs.

If it is in a plain, and the enemy, having formed but one attack, charges the chain in one particular part, the troops of horſe and dragoons which are oppoſite to him ſhould march up reſolutely and ſuſtain his efforts: if they are repulſed, they will be ſupported by the infantry that hath remained in its poſt; the huſſars which were in front will unite, and place themſelves upon the flanks of the troops which are attacked, in order to cover them, and endeavour to defeat the enemy by charging him in flank and rear. If the general is certain that the whole of the enemy's troops are engaged in this one attack, he may then bring up all the troops belonging to the chain, both cavalry and infantry, in order to oblige him to retire the ſooner: which if he does, ſome huſſars, ſuſtained by horſe and dragoons, ſhould be ſent in purſuit of him, till his retreat becomes certain; but with caution not to purſue too far, leſt he ſhould rally upon thoſe troops, who, being too far from the chain, cannot receive aſſiſtance ſo ſoon as would be neceſſary; and beſides, the making and accompliſhing the forage being the grand object, the commanding officer ſhould be contented with ſucceeding in that, without ſeeking for any other advantage unconnected with the original deſtination of the troops.

If the enemy forms more attacks than one, the foragers, who, as hath been already obſerved, muſt be aſſembled in the centre, ſhould have orders to take the road to the camp, and will re-enter it covered by the ſmall eſcorts from the rear-guard: but as a forage ſhould never be abandoned till the laſt extremity, they ſhould be ordered to draw up in order of battle, when they are within a quarter of a league of the camp, in order to return and complete the forage on the firſt order. But if the enemy is in force, and by his ſuperiority all hope of obtaining the forage is deſtroyed; or if it is made at ſo great a diſtance from the camp that the troops belonging to the chain cannot expect to be readily aſſiſted; the commanding officer ought to make a retreat, with every diſpoſition a good officer is capable of, and to join courage and vigilance with knowledge and experience.

If, on the contrary, the enemy is weaker, or of equal force with the chain, he ſhould be charged without heſitation; becauſe the enemy, regulating his attack by his defence, will be obliged to contract himſelf, in order to make his attack heavier and more conſiderable; ſo that the troops being united, will charge the enemy: and if, by the aſſiſtance of the huſſars who are advanced, and act after the manner already mentioned, the enemy is forced to retire, he muſt be purſued in the manner above directed; after which the troops muſt return and complete the forage.

As a commanding officer is, in caſe of a forced retreat after being beat, obliged to ſubmit to circumſtances, and regulate his diſpoſitions by the enemy's, he muſt retire with the greateſt order poſſible, cauſing the infantry to march in the centre, either in columns or in order of battle, as the ſituation of the ground will beſt allow; the horſe and dragoons upon the wings, the huſſars upon the flanks, that they may not confuſe the diſpoſitions, but ſerve as a ſupport for the chain, and prevent its being taken in flank; and the diſpoſition of the troops ſhould be ſo managed, that the enemy ſhall not be able to preſent a larger front than that which is oppoſed to him; and although it is impoſſible for a general to foreſee, for certain, what will be the diſpoſitions for an attack and retreat, becauſe they muſt be changed according as thoſe of the enemy alter, or as the nature of the ground varies; they ſhould nevertheleſs be ſo ordered, that each body ſhall be ſupported, and capable of acting without confuſion. It is only on occaſions thus preſſing, that the commanding officer ſhould ſuffer the forage to be abandoned; and even then it will be ſome ſatisfaction that he hath been able to place the foragers and their horſes in a ſtate of ſecurity.

If, during the retreat of the chain, it ſhould receive aſſiſtance from the army, it ſhould charge the enemy, notwithſtanding its being too late to go on with the foraging; and if this charge ſhould prove ſucceſsful in either beating or cauſing the enemy to retire, he ſhould be purſued without intermiſſion, in order to deprive him of all deſire for repeating the attack. In order to improve this advantage to the utmoſt, the commanding officer ſhould leave a large detachment, conſiſting of infantry, cavalry, dragoons, and huſſars, to continue all night upon the ſpot, and the next morning betimes, the foragers, properly eſcorted, will come to take away the forage; and as ſoon as the eſcort is arrived in the front of the chain, the detachment which hath remained there all night muſt return to the camp.

There ſtill remain many other precautions to be taken for the ſecurity of foraging parties, but the limits preſcribed to us will not admit of our ſtating them. We ſhall only add, that the foragers, in entering the ground they are to encompaſs, do not occupy more than is abſolutely requiſite, and that they do not ſpoil more grain than they carry away with them; firſt, becauſe by extending the chain it would be weakened, and become eaſier to be forced; and in the ſecond place, every prudent officer ſhould be an economiſt in the article of forage; the officers commanding the ſmall eſcorts which march at the head of each regiment ſhould be charged with the care of this. Theſe officers will cauſe their troops to march as much as poſſible through roads and over grounds which are untilled, till they arrive at the place intended to be foraged. If all the grounds are ſown, the commanding officer muſt cauſe the cavalry to diſmount at the place where the chain halts, and part of the troopers furniſhed with ſcythes muſt go and cut the grain, while the remainder hold the horſes; and when there ſhall be no farther room to fear damaging the forage, the cavalry will remount and take it up. Each place ſhould be marked out for a brigade or a regiment; which diſtribution ſhould be made by the ſtaff-officers before the troops arrive.

Sect. IX. *Of the Detachments for forming a Chain of dry Forage.*

If there is great exactneſs and knowledge required in the conducting of parties for green forage, thoſe for dry forage perhaps require more; and, in general, every thing that reguards foraging parties, whether green or dry, excites a particular attention in the commander in chief; and according to the chevalier Folard, all ſucceſs in war depends upon ſecrecy, diligence, activity, and the thorough knowledge of the country.

The diſpoſitions for forming a chain of dry forage, which differ from thoſe for forming one of green, will direct the means for extending the chain in proportion to its ſtrength, and at the ſame time place the foragers in ſecurity; although, in parties of dry forage, the foragers generally take up leſs ground, according to the diſtance of the villages that are to be foraged from each other.

The diſpoſitions for a chain of dry forage are alſo varied according to the nature of the country; but whether it be open or mountainous, each different body ſhould be placed in that part where it can act with the greateſt facility; the infantry therefore ſhould occupy the villages, and the cavalry the plain in front, and ſhould be diſpoſed after ſuch a manner as to be able to retire eaſily to the protection of the infantry. Before the foraging is put in execution, the commander in chief ſhould mark out the villages to the general officer who is to command the foraging party, and regulate their number by the quantity of troops that are to forage. The firſt diſpoſitions will be the ſame with thoſe mentioned in the foregoing ſection in relation to green forage: therefore the general who is to command the forage ought to ſet out with a detachment in order to examine the ground, the poſts neceſſary to be occupied, the villages which are to be foraged, their ſituation, the rivers which cover or run through them, the bridges to be guarded, the diſtance from one village to another, and with what degree of eaſe the communication with them may be ſecured. After having thoroughly examined into theſe particulars, he can with eaſe form a judgment of the number of troops that will be neceſſary to form the chain and ſecure the foragers; after having done this, he will order the bailiff or burgomaſter of every village to come to him, and inquire of them the number of huſbandmen, and how many ploughs each huſbandman hath belonging to him; by which he will be able to calculate the number of ſheafs reaped by each huſbandman.

The general may, for every plough, reckon about 30 acres of ground; and, in proportion to the fertility of the ground, every acre will produce from 120 to 160 ſheafs: by this method may be computed the number of ſheafs reaped by a huſbandman who had three or four ploughs; and from this calculation the general will judge whether the number of ſheafs, ſuppoſed to be in each village, will be ſufficient for the troops coming to them.

Let every acre of ground be ſuppoſed to yield 144 ſheafs; then a huſbandman who hath three ploughs will have reaped 12,960 ſheafs; ſo by reckoning 12 ſheafs to a truſs, and every truſs to weigh 600 pounds weight, this huſbandman will ſupply ſufficient for 124 truſſes. It is true, that ſome deduction ſhould be made from the number of truſſes that every acre may yield, as the huſbandman or farmer may have preſerved or conſumed ſome either for daily uſe or for ſeed.

It is very neceſſary that the general ſhould take care to leave ſufficient grain, not only to enable the huſbandman to live, but alſo to ſow his grounds; particularly if he foreſees a probability of the next campaign being carried on in the ſame country.

Nevertheleſs, as this manner of reckoning may be attended with inconveniences, becauſe there are ſome villages which keep up a particular trade of forage and grain, and therefore the granaries and barns may ſometimes be found empty, yet the quantity of ſheafs and grain remaining in the village may be calculated by the number of inhabitants to be ſubſiſted. Marſhal de Puyſégur's method, which conſiſts in informing himſelf of the number of horned cattle and horſes, and by deducting the time they graze, is a very good one; but ſtill there muſt be ſome deficiency in this calculation, as it will be impoſſible to fix with certainty the time of their grazing.

When the general ſhall have arrived at a tolerable certainty of the quantity of forage; the ground where to eſtabliſh his chain; the poſts which the infantry are to occupy; and taken a note of the quantity of forage; he will carry away one or two of the bailiffs or burgomaſters, as hoſtages for the ſecurity of the forage: he will alſo direct them to inform the inhabitants, that if they conceal or purloin but even a ſingle ſheaf from the whole, he will cauſe their village to be firſt pillaged, and afterwards ſet on fire; ſo that the peaſants, on whom theſe threats have often great effect, will ſcarcely give the enemy information of the intended forage. The general muſt leave ſome companies of infantry, ſuſtained by a detachment of huſſars in every village, who, by conſtantly patroling on the outſkirts, will ſtop all comers and goers; while the infantry will keep a ſtrict guard on the inſide of the village, and permit no perſon to go out of it; nor ſuffer the bells to be rung, colours to be hoiſted upon the ſteeple, or fires to be lighted; and will put a ſtop to every thing that may be ſuppoſed to be a ſignal agreed on with the enemy. When the general hath completed all theſe diſpoſitions, he will return and give an account of them to the commander in chief.

The ſame general ſhall, upon the day appointed for the forage, ſet out at day-break, with the troops deſtined for the chain, and the ſtaff-officers. As ſoon as he ſhall be got within ſight of the villages, he will not fail to have them examined, notwithſtanding he left troops in them the foregoing evening. When they are all examined, he will leave them in the rear, march on into the front, and draw up in order of battle; after that, he will form the chain, regulating the diſpoſitions of it by the ſituation of the ground, and of the villages examined over-night. The huſſars will advance three quarters of a league or a league, in order to ſcour the country; during which time the ſtaff-officers, inſtructed by the general of the quantity of ſheafs contained in each village, will, attended by the bailiffs or burgomaſters, make a diſtribution of the forage by regiment or brigade, and aſſign a barn to each, or one to two. When this diſtribution is made, the ſtaff-officers will make a report of it to the general commanding the party.

As all the villages marked out to be foraged are not in the ſame line, thoſe which are in the rear, and covered by others in which there is infantry, and by the chain of horſe and dragoons in the front, require but a ſmall number of troops; and if a detachment of infantry is poſted in them, it is more with a view of preventing the troopers and ſervants from marauding than any thing elſe.

The eſcort belonging to each regiment, commanded by a captain, ſhould remain upon the ſpot where the regiment forages, and, with the aſſiſtance of the infantry, prevent diſorder among the foragers, and ſend off thoſe who are loaded. As ſoon as a regiment is ſet off, the captain commanding the ſmall eſcort muſt report it to the general officer commanding the forage; after which he will follow, and form the rear-guard of it.

As ſoon as the general ſhall be appriſed by the ſtaff-officers, and the captains commanding the ſmall eſcorts, that a village is evacuated, he may contract his chain, and draw it nearer together, till the foragers are gone; which when they are, he will aſſemble his troops, and detach as many platoons of infantry as there are villages: or rather the body of infantry poſted in each village during the forage, ſhould leave a party to make a ſtrict ſearch after all ſtragglers and marauders; the firſt they ſhould keep with them, and make the others priſoners, and puniſh them ſeverely on their return to the camp. When all the different bodies ſhall be re-aſſembled, and the officers commanding them have made the report, the general will order the huſſars to be called in, and form a rear-guard according to the manner directed in the foregoing ſection, and return to the camp in the ſame order, and with the ſame diſpoſitions, as if he expected to be attacked.

PART II. Of the OPERATIONS of OFFENSIVE WAR.

JUSTICE and humanity having been conſidered, in this article, as the firſt principles of war, the chief intention of the firſt part hath therefore been, rather to convey maxims for a juſt defence, than to lay down rules for attacking. But though defenſive war be that alone to which religion and philoſophy give their ſanction, it does not follow that a nation is bound to wait patiently for the attack of its enemies. When the conduct of other nations is ſuch as evidently to ſhow that they meditate a war, the nation threatened may arm itſelf, and ſtrike the firſt blow when it can be ſtruck with advantage. There is only one precaution for avoiding the danger with which it is beſet. By obſerving the various operations of an offenſive war, it may indeed be often ſeen that the whole is nothing more than a ſeries of defence, and that the fear of being attacked is the real ſource whence theſe precautions for attacking ſpring.

SECT. I. *Of Spies.*

IT is impoſſible for a general, or even for an officer charged with the command of a detachment, to act with certainty if he have not ſpies or ſecret intelligence diſperſed about the enemy's army; for, without the information which they alone can give, he will have the mortification to ſee all his deſigns miſcarry, and all his precautions become uſeleſs, becauſe improperly taken.

No expence therefore ſhould be ſpared to procure intelligent ſpies; but care ſhould be taken that they are unacquainted with each other, and particularly that they are not known to any inferior officer: they ſhould be always ſpoken to alone, and never be ſuffered to meet each other. The general ſhould ſtudy their character, and prove them by repeated trials; he ſhould ſound them by degrees, beginning with things not difficult to be explained, and which if diſcovered, will not be of great conſequence; he ſhould engage them in long converſations, thereby to form a judgement of their parts and comprehenſion; and he ſhould alſo employ them often in bringing him intelligence.

Although a general ſhould always be upon his guard with a ſpy whom he hath cauſe to ſuſpect of treachery, he may nevertheleſs draw great advantage from him, provided he knows how to deceive him properly; becauſe he may be very certain he will inform the enemy of all the reſolutions which have been taken.

The emperor Leo, in his Tactic, adviſes a general, who hath reaſon to imagine his counſels are betrayed to the enemy, to conceal his real deſigns, by ſpeaking in a manner quite oppoſite to them: For, ſays he, in the maxims at the end of his book, an enemy muſt be deceived who receives intelligence from ſpies or deſerters directly contrary to what is actually reſolved upon. But, adds he, ſhould theſe ſpies be entruſted with the general's real intention, he ſhould, by ſome alteration in his operations, endeavour to perſuade the enemy that they have deceived him; upon which he will grow miſtruſtful of them, and be obliged to look out for others, no longer daring to confide in the former.

If a ſpy employed by the enemy is diſcovered, and brought to the general, he ought to take him in private, queſtion with mildneſs, ſpeak to him with a ſort of confidence, and, inſtead of threatening, ſhould promiſe him a reward if he will diſcover to him what he knows of the enemy's intentions. If the general finds him intelligent, he ſhould endeavour to engage him in his ſervice; and, provided he can gain him over by force of money, a thing not difficult, he may derive great advantage from him; but he ſhould be careful how he employs him, till he hath very good reaſon to be aſſured of his fidelity.

There are many different methods of trying the veracity of a ſpy: if, for example, the general receives information, that, on ſuch a day, a detachment of the enemy is to ſet out on ſome expedition, he ſhould then ſend out troops to double the number of thoſe detached by the enemy; by

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which means, if the ſpy's intelligence is true, the enemy will not only be baulked in his deſign, but may alſo be beat by the ſuperior detachment. If the enemy's detachment has but a trifling object in view, it will be ſufficient to ſend juſt troops ſufficient to examine into the truth of the ſpy's report. The general may alſo pretend to appoint a foraging within two days, and order but few troops for the chain; in which interval, if the ſpy is falſe, he will find an opportunity of giving the enemy notice of it: but inſtead of the few troops publicly ordered, the general will privately add another body to them, which will be placed in ambuſcade behind the place where the pretended forage is to be made. If the enemy, in conſequence of this information, ſhould come and attack the chain, it ſhould immediately retire, as if too inferior in number to continue the forage, toward the troops in ambuſcade; when, being joined, they will fall upon the enemy on all ſides. If this attack is made with vivacity and reſolution, there may be great reaſon to expect it will terminate in a complete victory.

If, on the contrary, the ſpy does not appear intelligent, or affects ſtupidity, the general ſhould puniſh him with death, and cauſe him to be hanged in the ſight of the whole army, in order to deter others, which may be diſperſed in the camp, by his fate. It would be needleſs to queſtion him concerning the enemy, becauſe it would appear inhuman to execute a man who had given intelligence of importance, whether extorted from him by fear, force, or perhaps a promiſe of pardon.

Spies are as neceſſary to a general as arms are to an army: but it is money only that can ſecure their fidelity; and if a general finds himſelf ill ſerved, it is becauſe he has been too ſparing of the funds intended by his ſovereign for that purpoſe. Notwithſtanding it is the duty of a good ſubject to manage his maſter's finances as much as it is in his power, yet there are intelligences of ſo great importance, that it is ſcarcely poſſible to pay ſufficiently for them. A man is ſufficiently indemnified when, by means of the intelligence he has received, he has concerted his meaſures in ſuch a manner as to beat the enemy, gain ſome marches over him, or to be beforehand with him in ſome enterpriſe.

Spies, when diſcovered, ſhould not always be puniſhed with death; great advantage may be made of them by pretending ignorance of their real quality, eſpecially if they are not ſufficiently diſguiſed. Tacitus, in his Annals, ſays, that Vitellius's party got information of Otho's deſigns by means of his ſpies, who, by endeavouring to dive too minutely into their enemy's ſecrets, did not ſufficiently conceal their own. Vigetius's method for diſcovering ſpies who are ſuſpected to be ranging about in a camp, is to order all the ſoldiers and ſervants into their tents during the day, and the ſpies will be taken immediately.

When a general is ignorant of the enemy's deſigns he ſhould always affect a knowledge of them; but whenever he is informed of them, he ſhould, on the contrary, pretend to be ignorant of them; by which means the enemy, being eaſy with regard to his ſpies, will not alter his deſigns, or ſuſpect the general of having any knowledge of them.

If the general can procure ſuch ſpies as, by their employment, are near the perſon of the enemy's general; as, for example, a ſecretary, or any others who are near him, and who conſequently can give intelligence more to be relied upon than thoſe who are conſtantly paſſing from one army to another; their ſervice may be turned to a very great account.

If a general diſcovers an enemy's ſpy to be one of thoſe who, by their employment, are near his perſon, he can receive great advantage, by forcing him to write a letter of falſe intelligence, thereby to divert the enemy's attention from the plan he would execute; but he ſhould cauſe him to be hanged immediately after, for it would be very imprudent to uſe him above once. The prince of Orange, when he came to attack M. Luxemburg at Steinkirk, having diſcovered one of his muſicians who gave the enemy intelligence of every thing he intended, made uſe of this ſtratagem; and although it was rendered abortive by the vigilance of M. de Luxemburg, and the courage of his troops, there are nevertheleſs but very few inſtances where it hath failed: and even M. de Luxemburg would have been beaten, if he had not had early notice given him by his advanced detachments; by which means he had time ſufficient to make his diſpoſitions, and to avoid being ſurpriſed.

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There is a ſtratagem which may be made uſe of when ſpies are wanting, and which is leſs expenſive; that is, to ſend ſuppoſititious letters by the firſt peaſant that comes in the way, who will have nothing to fear; and ſo far from concealing himſelf, he muſt take a road where he will be ſure of falling into the enemy's hands: theſe letters ſhould be directed to the general officers commanding a body of troops; or even to the general of the army, ſuppoſing they come from an advanced body. They ſhould contain ſchemes that are good, and practicable in their execution, but quite oppoſite to what is intended and will really be undertaken: it often happens that the enemy, too credulous, abandons his original deſigns to purſue chimerical ones, which to him appear very good, and do not preſent any obſtacle to thoſe which the general deſigns to execute. Prince Eugene ſucceeded, by this ſtratagem, in raiſing the ſiege of Coni, formed by the French in 1691.

But nevertheleſs a general ſhould take care that, through a fear of being deceived by ſuppoſititious letters, he does not himſelf too much neglect the intimations which are given him: a general ought, ſays Onozander, to liſten to every body at all times, and upon all occaſions. Alexander, when at a great diſtance from his own country, not being able to receive his couriers till very late, refuſed to give attention to a peaſant, who came to inform him of a ſhorter route; but ſoon repenting of what he had done, he ſent to ſeek after him, but in vain.

The ſame reaſon that ſhould make a general always have ſpies in the enemy's army, ſhould alſo make him ſuſpect that the enemy has ſome in his; therefore he ſhould endeavour to deceive them, he ſhould keep his intentions ſecret, mention them to very few, and always talk openly, contrary to what is really deſigned. Onozander obſerves, that it ſhows great folly in a general to mention his deſigns publicly, eſpecially when they are on the eve of execution; for deſerters generally go over to the enemy at the time an action is unavoidable.

But if it is diſcovered that the enemy has received information, Vigetius ſays, that the diſpoſitions muſt be immediately changed. Polybius, on like occaſions, particularly recommends ſilence and diſſimulation; he even ſtretches this rule as far as the thoughts themſelves, which he ſays muſt ſometimes be repreſſed, for fear our actions ſhould ſometimes betray and diſcover them. Metellus anſwered one of his friends, who, on an important occaſion, aſked him the reaſon of certain diſpoſitions, "that if his ſhirt knew what he thought, he would burn it."

To avoid the danger of treachery, ſealed orders have been uſed with great ſucceſs, which have been ſent to officers, with expreſs orders not to open them till at ſuch a time and at ſuch a place: this is an eſtabliſhed rule at ſea, and can alſo be practiſed on ſhore when employed in an expedition which it is eſſential to conceal from the enemy.

SECT. II. *Of Ambuſcades from the Army.*

A GENERAL who loſes a battle, ſays Vigetius, may attribute his ill luck to fortune, although theſe kinds of events are generally the effects of art and ſkill; but he who ſuffers himſelf to be ſurpriſed, and who falls into the ſnares laid for him by the enemy, has no excuſe to make, becauſe, by his vigilance, and the goodneſs of his ſpies, he might have avoided them.

A deſign ſhould never be formed for an attack upon marches, detachments, convoys, forages, or upon one or many quarters, without knowing the ways which are to be paſſed, and the places where ambuſcades may be formed; whether to avoid, or whether to conceal troops in them, in order to facilitate a retreat, or to draw the enemy into it. A general who receives information from his ſpies that ſome enterpriſes are intended upon ſome bodies detached from the army, upon one of his convoys, on a forage, or upon his quarters, ought alſo, on his ſide, to form ambuſcades in the ways leading to it. The number of troops in ambuſcade ought to be regulated by that of the detachment intended to be ſurpriſed; it ſhould be ſufficiently ſtrong to attack the enemy on all ſides, that is, in head, flank, and rear. The troops who ſet out to form an ambuſcade ſhould always march by night, unleſs it be in a country ſo covered that the enemy cannot perceive them.

A general, according to Santa Cruz, ſhould endeavour to form as many ambuſcades as poſſible; ſo that if the enemy ſhould not fall into one, he may not eſcape the others: they ought to be diſpoſed after ſuch a manner, that one can neither attack nor be attacked without being heard, ſuſtained, and aſſiſted by the others: this junction is a ſtratagem which the enemy could not expect, and which will aſſure the victory. If, from the fewneſs of the troops, or the fatigues of the campaign, it is impoſſible to form many, there ſhould at leaſt be one ſufficiently ſtrong to reſiſt the enemy it would attack: but ſtill it is not requiſite that it ſhould be as numerous as the enemy, becauſe troops in ambuſcade, who charge a detachment that is unprovided on all ſides, ought, by this ſurpriſe, to have a particular advantage, and conſequently ſupply the place of number; which will certainly be the caſe, particularly if the enemy falls into the ambuſcade during the night, and that care hath been alſo taken to place a great number of drums and trumpets, that when the troops of ambuſh charge, they may ſerve to increaſe the numbers in appearance, by the terror which noiſe always raiſes in the night time.

In order to deceive the enemy who is in detachment, ſmall bodies ſhould be ſent out towards him, with orders to retire to the troops in ambuſcade as ſoon as they meet him.

Ambuſcades ſhould always have ſome object. Before they are undertaken, it ſhould be known whether the enemy is in the field; if he intends either to attack or moleſt the quarters; whether it is proper to wait for him or to ſeek him: without theſe precautions the troops will be fatigued, and no end anſwered.

Ambuſcades may be compoſed of infantry, huſſars, or dragoons; but it is the ſituation of the country that muſt determine which. Theſe troops may be mixed together or ſent ſeparately; but that muſt be according to the deſign intended to be executed, or according to the nature of the troops employed by the enemy in his detachments.

If the deſign is to attack a convoy, all theſe troops are neceſſary, becauſe the eſcort of it will undoubtedly conſiſt of infantry, cavalry, or dragoons, and alſo ſome huſſars to clear the march; if a green forage, infantry is very neceſſary, but it ſhould always be left in the rear to ſecure the retreat: cavalry, with huſſars or dragoons, is ſufficient to attack a forage, to beat the eſcort of it, or at leaſt to prevent the foraging being executed. If a dry forage is to be attacked, it muſt be done with infantry, becauſe, as it can only be performed in the villages, it is certain they will be occupied by infantry, and that there will be a chain of cavalry in the front, which will be protected by it: if a detachment, it is according to the nature of the country through which it marches; if an open country, horſe, huſſars, or dragoons, muſt be employed: but in a woody or mountainous country, infantry muſt be made uſe of. After all that can be ſaid, it is impoſſible to lay down fixed rules for the kind of troops which ſhould be employed: there are ſome woody countries where huſſars and dragoons can act with eaſe, and be of great ſervice: there are mountains where they can act ſecurely, becauſe very fine plains, divided by woods, are to be found in the bodies of them, where they can place themſelves in ambuſcade; but care muſt be taken to ſecure their retreat. There are, on the other hand, plains ſo divided by hollows and canals, that infantry only are capable of acting; therefore it is the general's buſineſs to diſcover from which kind of troops, in either country, he may expect the greateſt advantage.

There is no country but preſents ſome place proper for forming ambuſcades; hollows from which it is eaſy to ſally, the leaſt height, woods, hedges, ruins, vineyards, ſometimes corn-fields, marſhes covered with reeds, all preſent expedients to a general who knows how to take advantage of them: he muſt only be careful to place the ambuſcades after ſuch a manner that they ſhall not be diſcovered by the enemy's parties; and that they are not themſelves diſcovered by the inattention of any of the ſoldiers, by noiſe, or by other accidents.

If the ambuſcade conſiſts of huſſars or dragoons, the horſes muſt not be together; their neighings may prove very prejudicial. Even a peaſant, attracted by the barking of a dog or the neighing of a horſe, may go into a wood, diſcover an ambuſcade, and, often induced by the hope of a reward, will go and give the enemy information of the whole. Every perſon paſſing near an ambuſcade ſhould be ſtopped, and that without noiſe; the peaſants ſhould be tied to trees, and guarded by ſentries. If the ambuſcade is formed in an hollow-way, behind an high ground, or in any places whatever, the general muſt cauſe every body that is taken to be tied together, and well guarded.

The troops in ambuſcade muſt fall on all parties of the enemy that paſs near them, unleſs when the deſign is to carry off a convoy or to attack a large detachment. It ſhould in that caſe continue ſilent, and let them paſs: but if theſe parties, by making a ſtrict examination, diſcover the ambuſcade, as there can no longer remain any hope of attacking the convoy or detachment, it ſhould fall upon and endeavour to ſurround them, and, if poſſible, take them priſoners; and if the troops in ambuſcade are ſo lucky as not to let any of the enemy eſcape, the ambuſcade may remain in its firſt ſituation, but always purſue its firſt object, becauſe here will be no reaſon to apprehend the enemy's having received intelligence of it.

The troops in ambuſcade ſhould attack theſe parties ſword in hand, and not with their fire arms, and, if poſſible, prevent them from uſing theirs. From this manner of attacking, there will reſult two conſiderable advantages. The firſt is, that a briſk and unexpected attack aſtoniſhes, and ſcarcely gives them time to think of their defence. The ſecond is, that, by firing, it is to be feared, that if there are any other parties farther off they will hear it, and ſend and give notice. In that caſe, the ambuſcade muſt change ſituation,

ation, and place itſelf in ſome other part, but not abandon its original project till the laſt extremity, and till there is no longer any hope of ſucceeding otherwiſe.

The leaſt thing, as has already been ſaid, may be the occaſion of an ambuſcade's being diſcovered. The fire of a pipe may be ſeen at a great diſtance in the night-time: beſides, however ſmall the number of ſoldiers who ſmoke may be, the wind may carry the ſmoke and the ſmell of the tobacco toward that part where the enemy patroles. The ambuſcade ſhould not be cumbered with ſervants, or any thing elſe that is unneceſſary; orders ſhould be given that the horſes are tied with care, and that a profound ſilence is obſerved by every body. As it is very difficult for huſſars or dragoons to march without leaving marks behind them, by which means the road leading to the ambuſcade may be diſcovered, they ſhould try to enter it by ſome bye-way, or at leaſt by as dry a one as poſſible. In order to efface the marks of the horſes feet, eight or ten huſſars or dragoons may tie branches of trees to their horſes tails, and, by marching behind the detachment, in as large a front as the whole body, will deſtroy any marks that are made: as ſoon as they ſhall have entered the wood, they will cloſe up the entrance with the ſame branches, of which they will make a ſort of hedge.

If the detachment intended to form an ambuſcade, whether infantry or cavalry, is obliged to march upon a high-way, as ſoon as it comes near the place appointed, the commanding officer ſhould detach a body on before, with orders to take up the ſame front as the whole detachment. As ſoon as it ſhall have proceeded a quarter or half a league, it will return by another way; and it ſhould alſo make a large circuit, ſo that the enemy's parties, coming the ſame way, will not perceive that they ſhall be ſtopped by any troops in that place. This body will rejoin the troops which are in ambuſcade, by a road the moſt out of the enemy's view, never in a body, but ſcattered, ſo that they may leave fewer marks behind them. Sentries ſhould be concealed behind buſhes, in the front of the ambuſcade, ſo that they may be able to ſee the country and ways about them, without being ſeen themſelves: two or three ſoldiers ſhould alſo be made to climb into trees, in order to ſee at a great diſtance, and give notice if they perceive any troops; the ſame method muſt be obſerved with regard to huſſars or dragoons.

Before the commanding officer enters the wood where he would form his ambuſcade, he ſhould detach two or three patroles to ſcour it, for fear the enemy ſhould happen to be there in ambuſcade himſelf; after every part has been ſearched, the troops muſt enter the wood, and range themſelves according to the order that ſhall have been given them. The commanding officer will form three bodies of his detachment, and place them at a diſtance one from another; one will be deſtined to attack the advanced guard, the other the centre, and the laſt the rear-guard. If the detachment conſiſts of cavalry, the half of each corps ſhould be on horſeback; no perſons ſhould ſlip or paſs the ſentries or vedettes under pain of being declared deſerters. During the night, the cavalry ſhould be mounted, and the infantry under arms: in the day-time, half thoſe on foot will relieve thoſe on horſeback every three hours; and the ſame ſhould be done with the vedettes, as well as the infantry and ſentries.

If the ambuſcade is behind an height or ſmall mountain, ſentries muſt be placed on the top, lying on their bellies, and without hats; in other reſpects the ſame diſpoſitions ought to be obſerved, whether on the march or for the conducting of ambuſcades, always paying a proper regard to circumſtances and the ſituation of the country.

There are divers methods of drawing the enemy into ambuſcades. The general commanding the army or quarters ſends out a detachment under the command of an intelligent officer, to form an ambuſcade, at the diſtance of one or two leagues, more or leſs, according as the country is fitting for thoſe ſorts of diſpoſitions, or according to the diſtance of the enemy. The general muſt acquaint this officer, that two hours after he is ſet out, he will ſend out another detachment, of leſs force, with orders to go on the ſide where the enemy is, to endeavour to meet him, and at firſt ſight to make a feint of charging him; but, as if finding him too ſtrong, he will begin his retreat, directing it toward the place where the troops are in ambuſcade: furniſhed with theſe inſtructions he will ſet out.

Then the general will ſend for the officer intended to command the detachment that is to go in ſearch of the enemy, and inform him of that which is ſet out to form the ambuſcade, and of the place where it is; he will order him to advance as near to the enemy as he can, and to draw him by a feigned retreat upon the troops in ambuſcade.

Theſe two officers ſhould be the only perſons informed of the deſign: but nevertheleſs the commandant of the detachment which is to go towards the enemy, may communicate it to the principal officers under his command; ſo that in caſe he ſhould be taken or killed in the retreat, he that ſucceeds in the command may be able to act according to the general's intentions. He muſt be particularly careful, that no ſoldier, trooper, huſſar, or dragoon, penetrate into the deſign of the detachment, as it would then be in the power of a ſingle deſerter to make the ambuſcade miſcarry. The detachment which is to go and ſeek the enemy, in order to draw him into the ambuſcade, ought to be compoſed of huſſars, unleſs the country be of ſuch a nature that infantry only is capable of acting.

During the time that the huſſars are gone before, endeavouring to draw on the enemy, the troops in ambuſh will be on horſeback, and waiting in ſilence for their commander's order to go out and charge. As ſoon as they ſhall have charged and beaten the enemy, for fear leſt another detachment, at a little diſtance from that which has been beaten, ſhould come to its aſſiſtance, they will take the ſhorteſt way, and march leiſurely, but with order, towards the camp or the quarters. The detachment which drew the enemy into the ambuſcade, muſt form the rear-guard of it, and will march ſlowly on, while the reſt of the troops will retreat, conducting the priſoners with them. If the enemy ſends any ſuccours, as ſoon as the rear-guard perceives them, it will double its pace, but with order; there will be no reaſon to apprehend the enemy's coming too briſkly upon it, becauſe he will be fearful of falling into another ambuſcade: thus the rear-guard will retreat with eaſe, and the troops who conduct the priſoners have time enough to reach the camp, without any moleſtation.

It is on theſe occaſions that a man ſhould know how to keep his courage within proper bounds, and be ſenſible that flight is glorious: the deſpair of an enemy that is ſurpriſed, and even beaten, is always to be feared, when he is not entirely defeated. A man ſhould always be content with one victory, without attempting a ſecond: he may, by purſuing the enemy too eagerly, fall himſelf into ambuſcades more dangerous than that he has juſt drawn the enemy into.

If there is reaſon to apprehend that the enemy, having notice from ſome deſerters, are coming in full ſtrength, the ambuſcade muſt then change its ſituation and draw nearer to the place from whence it ſet out. This will ſerve two purpoſes; for ſhould the enemy appear in force, the ambuſcade will have the ſhorter way to retreat; or it may again happen that

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that the enemy, not finding the ambuſcade in the places pointed out by the deſerters, will imagine it to be retired, and, in that belief, will neglect the precautions neceſſary in ſuch a ſituation.

An ambuſcade that is ſucceſsful may cauſe the deſtruction of a whole army. The example cited by M. de Feuquieres, in his Memoirs, on that head, is ſtriking. M. de Luxemburg, ſtill attached to the prince, took all the baggage belonging to M. Turenne's army, becauſe the lieutenant-general who commanded the eſcort did not foreſee that the enemy, ſhut up in his lines of circumvallation before Arras, having two armies near his camp with a deſign of attacking him in his lines, could think of ſending out a large detachment of cavalry on an enterpriſe of ſuch a ſort. In the mean time M. Luxemburg, who was in ambuſcade, within reach of the column of baggage, ſeeing that the lieutenant-general was gone on before with the head of the eſcort, imagining the baggage in ſecurity, marched ſpeedily to the head of that column, whoſe march he ſtopped, and turned toward St Pol, where he conducted the whole baggage belonging to M. Turenne's army, without his knowing any thing of the matter. It is thus that, by the negligence of an officer, and by an ambuſcade ſeaſonably placed, an army finds itſelf ſtripped of all its baggage, and, as may be ſaid, not in a condition of continuing the campaign.

If this lieutenant-general had been provided with ſpies, detachments in front and on the flanks, theſe detachments would have diſcovered the ambuſcades, and, by the precautions uſual on ſuch occaſions, he would have placed the baggage of the army in ſafety. Again, his ſpies would have given him notice, that a large body of cavalry was detached from the camp before Arras, conſequently he would have been upon his guard; inſtead of which, being full of a falſe confidence, he marched as if in a champaign country, and, by this unpardonable remiſſneſs, occaſioned the loſs of the whole baggage. An officer who commands a detachment for any expedition whatever, cannot poſſibly take too much care to foreſee the checks that may happen to him; if he is beaten, it ſhould be wholly owing to a ſuperiority of force. He who, after having taken all the precautions poſſible, is beaten by an enemy who has the advantage of number, has nothing to reproach himſelf with: but he who, with ability, has nevertheleſs neglected certain precautions, and is beat becauſe they were not taken, is certainly culpable in the eyes of intelligent men.

Sect. III. *Of Camps in offenſive War.*

To take an advantageous poſition for an army; to make choice of a ſpot that by its ſituation is ſtrongly ſecured; to eſtabliſh a camp there, and to be alſo able to have the army within diſtance of marching eaſily to the enemy, without fear of being moleſted; in ſhort, to throw ſuch difficulties in the enemy's way as may prevent his haraſſing the army, is one of the moſt eſſential branches of knowledge for a general. He who is endowed with this talent can, with an inferior army, not only make head againſt the enemy, but alſo cauſe his deſigns to miſcarry; fatigue him the whole campaign by marches and counter-marches, which lead to nothing; oblige him to remain inactive, and at length draw him into a favourable poſition, where he will be morally ſure of beating him. All this was done by M. Turenne in 1675, who, after having exhauſted every expedient wherewith his military knowledge could furniſh him to draw M. de Montecuculi into a diſadvantageous poſt, at length ſucceeded, found an opportunity of attacking him, and glorioully fell at the inſtant victory declared itſelf in his favour.

Offenſive Operations.

Before a general takes the field, he ought to be very certain what number of troops he ſhall have, that his magazines both of war and proviſions are ready, as well as the waggons, pontoons, and all other implements whatever that are neceſſary for an army; for events may happen that it is almoſt impoſſible to foreſee, and which often alter the beſt concerted deſigns. But when every thing is in order, a general poſſeſſed of the neceſſary talents can foreſee the event even before taking the field: he will know beforehand the marches he is to make, the camps he is to occupy, and thoſe which the enemy will endeavour to ſeize in order to oppoſe his deſigns.

An offenſive war is undoubtedly carried on with greater eaſe in an open than in a mountainous country. But whether in the one or in the other, no ſuperiority of number ſhould make a general neglectful of the ſafety of his troops in their camp; he ſhould always be aſſiduous in preſerving the ſtricteſt order and diſcipline among them; one or two checks are generally ſufficient to diſcourage the ſoldier, and take away that confidence which he ought to have in his general: the advanced poſts ſhould be well guarded, the flanks ſecured, and detachments frequently ſent out towards the enemy; for as ſucceſs is inſured by vigilance and care, ſo negligence and ſlack diſcipline are ruin to the moſt formidable army, and entertaining a contemptible opinion of an enemy renders him more daring.

It is to be obſerved, that a camp ought never to be fixed on the banks of rivers; but a ſufficient ſpace ſhould always be left between them and the camp, to draw out the army in order of battle. If this precaution is not taken, it may happen that the enemy, encamped either near to, or at a diſtance from the other ſide of the river, being informed of the poſition of the army, will come in the night to alarm the camp, and by a diſcharge of artillery and ſmall arms throw the whole camp into confuſion, without riſking the loſs of a ſingle man. For this reaſon a camp ſhould always be placed at leaſt eight or ten hundred yards from a river; ſo that the guards may be advanced without being expoſed, and within the circumference of the camp and compaſs of the guards the army may be ſupplied with forage for at leaſt four days, and more if poſſible.

There are ſome ſituations for a camp which are in appearance ſtrong, but may notwithſtanding prove very dangerous, if care be not taken to examine whether or not the army can with eaſe come out of it, to form itſelf in order of battle; or whether the enemy can prevent it, by blocking up the avenues and outlets. If this precaution be not taken; an army may be the means of ſhutting itſelf up; as was done at Seneff in 1674, and by the allies at Aſchaffenbourg in 1743.

The choice and ſtrength of a camp depend on the poſition of the enemy and ſituation of the country: a general ſhould always avoid encamping the cavalry in a wood, and ſhould be particularly careful that the wings are ſheltered; the woods ſhould be occupied by the infantry, and entrenchments thrown up in front, according to the deſigns intended to be put in execution. If the wings are ſheltered by a village, it ſhould be entrenched, and infantry poſted in it; and the camp ſhould be covered by a river as much as poſſible, unleſs the intention is to march towards the enemy; then all the obſtacles that can prevent the army coming up with him ſhould be avoided: but if, from ſome ſucceſſes of the enemy, or from his ſuperiority of troops, the general cannot determine upon opening the campaign offenſively, he muſt uſe other means to bring it about; and in the mean time ſhould ſtrengthen himſelf in his camp, eſtabliſh poſts on the banks of the river, and cover them by continual detachments of light horſe; who, by extending themſelves, will prevent parties of the enemy from paſſing to ſeize on the hind parts of the camp, moleſt the convoys, and attack the foragers.

Whatever may be the nature of the country, it is often neceſſary to have corps detached from the body of the army, to cover or keep open a communication with ſome place, in order to prevent the enemy from foraging too near the camp; to preſerve the forage; to raiſe contributions at a diſtance; to occupy ſome advantageous poſt; to oblige the enemy to divide his forces in order to oppoſe that body; to cover the camp either in the front or on the flanks, according to that ſide which is left moſt unguarded and expoſed: in a word, there ſhould always be continual detachments toward the enemy, as hath been the practice of many generals, and particularly of marſhal Saxe. The ſtrength of this body is to be proportioned to the uſe deſigned for it by the general; but it is uſually compoſed of light horſe, ſome regiments of light infantry, and a brigade or two of dragoons. In the end will be ſeen what uſe ſhould be made of this body; but in whatever ſituation it is to be placed, the communication between it and the army muſt always be kept open, that it may at any time be able to join it on the firſt order; and its camp muſt be ſo choſen, that the general may always receive intelligence from it of the leaſt movements made by the enemy. See Plate DXVII.

In every country, and on every occaſion, a camp is always defective if the wings are not ſheltered, or can be eaſily diſtreſſed by the enemy; if the front is not guarded and the rear well covered; if the communications with the frontier towns are not ſecure and eaſy; if there is any want of forage, wood, and water; and if there are not detachments in front, to prevent the enemy from approaching the camp.

A general who joins experience and ſtudy together, ought to ſee into the intention of the enemy's general, and judge of his deſigns by any of his proceedings, however trifling. All thoſe who are deſtined to the command of armies cannot indeed be endowed with this quick and exact eye, that ready power of judging of a good motion or a good poſition upon the ſpot. Some generals have excelled in marches, others in the poſition of camps; theſe in the arrangement of troops in order of battle, thoſe in their conduct in time of action; others in providing ſubſiſtence, others in projecting a campaign. There have nevertheleſs been ſome of theſe great men, whoſe genius and temper have united and carried all theſe qualifications to the greateſt degree of perfection; but the rarer theſe examples are, the more a man ought, by continual ſtudy, to endeavour to augment their number, and ſtrive to merit the honour of being enrolled among thoſe heroes, the ornament of mankind, their country's ſupport, and their maſter's glory.

SECT. IV. *Of the Attack of an Army on its March.*

HOWEVER difficult certain operations in war may appear, they are nevertheleſs not impracticable when a general knows how to take the neceſſary precautions for leſſening thoſe difficulties. The attack of an army on its march ſeems to be above all reach of attempting; whereas the ſucceſs of ſuch an attempt depends only upon knowing how to take proper meaſures, on chooſing the ground, and on ſeizing a favourable opportunity.

When an army would attack another upon its march, it ſhould endeavour to be beforehand with it, and by the means of ſtolen marches, come up with it before it can know any thing of the matter: ſome parties ſhould be detached, who muſt place themſelves in ambuſcade, in order to ſtop all the comers and goers, ſo that the march and deſigns of the army may be kept ſecret from the enemy. Whenever a general hath determined to attack his enemy, he ſhould ſend off all the baggage, both great and ſmall, belonging to the army; and it ſhould be left in the rear under a good eſcort, near enough to join after victory, without the army's being obliged to wait three or four days for it.

The general ſhould be well aſſured of the day on which the enemy's army ſets out; or the country through which it is to march; whether it is an open, mountainous, or woody country; if it is divided by rivers; whether there are many bridges to paſs; and in how many columns it marches: he ſhould alſo get all poſſible information of the diſpoſition of it. In the third ſection of the firſt part, relative to the march of an army in an open country, the diſpoſition which it ought to make, in caſe it preſents its front or flank to the enemy, hath been laid down. The general deſigning to attack ought to regulate his diſpoſitions by thoſe which the enemy hath taken, and which he can only know from his ſpies; but if he cannot receive any information concerning them, the beſt rule for him is to ſuppoſe them good, and to form his own accordingly.

As in the caſe of a ſurpriſe there cannot be ſignals given, without running the riſk of the enemy's diſcovering that he is going to be attacked; it is therefore neceſſary, that every general officer leading columns ſhould have a watch, regulated by the general's, ſo as to march all at the ſame time, at the hour agreed on and ordered. The ancients, deſtitute of watches, regulated their motions by the courſe of the ſtars; and it is, without doubt, on that account that Polybius, Onozander, Ælian, and many others, exhorted military men to the ſtudy of aſtronomy: but as it is not often that an army marches by night, this knowledge would be very uſeleſs for an attack in the day time; beſides, the ſun, by which they were alſo regulated, could be no way ſerviceable to them, ſhould the ſky be overcaſt.

If the general's intention is to attack the enemy's army in front, he muſt detach all his light troops, ſuſtained by a large body of cavalry and ſome battalions, with orders to haraſs the flanks, in order to perplex the enemy with regard to the real attack. It is impoſſible to give the enemy too many falſe alarms with regard to what is really deſigned: the huſſars, from their readineſs in retreating and their quickneſs in paſſing from one ſpot to another, are the fitteſt troops for theſe ſorts of expeditions. The ſame rule ought to be obſerved if the real attack is deſigned to be upon the flank; then the falſe attacks ſhould be upon the front. In Santa Cruz may be ſeen the diſpoſitions which he has made to attack an army on its march.

Stratagem, and the means of ſurpriſing an army, are allowable in war, provided treachery is avoided. Whilſt the law of nations is not infringed, ſucceſsful ſtratagems add luſtre to the genius of the general; but there is no profeſſion in which rectitude of mind is more neceſſary than in that of war.

In order to carry on a ſurpriſe by ſtratagem, one of the moſt certain methods is, to calculate what time is neceſſary for the army to arrive at day-break near the road by which the enemy is to paſs, ſo as to be able to examine the country, and make the neceſſary diſpoſitions for the attack. In an open country the army may be concealed behind corn, or behind a riſing ground. Prince Eugene, in 1702, after the battle of Croſtolo, having gained ſome days march of the king of Spain, poſted himſelf between the Zero and the Po. He ſo well concealed his army behind the bank of the Zero, that the combined army of France and Spain, which was on its march, and ready to enter into its camp, was obliged to range itſelf in order of battle, and to fight, without having ſcarcely time to make any diſpoſition.

A woody country offers more expedients for the concealing of troops: but as it is to be ſuppoſed the enemy's advanced guard will be advanced at leaſt a half or three quarters of a league, to ſcour the country; therefore, if the general's deſign is to attack the enemy's flank, he muſt preſent ſome cavalry and huſſars in the front of the enemy's army, ſo as to engage his attention. Some infantry ſhould be placed in the woods, in the rear of theſe troops, in order to ſuſtain them: this calvary and the huſſars ſhould retire in proportion as the advanced guard advances, in order to induce the enemy to believe they are not ſufficiently ſtrong, and that the reaſon of their advancing was only to examine the march of the army. As ſoon as the enemy ſhall have reached the place agreed on by the generals leading columns that are to attack, the body of infantry that is in ambuſcade in the wood, the number of whoſe columns ſhould be regulated according to the ſituation of the country, will march ſilently, and near enough to the enemy, and will charge him with bayonets, without giving him time to recover himſelf: during this attack the cavalry, dragoons, and huſſars, who keep the enemy's front in awe, will charge the troops who have paſſed the wood and ſpread themſelves over the plain. Theſe troops of cavalry muſt be ſuſtained by the infantry which was in their rear in the wood, and which ſhould be furniſhed with cannon. Theſe two attacks, made one after the other, but at ſome ſmall diſtance of time, will render the enemy doubtful with regard to the diſpoſitions he is to make; he will be undetermined where to ſend aſſiſtance, as the cannon which he will hear at the head will induce him to believe that attack the real one: he will fly to that part, and will conſequently weaken the flank, which is deſigned to be attacked by all the infantry. By this diverſion the flank will with greater eaſe be broken through, and the enemy taken in rear: the enemy thus ſurrounded, and finding himſelf between two fires, cannot avoid being beaten.

It is more difficult to form ambuſcades in an open country, particularly for a whole army, unleſs it ſhould find a bank like that at Zero; then the general ſhould conſider whether or not the attack of the army on its march is practicable. If the general by his ſuperiority can, without weakening himſelf, divide his army, and find means to conceal it, he will attempt the attack, provided that each detached body is poſted before the enemy has begun his march, and that they can all join on the firſt order, without a poſſibility of being cut off or finding any obſtacle to prevent their marching up to the enemy: but, in order to a greater certainty of ſucceſs, theſe firſt diſpoſitions being made, great exactneſs in giving, and diligence in the execution of the orders, is neceſſary; each ſeparate body ſhould charge at the ſame time, and at different parts. But as the attack may prove unſucceſsful, whether owing to the good diſpoſition of the enemy, or whether becauſe the attacks were not made together or executed with equal vivacity, it is neceſſary that the general ſhould have provided for a retreat, and that the officers commanding different bodies ſhould know after what manner and from what part it is to begin. For the greater ſecurity, the general officers ought to communicate their inſtructions to the commanding officer of each body compoſing that which they command, ſo that at the time of the attack or of the retreat, they may inſtantly comprehend the meaning of whatever they are ordered to perform.

If the army intending to attack the enemy on his march is weaker, or equal, either in number or in the nature of the troops, it is then only the ſituation of the country, and the facility with which the enemy may be ſurpriſed, that ſhould determine the attempt of this grand enterpriſe: the prudence of the general, his experience; that of the generals who are under his command; the quality of his troops; whether they are well diſciplined or not; whether they are compoſed of one or of many nations; the quality of the troops to be attacked; and, in ſhort, the genius of their general, are circumſtances by which the attacking or not attacking ſhould be decided. It is impoſſible to be deciſive upon theſe circumſtances, which depend entirely upon the ground, upon the vigilance of the enemy's general, upon the order which he cauſes his troops to obſerve in their march, and in ſhort upon the troops under his command. A general, at the head of a well-diſciplined army, compoſed of veterans and good general officers, will undertake and execute deſigns which he would not even dare think of with a new-raiſed army, however numerous: it is alſo very difficult to ſurpriſe a vigilant general, who is beſides a good ſoldier, and who is alſo aſſiſted by the counſels of able and intelligent officers.

A general ſhould alſo be guided, in attacking the enemy on a march, by the country and the nature of the troops of which his army is compoſed. If the enemy marches through an open country, and the general is equal to him in infantry but ſuperior in cavalry, he ſhould make no heſitation in attacking him; but if the country is woody or mountainous, and the enemy's army is more numerous in cavalry than infantry, the general has ſtill the ſame advantage with a ſuperiority of infantry; becauſe the enemy's cavalry in thoſe kinds of countries is unable to act againſt infantry; and the infantry alſo which the enemy may have will never be ſufficiently ſtrong to maintain itſelf upon the heights againſt forces ſo ſuperior: and if the heights are forced, there can be no doubt of the enemy's being beaten, of his cavalry being ruined and cruſhed to pieces, or that his retreat will be attended with great difficulty, and that he will loſe the greater part, if not the whole, of his army.

SECT. V. *Of the Attack of entrenched Camps.*

THE principles of war among all nations and in all times have been ſtill the ſame; but the little experience of the early ages of the world would not permit thoſe principles to unfold themſelves, as they have ſince done, and to which it is owing that new expedients both for attack and defence have been diſcovered.

What a ſenſible difference is there in the military art, ſuch as it at preſent is, compared with that of which the rules are handed down to us by Onozander, Vigetius, the emperor Leo, Frontinus, Ælian, and many others? The towns, in their times, had no other defence than walls, raiſed at a great charge, flanked at little diſtances with towers, and a large ditch in front: it is true that the little force of their weapons contributed much to the advantages of their fortifications. Their entrenched camps had only a large ditch with ſome waggons placed behind it; and whenever the ancients were willing to practiſe all the art at that time known in war, they ſurrounded the camp with walls, in the ſame manner as they did their towns, with towers at little diſtances. Of this kind was Pompey's camp at Dyrachium in Epirus, the plan of which is given in the marſhal de Puyſegur's Art of War: the wall by which it was ſurrounded was 15,000 paces in extent.

The emperor Leo was unacquainted with any other method of entrenching a camp, than by heaping faſcines together, putting trees upon one another, and poſting advanced guards.

The experience which hath been ſince acquired, hath, without increaſing the labour, rendered the works of places ſtronger, and eaſier to be defended: the labour of the en-

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trenchments for camps hath been ſhortened; they have taken a new form; and being conſtructed upon the ſame principles as the fortifications of towns, they are become more difficult to be forced (ſee Part I. ſect. vi.). By this ſame experience the means of attacking them hath been diſcovered; and in proportion as offenſive weapons have changed, and are become more powerful, the ſyſtem of fortification has been new-modelled.

Let an army be ſuppoſed entrenched behind lines where art and nature are both joined; whoſe flanks are ſuſtained and ſecured, furniſhed with troops and artillery along the whole front, with more troops behind to ſuſtain thoſe which line the lines. The general who would attack, ought firſt to ſurvey the ſituation of the lines himſelf, and as much as poſſible the enemy's diſpoſition; he ſhould examine the conſtruction of the lines, how they are ſupported, their extent, and whether the ſoil is firm or light. As ſoon as he ſhall be perfectly acquainted with theſe circumſtances, he may form his plan of attack, and cauſe his army to march in as many columns as there are attacks to be made; but he ſhould endeavour as much as poſſible to occupy the whole front of the enemy, in order to prevent him from ſending aſſiſtance to thoſe places where the attack will be briſkeſt. The head of each column ſhould be well furniſhed with artillery; and as ſoon as it ſhall be within diſtance of cannonading the lines with effect, it ſhould keep up a briſk and continual fire for the ſpace of an hour at leaſt, ſo as to beat down the earth of the parapet, and tumble it into the ditch, which will in ſome meaſure render the paſſage of it leſs difficult for the troops. The time of the attack ſhould be an hour before day, ſo that the cannon may have fired before the enemy ſhall know where to direct his artillery: after every diſcharge, the ſituation of the cannon ſhould be changed either to the right or the left, in order to deceive the enemy's gunners, and prevent their knowing where to direct their pieces. If there ſhould be any height within proper diſtance, the cannon ſhould be planted upon it: if the cannon can be brought to croſs each other upon the lines, the artillery will then have a very great effect.

The infantry ſhould follow the artillery, furniſhed with hurdles, planks, faſcines, pick-axes, and ſhovels; the faſcines will ſerve to fill up the wells, if there are any, before the ditch; or if there are no wells, they will fill up the ditch, and the hurdles will be thrown over them. The cavalry ſhould be formed in two lines in the rear of the infantry, in order to ſuſtain it. The general ſhould endeavour to find ſome ridges, to conceal the cavalry from the enemy; but ſhould there be none, it muſt be placed at ſuch a diſtance, as not to be expoſed to the cannon of the lines; for ſhould it be placed too near, it will very ſoon be deſtroyed, without having it in its power to be of any ſervice. In the beginning of an attack of lines, the cavalry cannot be of any aſſiſtance, and cannot even act till the infantry hath penetrated in ſome part. It would therefore be uſeleſs to cauſe it to advance too near, provided it is within reach of marching readily when the infantry has paſſed, and hath made a paſſage large enough for it, by beating down the lines and filling up the ditch: the cavalry then will have no more to fear from the cannon of the lines, becauſe the enemy's attention will be more engaged with endeavouring to repulſe the infantry, than with firing upon the cavalry. As ſoon as the lines have been beaten down, and the enemy thrown into confuſion, the infantry ſhould march reſolutely and together; and ſhould take care to leave room for the artillery, ſo that it may advance at the ſame time, and continue its fire. The attack ſhould be made by the grenadiers, ſuſtained by the piquets: they will protect the ſoldiers who fill up the wells and the ditch: and as ſoon as they find an opportunity of paſſing, they will endeavour to get over the entrenchments, ſuſtained by the whole infantry of the column, which will then be diſencumbered of the faſcines, hurdles, &c. in order to drive the enemy from his lines. As ſoon as there are ſoldiers enough upon the lines to bear the reſiſtance of the enemy, the ſoldiers who have the ſhovels and pick-axes, and who ought to be laſt, will finiſh the filling up of the ditch by beating down the parapet of the lines, and making an opening ſufficient for the paſſage of a ſquadron in order of battle. Then the whole infantry of the column that has broke through, will paſs and divide into two parts, to let the cavalry paſs, which will form under the cover of the fire of the infantry, and will not attack the enemy's cavalry till it ſhall have collected its whole force together.

If one of the attacks ſucceeds, on the firſt news, which will ſoon be ſpread throughout the army, all the troops at that time ought briſkly to attack the whole front of the line, in order to employ the enemy, and prevent his ſending aſſiſtance to that part that is forced. The reſerve, which is compoſed of infantry and cavalry, ought to join the troops that have broke through the lines, to ſuſtain the cavalry which is charging that of the enemy, and cannot be ſuſtained by the infantry who paſſed firſt, becauſe it is employed in taking the enemy in flank to the right and left. In this ſituation, when the reſerve and all the cavalry which followed the column that hath paſſed, and to which others may yet be joined ſhall have paſſed, it ſhould attack the enemy; if it is repulſed, it can never be to any great diſtance, becauſe it has infantry behind it, to ſuſtain it, and by its fire to ſtop the enemy. If the lines are forced by many columns, the ſucceſs and alſo the defeat of the enemy will be thereby rendered more certain.

When the duke of Savoy and prince Eugene, ſtill encamped between the town of Pianeza and la Venerie, in 1706, marched to attack the lines of the French army that beſieged Turin, they cauſed their armies to march in eight columns; the infantry formed the advanced guard, the artillery, diſtributed by brigades, marched at the head between the columns, the cavalry was behind in ſix, and out of reach of cannon-ſhot.

The diſpoſition of marſhal de Coigney in 1744, in order to attack the lines of Wiſſembourgh, of which the enemy were in poſſeſſion, was ſimilar to this, except that the whole of his army had not time to get up; but as the moments were precious, he did not wait for it. The army which came from Landau divided itſelf into four which formed the four attacks; one of which was at Wiſſembourg, the other at the mill between that town and the village of Picards, the third at the village of Picards, and the laſt was made above that village, which was entruſted to the Heſſian troops. His cavalry, which was behind, paſſed after the infantry had broke through the lines; but the enemy were then almoſt all either killed or taken, and thoſe who could ſave themſelves, retired to Lautrebourg, where their army had aſſembled after having paſſed the Rhine. It is difficult to determine which is moſt to be admired, whether the general's diſpoſition, the quickneſs and exactneſs of his eye, and his coolneſs in a circumſtance ſo delicate, or the courage of the French troops, who forced theſe lines in leſs than two hours.

As ſoon as the enemy is beat and abandons his lines, he muſt be purſued, but with precaution. The vivacity with which he ſhould be purſued depends upon the order with which he retires: if it is an open country, the general may follow him ſo long as he ſees all clear before him; but if the country is divided with defiles and woods, it would by no means be prudent for him to engage himſelf in them, for fear of any ambuſcades being placed there by the enemy, in order to ſecure his retreat: nevertheleſs, the general ſhould endeavour to make the moſt of his victory, and ſhould never be content to win a battle by halves; at leaſt it ſhould be carried ſo far as to make the enemy ſenſible of his loſs, and of rendering him incapable of continuing openly in the field.

But if the army that attacks the lines ſhould be unable to force them, after many repeated attacks, and if the general perceives that his troops are diſcouraged, he ſhould immediately retire. If the retreat is made over an open country, he ſhould begin it by marching off the cannon, the infantry next, and the cavalry will form the rear-guard in two or three lines; the huſſars and dragoons will be upon the flanks of the cavalry: if there are any defiles or woods to paſs through, the general ſhould leave ſome infantry at the entrance of them, to ſuſtain and protect the cavalry, which will retreat by files. If the enemy is in full ſtrength, the general ſhould leave ſome field-pieces with the infantry that is poſted at the entrance of the woods and defiles, which will certainly ſtop the enemy's impetuoſity: if, on the contrary, the enemy purſues the army with only a few troops, it will be proper to charge him if he approaches too near. In this diſpoſition an army may retreat eaſily, provided that order is obſerved, and the movements not made with too much precipitation.

Sect. VI. *Of the Attack of a Convoy.*

The ſame motive that ought to oblige a general to practiſe every reſource of art, in order to conduct the eſcort of a convoy in ſafety, ſhould alſo induce him to uſe the ſame expedients to carry off the enemy's ſubſiſtence; for to deprive him of the means of ſubſiſting, is, in reality, to overcome him without fighting.

An advantageous method for attacking a convoy is, by forming three attacks, one real and two falſe. Thoſe attacks are called *real* which the troops make with vigour and in full ſtrength, and when their charging is provided for and determined; the *falſe* ones are when the general's intention is only to keep back the enemy, and prevent his ſending aſſiſtance to the troops that are really attacked.

Theſe attacks, true or falſe, are determined by the ſituation of the country, and in proportion to the degree of eaſe with which the convoy may be turned from the road it is in; that is, if the general ſhould meet with an avenue near the advanced guard, which will draw the enemy ſome diſtance from his main body, and which alſo leads to that of the troops which attack, it is at that part the real attack ſhould be made: if this avenue is found at the rear-guard, the two falſe attacks ſhould be made at the advanced guard and at the centre, ſuppoſing there is an opportunity of attacking the centre. Theſe falſe attacks ought to be ſufficiently numerous in troops, to be able to employ the enemy, without running a hazard of being beaten, and to prevent his ſending aſſiſtance to other parts.

If the troops deſigned to attack the convoy are ſufficiently numerous, although divided into three bodies, to attack every part at the ſame time with equal vigour, the ſucceſs will thereby become more certain. The eſcort of a convoy is often more numerous than the troops which attack it; but it being certainly weakened by the diviſion it is obliged to make in order to guard the whole length of the convoy, the troops which attack have greatly the advantage, although inferior in number, becauſe thoſe which they attack cannot ſend aſſiſtance to the parts attacked, eſpecially if attacked on all ſides.

If the road is wide enough, and there is room for a waggon to turn, the general ſhould rather chooſe to attack the advanced and rear guards than the centre, to prevent the enemy's ſaving any of the waggons belonging to the rear-guard, which will undoubtedly be the caſe, if only the advanced guard and centre are attacked. If the road is ſo narrow that the waggons cannot turn about in order to go back, the general ſhould attack the advanced guard, and employ the centre and rear-guard as much as poſſible.

A convoy may alſo be attacked at the opening of a defile into a ſmall plain; then it is again the advanced guard that the general ſhould attack, though he ſhould alſo contrive to have the rear-guard attacked at the ſame time. The troops in the centre will be confuſed, and not know where to ſend aſſiſtance, becauſe they will hear firing both in front and rear; nevertheleſs, the general ſhould defer charging till part of the waggons are paſſed, and the troops of the centre are ſtill on this ſide of the defile. An attack, when unforeſeen, briſk, and ſuſtained, can never fail of ſucceeding, particularly when the troops attacked are ſo divided as not to have it in their power to aſſiſt each other; and if the whole convoy is not taken, there is almoſt a certainty of taking a great part of it, or at leaſt of ſetting it on fire, and hamſtringing the horſes, if there is not time to carry them off.

The ſucceſs of theſe attacks partly depends upon the choice of thoſe places where the troops which are to fall upon the convoy are placed in ambuſcade; the moſt ſecure are thoſe which are leaſt liable to the inſpection of the enemy's parties. It is ſufficient to have ſentries upon the tops of the hills, ſo that they may ſee into the roads, and give notice when the convoy is near the place appointed for the attack: then the troops charged with the attack of the rear-guard, having nothing more to apprehend from being diſcovered by the enemy's parties, may draw near the entrances of the avenues.

If the ambuſcade is diſcovered, the conduct which ought to be obſerved by the troops compoſing it depends entirely upon their force and that of the eſcort; nevertheleſs, even when they are weakeſt, the attack ſhould be attempted, which, if unſucceſsful, will at leaſt have retarded the march of a convoy, for want of which the enemy may be greatly diſtreſſed. A general never riſks much in attacking a convoy; the object of the officer commanding the eſcort being to conduct it in ſafety, and to avoid fighting: it is the ſame with the eſcort of a convoy as with a chain of forage, the end of which is only to complete it; and conſequently the troops charged with them will rather be attentive to execute the orders which have been given them, than to purſue the enemy, although beaten and driven back.

When a convoy marches through an open country, there ſhould be many ambuſcades formed: an enemy is leſs apprehenſive in an open country, becauſe, ſeeing all before him, his ſearches become the leſs exact, in proportion as the country is unfavourable for troops to form ambuſcades; nevertheleſs, a general may always find ſome hollows, heights, or places of the ſame nature, where troops may be concealed. As ſoon as the convoy ſhall be arrived at the place fixed on for the attack, the general ſhould fall upon the advanced and rear-guards, in order to take in the whole, and to induce, if poſſible, the troops in the centre to divide themſelves, to run to their aſſiſtance; then the third ambuſcade muſt ſhow itſelf, and attack the centre, and endeavour to divide the convoy, before the commandant of the eſcort has had time either to park it or double it up. If the general ſucceeds in dividing the convoy, and if the troops in the centre of the eſcort are beaten and broke, he ſhould detach ſome infantry, cavalry, and huſſars in purſuit of them: the remainder muſt be divided into two parts, in order to attack the troops lining the convoy; after which they muſt join thoſe who attack the advanced and rear-guards. The troops, when re-united, ought to make this attack with vigour, and entirely determine the defeat of the eſcort, and conſequently the taking of the convoy.

A convoy that is divided is half taken, as ſoon as the detachment of the centre is beaten; becauſe the victorious troops can be divided, and part ſent in purſuit of the body that is beaten, and the other part employed to reinforce thoſe who ſtill meet with reſiſtance; whereas, if only one part is attacked, that which is not attacked can readily ſend aſſiſtance, eſpecially in an open country, where there is nothing to prevent either cavalry or infantry from acting, and being a mutual aſſiſtance to each other.

A general who would attack a convoy never runs any hazard by dividing his troops, in order to divide thoſe of the enemy: the more the troops of an eſcort are divided, with the greater eaſe will they be beaten. An officer who would attack, ſhould know the ſtrength of the eſcort, in order to regulate the number of his troops by the enemy's, and to be proportionably ſtronger. He who is attacked, being ignorant of his enemy's force, and being charged on all ſides, is at a loſs where to ſend aſſiſtance, and how to take care of every part: he who attacks by the knowledge he ſhould have of the country, is enabled to poſt his troops after ſuch a manner as to employ all thoſe belonging to the enemy, without weakening himſelf. The troops which attack have certainly great advantages, becauſe, in dividing them, they are ſtill ſtronger than the body attacked; and then they can chooſe the place moſt favourable for the attack: whatever may be the precautions taken by the officer commanding the eſcort, whatever may be his vigilance, it will be very difficult for him, conſidering theſe different attacks and the number of the enemy's troops, to diſpoſe his own with ſufficient quickneſs to place the convoy in ſecurity, eſpecially if the attack is made with great quickneſs and vigour.

When a convoy is to be attacked as it paſſes a bridge, the commanding officer ſhould divide his troops into three bodies, placing two of them in ambuſcade on that ſide of the bridge to which the convoy is advancing, and the third on the ſide from which it is marching. All the three bodies ſhould remain concealed, if poſſible, till the advanced guard of the convoy, the body at the centre, and ſome of the waggons, have paſſed the bridge; when they ſhould inſtantly advance and attack, each that diviſion of the convoy properly oppoſed to it. Three ſuch attacks, made at the ſame time by ſuperior force, will have the whole advantage of the action; and the more ſo as the troops of the eſcort being everywhere employed, cannot ſend aſſiſtance to any particular part. If the two bodies which attacked the advanced guard and the centre ſhould break them and put them to flight, there ſhould be troops enough left in purſuit of them to finiſh their entire defeat, without any fear of being repulſed; the remainder ought to march to the bridge, and cauſe the waggons that are upon it to be ranged in order, and march to the rear-guard, in order to finiſh its defeat, if it ſtill continues to make reſiſtance.

It is neceſſary to obſerve, that ſome troops ought to be left at the head and along the convoy, in order to take care that the horſes are not taken off from the waggons, and that none of the ſoldiers or drivers make uſe of that method to eſcape.

If the general has not troops ſufficient to be divided into three bodies, he can place ambuſcades to attack only the advanced guard and the centre. This muſt be done with vigour, but not till the troops of the centre ſhall have paſſed; and the attack ſhould always be executed by the infantry with the bayonets fixed, and without firing, and by the cavalry, huſſars, and dragoons, ſword in hand. The general ſhould not then ſtay to make priſoners; but ſhould put to death all thoſe whom he finds armed. If the two firſt detachments are beaten, he ſhould march with the remainder to the rear-guard, which, not being ſtrong enough to reſiſt a body of troops much more numerous, will undoubtedly betake itſelf to a retreat. As it is the convoy, and not the troops of the eſcort, that is the principal object, the general ſhould leave only ſome troops of huſſars to purſue the rear-guard; he ſhould make the waggons file off as faſt as poſſible, and conduct them the neareſt way to the camp or the neighbouring town; or if this cannot be done, he muſt burn them and carry away the horſes.

SECT. VI. *Of the Attack of green and dry Forages.*

NEXT to the convoys, the forages become moſt neceſſary for the ſubſiſtence of an army, as it is by them that the cavalry is ſupported; and if a general can contrive to deprive the enemy of them, or to moleſt him in the making of them, his cavalry will ſoon be without reſource, his infantry without baggage, and his artillery without the means of being conveyed.

The detachment deſtined to attack a party on a green forage, made in an open country, ſhould be compoſed of infantry, cavalry, and huſſars: the infantry ſhould not appear, but ought to remain in ambuſcade in ſome hollows, behind ſome hedges, or other favourable places: and it ſhould be careful not to ſhow its arms; becauſe, by the glittering of the ſteel, they may be diſcovered: the cavalry ſhould be divided into two bodies, three quarters of a league one from the other, taking care to be able to join in caſe of neceſſity. As for the huſſars, they ſhould be diſtributed about in many ſmall detachments to the right and left, and in the centre of the two bodies of cavalry; upon one of the flanks there ſhould be a more numerous body of huſſars placed in ambuſh, at a greater diſtance than the ſmall detachments. Every one of thoſe ſmall troops ſhould have a number of trumpets with them; and when the chain is formed, and the foragers ſpread over the plain, a part of theſe detachments ſhould leave the ambuſcades, making a great noiſe, and attack thoſe belonging to the enemy which are advanced; and theſe detachments will charge them with ſo much the more vigour, as they will be ſuſtained by the large body of huſſars in ambuſcade behind them, and which ſhould march to ſuſtain them, and attract the attention of the officer commanding the eſcort. It may happen that this firſt attack, made on one ſide only, may induce the enemy to unfurniſh the chain in ſome place, by which it will conſequently be weakened; and if ſo the other detachment of huſſars ſhall inſtantly advance, followed by one of the bodies of cavalry, in order to attack that part that has been unfurniſhed. If the enemy, more prudent, does not weaken the chain in any particular part, but contents himſelf with making the reſerve march to the aſſiſtance of the troops which have been attacked, the ſecond attack ought always to take place; but in order to employ the enemy everywhere, the ſecond body of cavalry ſhould march and attack the centre. This attack ought to be made with great briſkneſs ſword in hand, whether the enterpriſe ſucceed or not; if it ſucceed, a great advantage may be drawn from the rout of the chain. Whilſt the cavalry and part of the huſſars are purſuing the troops of the chain, the other part ſhould fall upon the foragers, where they will without doubt find but little reſiſtance. If the attack do not ſucceed, and that, by the good diſpoſition of the troops of the chain, the detachment has not been able to force it, it ſhould retire to the infantry that has remained

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mained behind in ambuſcade; this infantry will facilitate the retreat of the cavalry and huſſars. But ſuppoſe that the enemy, too eager, is carried away by this firſt ſucceſs, a great advantage may be derived from his imprudence, by attacking him reſolutely. The whole ſtrength, and each body being united, it is to be imagined, and even hoped, that the advantage will turn on the ſide of thoſe troops which were repulſed but a moment before; and the more ſo, as the general commanding the chain can have purſued only with his cavalry, his huſſars, and dragoons; becauſe his infantry will have remained in the poſts which it occupied, either to guard them, or to ſuſtain the horſe, ſuppoſing they ſhould be repulſed.

If the forage is made in a mountainous country, the infantry muſt act alone, the cavalry being only neceſſary when it can have ground on which to act, and ſuſtain the infantry in caſe it is repulſed: the infantry ſhould attack the avenues and the heights, and poſſeſs itſelf, as much as poſſible, of thoſe which have the greateſt command, and make the attack in many places as in an open country. Theſe different attacks render the enemy undetermined with regard to his diſpoſitions; he does not know where to ſend aſſiſtance: the uncertainty of the general becomes viſible to every officer, and communicates itſelf to all the troops; and thence proceeds their confuſion, and conſequently their defeat.

The priſoners and horſes that have been taken ſhould be ſent off firſt with an eſcort; the reſt of the troops will retire immediately after by the ſhorteſt road. It is cruelty to abandon the wounded, whether friends or enemies; and as the detachment has undoubtedly found, within the circumference of the chain, ſome waggons with horſes to them, they ſhould be made uſe of to carry off the wounded, who ſhould alſo be ſent on before: if there are no waggons, the detachment muſt take them from the neighbouring towns.

The attack of a dry forage is conducted nearly in the ſame manner as that of a green one; but it is often neceſſary to employ a greater number of troops; becauſe, as the forage is made in the villages, it is almoſt a certainty they will all be guarded by infantry ſuſtained by cavalry; whereas the chain of green forage is formed with a much greater number of cavalry than infantry, unleſs it ſhould be in a country where cavalry cannot act. It is difficult to force the villages where infantry is ſuſtained by cavalry; whereas it is eaſy for cavalry to attack each other in a plain, where the affair is immediately determined; but it is not ſo ſoon decided when entrenched infantry is attacked by infantry: but whatever reſiſtance a commander may find, he ſhould always attempt to force it. As the principal object is to prevent the forage, it is obtained by attacking the chain briſkly and in all parts; becauſe it is certain that the general commanding the forage will cauſe the foragers to aſſemble; or elſe, ſeeing the chain attacked, without waiting for an order, they will of their own accord diſmiſs, and fly toward the camp: but whether they aſſemble, retire in order, or ſhift for themſelves, the end is anſwered, and the forage is left unperformed. If by their flight the commander cannot hope to make any priſoners, he muſt keep the troops of the chain at bay ſuch a length of time as to make it impoſſible to continue the forage for that day: he ſhould even if poſſible endeavour to force them to retire; which if they do, he ſhould purſue them long enough to be certain of their retreat, and then collect all the waggons from the neighbouring villages, cauſe them to be loaded with the forage intended for the enemy's army, and conduct it to the camp: if they do not retire, the commander muſt remain in ſight of them during the night, and ſend to the camp to demand a reinforcement of troops, in order to oblige the enemy to retire. For the ſame reaſon that a forage ſhould not be abandoned till the laſt extremity, the troops that would prevent the enemy from attacking it, ſhould be abſolutely bent upon it, at the ſame time without expoſing themſelves to the danger of being beat by any aſſiſtance that may come from the camp to the troops belonging to the chain.

Sect. XI. *Of the Paſſage of Rivers.*

There is hardly an operation of war more difficult than the paſſage of rivers, whilſt war cannot be carried on in countries where there are not rivers to be paſſed.

Rivers may be paſſed by ſwimming, by fording, or upon bridges; but ſmall bodies alone can paſs with ſafety by ſwimming, and, unleſs the ſtream be very ſhallow, none but the cavalry ſhould paſs at a ford; for it is ſurely much better to throw over a bridge or two, than to expoſe the infantry to the fatigue of wading through a deep current, or the artillery and baggage to the danger of being damaged by water. When a ford is diſcovered and intended to be made uſe of, it ſhould be ſecured in every part, and the ſoldiers employed for that purpoſe ſhould be furniſhed with proper inſtruments to clear the bottom of every thing which may retard the paſſage. Its banks ſhould likewiſe be examined, that it may be known whether they are of difficult or eaſy acceſs, and whether the ground on the other ſide be marſhy, or ſuch as will permit the troops to form immediately on their landing. When bridges are to be built for the paſſage of the army, they muſt be laid upon boats, pontons, piles, or wooden horses (ſee theſe articles); or in ſome caſes rafts may be employed inſtead of them; and when a general is furniſhed with theſe neceſſaries, he will paſs the largeſt river, in the abſence of the enemy, without difficulty or the loſs of a man.

It is not, however, to be ſuppoſed that the enemy will be abſent. When a country is invaded, the army that is defending it will endeavour to meet the invaders with the greateſt advantage; and as in the paſſage of rivers the advantage is wholly on the ſide of the defenſive army, the general commanding it ſhould there, if poſſible, oppoſe the enemies of his country. We ſhall therefore, in this ſection, treat 1*ſt*, Of the defence neceſſary to be made for oppoſing the enemy, and preventing his paſſage; 2*dly*, Of the means which a general ſhould employ in order to facilitate the paſſage, notwithſtanding the enemy's oppoſition; and 3*dly*, We ſhall demonſtrate by facts the ſecureſt method of retreating.

I. It would be impoſſible to run through every precaution that can be taken to diſpute the paſſage of a river; we ſhall therefore confine ourſelves to the principal ones, by a ſuccinct relation of the different ſyſtems of the authors who have treated on that ſubject.

The firſt precaution to be taken, according to the chevalier de Folard, is, to draw off all the boats which are upon the river; to obſerve whether any other river has a communication with it: to examine the courſe, the windings, and the moſt acceſſible parts of it; to raiſe good redoubts near the banks; to render the bottom uneven by means of ſacks and baſkets filled with ſtones, large trees with their branches, and by ſtopping them with ſtakes.

To this precaution may be alſo added another, which, executed with exactneſs, may produce great effects; that is, to throw whole trees with their branches into the river, not ſo heavy as to ſink to the bottom, but whoſe ſize and quantity ſhall be ſo conſiderable as not to be eaſily ſtopped; their branches ſhould alſo be interwoven, and formed like a chain from one bank to the other; they ſhould be held faſt till the enemy's army is engaged in the fords or upon the bridges,

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bridges, at which time they ſhould be let into the current, the quickneſs of which will increaſe the force of this kind of moving bank, which will overturn every thing it meets with, ſoldiers, baggage, horſes, bridges, and boats: in ſhort, nothing will be capable of withſtanding it, if there is any degree of rapidity in the torrent. This method is pointed out in M. de Puyſegur as levelled againſt bridges only. To avoid alſo giving any ſuſpicion to the enemy, this chain of trees can be placed upon the bank of the river, of which ſome engineer muſt have been careful to take the dimenſions before-hand; and when it ſhall be nearly the ſame ſize of the river, and the enemy is paſſing, it muſt be held at one end whilſt it is ſhoved off by the other; the whole of it will be taken by the current, which, without any other aſſiſtance, will direct it againſt the enemy.

In regard to the troops deſigned for the defence, the beſt method, according to M. Folard, is to form ſmall camps of 2000 or 3000 men, a league diſtant one from another, with patroles and ſignals from one to another; to have canoes, in order that the river may be croſſed ſilently in the night by ſoldiers, who will endeavour to make ſome priſoners, and who will alſo liſten in order to diſcover whether the enemy is preparing to march. A general ſhould particularly endeavour to poſſeſs himſelf of the iſlands, if any, under cover of which the enemy may attempt the paſſage; and if the general can be certain that the enemy's intention is to throw over a bridge where they are, in order to ſet out from thence, to ſave ſo much of the way, the general will by this means aſſure himſelf of the place where the enemy will attempt the paſſage, which circumſtance will be almoſt ſufficient to prevent him.

But in order the better to explain the manner in which a river ſhould be defended, let two armies be ſuppoſed, one of which, conſiſting of 40,000 men, defends the paſſage againſt another of 60,000. This laſt is divided into three bodies; that of the centre conſiſts of 40,000 men, and the two others of 10,000 each: the centre-body is encamped nearly oppoſite to the place where the paſſage is intended to be effected; of the two bodies which are upon the flanks of the centre, one will ſerve to keep the enemy in ſuſpence, with relation to the true place where the paſſage is deſigned. They ought to be continually moving, ſometimes at a diſtance from the main body of the army, and pretend to throw bridges higher up, or lower down, in order to induce the enemy to divide and ſeparate the different bodies of his army in ſuch a manner, that they can no longer be of aſſiſtance to each other, or be in a condition of oppoſing a ſuperior body of troops that may attempt the paſſage.

The army defending the paſſage is divided into many bodies; three of 10,000 men each, at a league diſtance from one another, and two others of 5000 men each, compoſed of the light troops, both horſe and foot, and dragoons, encamped at half a league upon the two flanks of the army. The communication ſhould be preſerved between each ſeparate body, and conſtant patroles kept upon the ſide of the river, which ought continually to croſs each other; and detachments of huſſars upon the right and the left, both up and down the river: the general is alſo ſuppoſed to have planted batteries of cannon, in different parts upon the ſhore; and to be poſſeſſed of two iſlands which he has fortified, and in which he has alſo placed troops and cannon: in ſhort, he is ſuppoſed to have taken every advantage of ground for rendering the paſſage difficult to the enemy, and to oppoſe troops to him in every part where he may attempt it.

See Plate DXIX. fig. 1. where A repreſents the camp of the main army, divided into three parts, for the defence of the river. B, The camp of the light horſe, light infantry, and dragoons upon the wings of the army. C, Caſtle and village, guarded by light infantry. D, A town occupied by the infantry belonging to the army. E, Bridge broken down. F, Iſlands occupied by infantry. G, Poſts of infantry diſtributed along the ſide of the river. H, Batteries eſtabliſhed along the ſide of the river. I, Poſts of cavalry, to keep up the communication between the camps. K, Bridges conſtructed to preſerve the communication of the iſlands. L, Bridges conſtructed for the communication of the camps.

If, notwithſtanding all theſe obſtacles, the enemy attempts the paſſage, he ſhould be attacked as he debarks; and it is for this reaſon that the defending army ſhould not be divided into very ſmall bodies, which, too weak to reſiſt a ſuperior number, will be eaſily routed. In attacking the enemy, there is no danger to be feared from their cannon, which they cannot make uſe of without annoying their own troops; whereas the cannon planted upon the ſide of the river, to defend the paſſage, can always fire upon the troops which follow, in order to ſuſtain thoſe who attempt the paſſage: there ſhould alſo be infantry placed near theſe batteries, to defend them, and to flank ſuch of the enemy as have already paſſed.

There yet remain many ſtratagems to be practiſed on theſe occaſions: a general may make uſe of thoſe mentioned in the ſection which treats of ambuſcades; and they ſhould be particularly directed againſt ſuch places as are ſuppoſed to be moſt favourable for the enemy. The hiſtory of prince Eugene, whom the chevalier Folard ſtyles a great traverſer of rivers, furniſhes many examples.

The general ſhould be particularly attentive in diſturbing the enemy when conſtructing his bridges; which appears the more practicable, as the bridge is never properly eſtabliſhed, if not guarded at each end: beſides, by the aſſiſtance of artillery, the enemy may be eaſily prevented from going on with his work. M. Feuquieres indeed relates examples, where the enemy hath not been able to prevent the bridges from being built under their very noſes; but beſides the rarity of theſe examples, the precautions he uſed are a very convincing proof of the difficulty attending ſuch undertakings.

A prudent general, and one who is himſelf acquainted with the river of which the enemy would attempt the paſſage, is guided by its depth, by the difficulty of gaining its banks, and in proportion to its rapidity: he often pretends to be inactive, permits the enemy to throw his bridges over it, and waits till he is in the middle of his paſſage; at which time he makes a furious fire upon him, ſpreads diſorder amongſt his troops, and overthrows his ranks; and the enemy, beſides loſing a great number of men, alſo fails in the ſucceſs of his enterpriſe.

II. With reſpect to the means to be employed for paſſing a river in the face of the enemy, it is to be obſerved, that the general who attempts ſuch a paſſage, ought, in the firſt place, to be very certain of the ſteadineſs of his troops. He ſhould place the moſt intrepid in the front, in order to encourage thoſe who follow them: on ſuch occaſions every thing is to be apprehended from ill-diſciplined troops, who, as ſoon as they are engaged in the river or upon the bridges, having no longer any place of refuge to fly to, will be diſcouraged, and ſpread the panic throughout the whole army.

If the army paſſes upon two bridges, it is impoſſible to take too much care for their ſecurity: hiſtory is filled with fatal examples of bridges falling under the weight of troops. One of the greateſt dangers ever experienced by Charles XII, was when, having cauſed a bridge to be thrown acroſs the Viſtula, the wood which had been made uſe of being too weak, and the timber-work ill ſecured, the bridge broke down whilſt the king was paſſing. Charles, the prince of Wirtemberg, and many others, fell into the water: the king, having caught hold of a piece of the timber that was floating, was carried away by the current. The troops which had already paſſed found themſelves at the enemy's mercy, who might have deſtroyed them; but they did nothing, ſays the hiſtorian Nordberg, becauſe of the heights of which the Swedes were in poſſeſſion, and from whence they kept a fire upon the Saxons. Was it not rather an inſtance of the good fortune which uſually attended that intrepid prince?

It is probable, when a river is paſſed upon bridges in preſence of the enemy, that they have been built before his arrival, and conſequently there has been time to entrench them at each end, but particularly on that ſide next the enemy. Theſe entrenchments ſhould be made in ſuch a manner as to prevent the bridges from being flanked by the enemy's cannon; therefore, inſtead of the entrenchments uſual at the heads of the bridge, ſuch as a horn-work, a crown-work, or a half-moon, the general ſhould cauſe redoubts to be thrown up, the fartheſt of which ſhould be 400 yards diſtance, and oppoſite to the bridge; and the others ſhould be thrown up nearer to the banks of the river, forming a ſemicircle: in order for their better defence, the general ſhould follow the ſame diſpoſitions which have been laid down in the preceding part. If there are many bridges, they ſhould be conſtructed as near each other as poſſible, that the ſame redoubts may equally ſerve to cover them: the reaſon of theſe redoubts being placed at a diſtance from the bridges is, that, as the troops paſs, they may have room to form, and ſuſtain thoſe occupying the redoubts. Theſe redoubts it muſt be acknowledged, require a greater degree of labour than is requiſite for the conſtruction of a half-moon, or even a crown-work; but it ſeems impoſſible to paſs a river upon bridges in preſence of an enemy, however ſtrongly they may be entrenched, if there is not ſpace enough left between the entrenchments and the bridges to contain a number of troops ſufficient to oppoſe the enemy, and to give time for the remainder of the army to paſs. Labour ſhould never be conſidered when an enterpriſe is ſucceſsful; a general, therefore, ſhould never ſpare any pains for the attainment of his ends, but ſhould take every precaution neceſſary for ſucceſs, without troubling himſelf about the time and the labour it will coſt: the glory of having forced the enemy to leave the paſſage open to him makes ſufficient amends for the trouble he has given himſelf in order to attain it.

Suppoſe an army of 60,000 men would paſs a river, guarded by an army of 40,000. Let it alſo be ſuppoſed, that the army intending to paſs has got the ſtart of the enemy, either becauſe he was not yet arrived, or becauſe he has been amuſed with marches and counter marches; that the general has alſo had time to conſtruct three bridges, and to entrench them in the manner above-mentioned: he muſt begin the paſſage by cauſing the redoubts to be occupied by a battalion, or half a battalion, according to their ſize; and he muſt plant cannon between thoſe redoubts, with infantry to guard them. Theſe diſpoſitions being made, the army muſt march in three columns; the centre column muſt be entirely infantry, and the other two compoſed of infantry and cavalry. As the infantry paſſes the bridges, it muſt divide, and form columns, conſiſting of four battalions each, which muſt paſs between the redoubts, having cannon upon their flanks: the cavalry muſt paſs to the right and left through the interval of the two redoubts neareſt the river, and form in order of battle upon the flanks of the columns; the right wing with its right towards the river, and the left with its left. When all theſe columns ſhall be formed, and ready to march towards the enemy, the right and left of the two lines of cavalry muſt ſuſtain it; and the right of thoſe of the right, as well as the left of thoſe of the left, will march to put themſelves in a line in preſence of the enemy: in this poſition the army muſt march towards the enemy, and attack him, if he is ſo raſh as to hazard an action; and if he ſhould retire before the army is entirely paſſed, the paſſage will be the more eaſily effected.

See Plate DXIX. fig. 2, where AAA are bridges of boats. B, Redoubts which cover the bridges. C, A battery, under cover of which the infantry work at the conſtruction of the redoubts. D, A battery to prevent the enemy from annoying the army on its march. E, The march of the army. F, The artillery diſtributed among the brigades of infantry. G, Infantry, forming in columns to open on the oppoſite ſide through the intervals of the redoubts. H, March of the columns into the front of the redoubts, where they halt in order to give time for a part of the cavalry to form upon its flanks. I, A battery erected to facilitate the forming of the cavalry. K, Cavalry, which, in gaining the oppoſite ſhore, forms in order of battle and poſts itſelf upon the flanks of the infantry. L, Eight battalions in column upon the right wing of the army, to go and examine the village, and attack the enemy in it, in caſe he ſhould be poſſeſſed of it. M, Huſſars and dragoons, who have taken poſſeſſion of the height which is on the left wing of the army. N, A brigade of infantry poſted next the height, covering the left wing of the cavalry. O, The diſpoſition of the army marching up to the enemy.

From this diſpoſition it appears, that the army which attempts the paſſage is almoſt certain of ſucceeding; it is ſheltered behind the redoubts during the paſſage of the bridges; it has ground to form itſelf upon, and to ſhow itſelf in full ſtrength. But it is ſeldom that a general has time to build the bridges and entrench them after this manner, when the enemy is on the oppoſite ſide with an intention of diſputing the paſſage: ſo circumſtanced, he muſt endeavour to find ſome fords, and, under ſhelter of one or more iſlands, conſtruct a number of rafts behind them; he muſt endeavour to keep the enemy at a diſtance from thoſe places by marches and counter marches; and when that is done, he muſt cauſe the cavalry to ford over with grenadiers and labourers behind them; theſe labourers muſt throw up entrenchments as faſt as they can, whilſt freſh infantry is cauſed to paſs over upon rafts. Provided theſe entrenchments can ſtop the enemy for ſome time, and contain infantry enough to reſiſt him, the remainder of the army will be very ſoon paſſed: the cavalry will at the ſame time paſs at the fords which have been diſcovered, in order to cover the flanks of the infantry; when it will ſpread over the plain, being itſelf protected by the infantry, as it leaves the entrenchments in columns.

The paſſage of a river cannot be ſafely attempted, if the general does not provide for a defence, and take infinite precautions to protect the army in its paſſage.

All that authors have ſaid upon this ſubject, ariſes from this principle of Vegetius, which they ſeem to have commented upon, and to which they have applied different examples. "As the enemy (ſays he) are accuſtomed to form ambuſcades, or to attack openly at the paſſage of rivers, the general ſhould poſſeſs himſelf beforehand of a good poſt on the oppoſite ſide, and entrench himſelf even on that on which he already is, to hinder the enemy from attacking his troops, ſeparated by the channel of the river; and ſtill, in order for greater ſecurity, the general ſhould cauſe the two poſts to be entrenched and well palliſadoed, that in caſe of

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an attack, he may be able to ſuſtain the efforts of the enemy without great loſs."

It may not be improper, in this place, to relate a diſpoſition of M. de Valiere's, formed upon this principle.

He ſays, "After the cannon are planted, a parapet ſhould be raiſed upon the banks of the river, 200 yards in length or thereabouts, behind which ſome infantry ſhould be immediately launched from the centre of the parapet, and ſome ſoldiers with labourers ſent over, who muſt immediately erect a ſmall half-moon: as ſoon as that is done, more ſoldiers ſhould be ſent in order to defend it in caſe it ſhould be attacked; more labourers ſhould alſo be ſent to erect another half-moon, both upon the right and the left.

"If the labourers are not annoyed by the enemy, they ſhould at the ſame time erect an horn-work, whoſe wings ſhould be flanked by the firſt parapet, and the cannon planted in it; if the river is ſo large that the wing of the horn-work cannot be defended by muſquetry, it muſt be defended from the half-moon, made from thence to the water."

In the mean time, the general ſhould cauſe the bridge to be continually worked at; and, as ſoon as it is finiſhed, make the troops paſs over it, if the enemy is not in ſight; but if he is, the horn-work muſt be completed, to prevent the enemy from falling upon the troops as they paſs. The horn-work being made as ſtrong as is judged neceſſary, as much infantry as it will hold ſhould be lodged in it, with ſome field-pieces; and as the cannon upon the riſing will keep the enemy at a diſtance, the general may order the cavalry to paſs: but ſtill all this cannot be effected but before an army very inferior. If the enemy's army is of ſuperior force, the ſafeſt method is to try a paſſage at ſome farther diſtance, ſtill keeping the army in ſight as long as poſſible, and concealing from the enemy that any troops have been detached.

It is impoſſible to foreſee every ſtratagem that may be employed, as they depend upon many circumſtances; but it is always right to ſend, if poſſible, ſome truſty ſpy to diſcover the enemy's poſition on the other ſide of the river, what obſtacles he can place in the paſſage, what methods are to be uſed to avoid them, and what parts of the bank are moſt acceſſible or beſt guarded.

A general ſhould make many falſe attempts, particularly at thoſe parts where he leaſt intends paſſing; they ſhould be made as ſecretly as poſſible; and alſo, in order to deceive the enemy, the general may throw over two or three bridges at hazard, in ſight of the enemy, at thoſe very places where he has reſolved not to paſs: the enemy's whole attention will be directed to that ſide; and a conſtant fire ſhould be made on him from the other ſide, ſo that he may not be miſtruſtful of the ſtratagem. There is no doubt of theſe bridges being taken, which is of no conſequence, provided the enemy is amuſed, and the general has time to throw over another bridge at a diſtance from that place, by which he can paſs.

We cannot pretend to recapitulate every ſtratagem which a general may practiſe: in the hiſtories of prince Eugene and Charles XII. the reader may ſee the different methods which they made uſe of; it will be ſufficient here to relate the rules laid down by Montecuculi, with ſome modern examples, by which they ſeem to be corroborated.

1. The general muſt plant artillery upon the bank oppoſite to the poſt he intends taking; which will be attended with great advantage, if the river forms a re-entering angle, and if there is any ford near it. 2. In proportion as the conſtruction of the bridge advances, he ſhould poſt ſome infantry upon it, in order to keep a fire upon the oppoſite ſhore. 3. When the bridge is completed, he muſt cauſe a body of infantry, ſome cavalry, ſome field-pieces, and ſome pioneers, to paſs it, in order to fortify the head of the bridge on the other ſide. 4. The general muſt take great care that the enemy has not poſted armed barks, or other machines, to break down the bridge when half the army ſhall be paſſed. 5. If the general would preſerve the bridge, he muſt fortify it at both ends, and place ſufficient guards in it.

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In 1743, prince Charles intending to paſs the Rhine, kept a continual fire upon all the French poſts from 11 o'clock at night till three in the morning, in order to conceal his real deſign with regard to the paſſage. Marſhal de Coigny aſſembled his army in three large bodies, and lay all night upon his arms, the only prudent ſtep he could take on that occaſion. By this diſpoſition he found himſelf in a condition of tranſporting himſelf oppoſite to the iſle of Raignac, of which the enemy was in poſſeſſion; and it is well known that they ended the campaign there, without being able to penetrate into Alſace.

The number of columns ought to be regulated by the breadth of the ford, or by the number of bridges that are eſtabliſhed.

The third of June 1747, at day-break, the army commanded by M. de Belleiſle paſſed the Var in five columns. This paſſage was effected without any reſiſtance on the part of the enemy, and M. Belleiſle had 15 men drowned, although there was a chain formed of peaſants, acquainted with the fords, to direct the march of the columns, and to aſſiſt the ſoldiers who were carried away by the rapidity of the current.

III. All paſſages of this nature, whether in a march, in defence, or for an attack, may be foreſeen. A general may, at a diſtance, make all the preparations neceſſary for theſe operations; he may anticipate or foreſee the diſpoſitions of the enemy: in regard to a retreat it is otherwiſe; for although it may have been provided for, a general cannot be certain whether it can be effected after the manner he hath intended; beſides, he muſt, in a retreat, unite all the different diſpoſitions already mentioned: the leaſt negligence becomes irreparable, and gives the enemy a very great advantage. A moment loſt, a movement diſcovered, may alſo be the cauſe of a rout, and render the retreat impoſſible, or at leaſt very bloody; therefore if a general, in theſe circumſtances, has not a perfect knowledge of the river he has to paſs, if he has not been careful to preſerve the bridges, or to keep the materials and inſtruments proper for the throwing over of new ones, he will be unable to paſs in ſight of the enemy. Xenophon's retreat with the 10,000 Greeks, furniſhes examples of the paſſages of rivers, which a general ſhould always have preſent to his view. What prudence, what activity in ſounding the fords himſelf whenever he met with any ſtream or river to be croſſed! What orders to prevent confuſion among his troops, and what ſtratagems to avoid being repulſed!

If a general is certain of returning by the ſame place at which he has formerly paſſed, the beſt way would be, as Vegetius ſays, to have the bridges guarded, and to erect a fort with large ditches at the head of each, for their ſecurity, and to place troops in it to guard the bridges and the paſſage, as long as ſhall be thought neceſſary.

Thus circumſtanced, a general ſhould entrench the heads of the bridges in the manner already directed; and that the troops may paſs the bridges without confuſion, according as one brigade of infantry ſhall enter the circle formed by the redoubts, another ſhall paſs the bridge, and that which enters ſhall take poſſeſſion of the poſts which that which paſſes occupied; he muſt be careful to eſtabliſh batteries of cannon to the right and the left, on the other ſide of the river, to flank the redoubts, and defend the approach to them;

ſo that when the whole army ſhall have paſſed, the troops who occupy the redoubts may retire with eaſe. The cavalry will paſs the bridges without ſtopping behind the redoubts.

In a retreat of this kind, the infantry ſhould march in column, and the cavalry in order of battle, upon the flanks of the infantry. Before the march is begun, ſome troops muſt be ſent to occupy the redoubts; and as ſoon as they ſhall be in poſſeſſion of them, the army will put itſelf in march, and proceed towards them. The cavalry of the right muſt paſs over the bridge neareſt to it, and that of the left will do the ſame. The columns of infantry muſt enter by the ſpaces which are between each redoubt; the grenadiers and the piquets muſt remain, in order to ſuſtain the troops occupying the redoubts: ſome pieces of cannon ſhould alſo be left to fire upon the enemy in caſe he ſhould approach too near; the columns muſt paſs over the three bridges; the grenadiers and the piquets muſt alſo draw near the head of the bridges at night-fall; the troops occupying the redoubts muſt quit them ſilently, and paſs the bridges; they muſt be followed by the cannon that has been left during the day; the grenadiers muſt paſs laſt of all; after they are paſſed, the bridges muſt be broken down. This may be eaſily executed, provided order and ſilence are preſerved; but if the enemy entertains the leaſt ſuſpicion of the redoubts being abandoned, he will come in full ſtrength to attack the troops ſtill remaining on that ſide. Theſe troops, too weak to reſiſt a ſuperior number, cannot avoid being beaten, ſlaughtered, or drowned, the cannon taken, and the bridges burnt.

For greater ſecurity, the grenadiers and the piquets may be furniſhed with chevaux-de-friſe, which will make an entrenchment, till the troops which occupied the redoubts are retired. A retreat never merits the epithet of *fine*, except it is performed with order, and with the loſs of as few brave men as poſſible, to ſave the reſt of the army.

In every enterpriſe formed by a general in difficult places he muſt, according to M. de la Valiere, provide for his retreat. In retreats of all kinds, adds the duke of Rohan, a general cannot be too attentive to render it ſafe, and to avoid diſorder: when it is the effect of his own choice, it ought to be made ſo early, and ſo expeditiouſly, that he may not be under a neceſſity of fighting.

During the paſſage of a river, or even after a general has paſſed it, if he ſhould be repulſed, the retreat becomes very difficult, and cannot be performed without great loſs; it is for that reaſon that many generals, who have been miſtruſtful of the firmneſs of their troops, have burnt their ſhips in the port, in order to animate them to victory, from conſidering the impoſſibility of retreating.

The following retreats by M. Saxe acroſs rivers, will give the reader ſome notion how ſuch enterpriſes ſhould be conducted.

In the campaign of 1742, the diſpoſition of that commander for paſſing the Danube owed its whole ſucceſs to ſecrecy, to his addreſs in profiting by circumſtances, and particularly to a very thick fog.

The two armies were encamped two leagues diſtant from each other, and the light troops ſkirmiſhed together the whole day. At ſeven o'clock at night, count Saxe ſent for the general officers, furniſhed them with inſtructions, and cauſed the guards to be doubled. At nine o'clock, the baggage filed off over two bridges; one of rafts and another of piles: after which the infantry paſſed, and the grenadiers, who formed the rear-guard, cut down and burnt the two bridges. The enemy advanced in order to charge his rear-guard; but 18 pieces of cannon that had been planted beforehand, very ſoon ſilenced the fire of their muſketry, and he loſt not a ſingle man. At day-break the army formed in order of battle, upon two lines, in order to give time for the Imperialiſts to retire from Pladling; and as ſoon as they had joined, the army put itſelf in march in four columns.

It is particularly neceſſary, either in paſſages or retreats, to be acquainted with the nature of places, and if they are fit to furniſh the timber neceſſary for making rafts and bridges. In Germany, and countries where wood is very plenty, in order to paſs with greater expedition, a general can make uſe of rafts or flying bridges. (See *Flying Bridge.*) Two may be placed, one upon the right, the other on the left, of a bridge built upon piles; by which means three columns can paſs at once. It ſhould be obſerved, that the flying bridges are by no means ſecure againſt torrents.

In 1742, count Saxe having beforehand poſſeſſed himſelf of Thonaſtauf, cauſed two flying bridges of rafts, and a great work of redans, to be erected, in which he poſted five battalions and ſome cannon.

On the 9th of September all the baggage paſſed the Danube: on the 10th the army put itſelf in order of battle in two lines, which retired ſucceſſively toward the river. The lines paſſed one after the other; that is, the cavalry at the ford, and the infantry upon the flying bridges.—Six thouſand of the enemy's advanced guard were witneſſes of this retreat without daring to moleſt it; ſo prudently were the orders given, and ſo exactly executed.

It is in retreats that bridges are moſt liable to break under the weight of the troops; it is at that time that precautions are neglected, becauſe the danger becomes more preſſing, and they are not ſufficiently acquainted with the rivers over which the bridges are thrown.

Sect. XI. *Of Battles.*

Of all the operations of a campaign, the moſt important, and that which is moſt deſerving of attention, is a battle, becauſe it is generally deciſive; every other operation is but preparatory to, or conſequent of it. A general engagement, ſays Vigetius, is often decided in two or three hours; after which there ſcarcely remains any reſource for the vanquiſhed. Battles, ſays M. de Montecuculi, beſtow and take away crowns; from their deciſions princes cannot appeal; by them war is put an end to, and the name of the conqueror immortalized.

A general ſhould by no means ſuffer himſelf to be forced to a battle; neither ſhould he offer it but when there is a real neceſſity for it; and even when he gives battle, it ſhould be rather with an intention of ſaving than ſhedding blood; more with a view of aſſerting the rights of his maſter, and the glory of his country, than of oppreſſing mankind. However bloody a battle may be, it is always leſs ſo than a long war; which by reiterated troubles, conſumes the treaſures of ſovereigns, that ſinew of a ſtate, and drains the blood of the ſubjects.

Nevertheleſs, there are ſome occaſions where it is not left to a general's choice, either to give or accept of battle. An army of obſervation, and an army acting on the defenſive, neither can nor ought to be deſirous of coming to action. Both the one and the other ſhould have no other object in view, than that of poſting itſelf in ſo advantageous a ſituation, that the enemy may neither entertain a thought of attacking it in its camp, or any hope of forcing it. The army of obſervation, whoſe only object is to protect, or to cover the troops forming a ſiege, ſhould never ſeek to fight the enemy, unleſs attacked by him: the other, obliged by its want of ſtrength to act upon the defenſive, ſhould only be deſirous of occupying advantageous poſts, to prevent the enemy's penetrating into the country, and attacking it in any poſition it ſhall have taken.

If the choice is left to the general, he ought to be particularly careful, before he comes to a reſolution of giving battle, to examine whether he can gain greater advantage by winning it, than he will ſuſtain damage by loſing it.

It is therefore neither caprice, nor a miſtaken courage, or the deſire of diſtinguiſhing himſelf at an improper time, that ſhould determine a general to give battle; but his ſuperiority over the enemy, both in the number and quality of troops, the enemy's incapacity, his ill-choſen encampments and negligent marches, the neceſſity of ſuccouring a place, or the certainty of a reinforcement, by the junction of which the enemy will become ſuperior, or circumſtances which may change the original deſigns of the campaign. This was the reaſon which induced the viſcount Turenne, in 1674, to give the battle of Einſheim, becauſe the prince of Bournonville waited the arrival of the Elector of Brandenbourg, who was coming to join him with a conſiderable reinforcement; and if he had not given battle before that junction, the enemy's army would have had a very great ſuperiority over his. The reaſons given by Montecuculi for avoiding a battle are, "when the loſs of it will be more prejudicial than the gaining will be advantageous; when inferior to the enemy, or when ſuccour is expected; when the enemy has the advantage of the ground; when it is perceived the army is working its own ruin, either by the fault or diviſion of the commanders, or through the diſagreement of confederates." It may alſo be added, when the enemy's army labours under ſome diſeaſe; when it is in want of proviſions and forage; and that, diſheartened by theſe circumſtances, his troops deſert from him.

It is on a day of battle that it becomes particularly neceſſary for a general to be acquainted with his own ground, and alſo that which is occupied by the enemy; to know in what manner his wings are ſupported, the nature of the places where theſe ſupports are; whether he can be ſurrounded, and in what part he can be attacked with the greateſt facility.

But however eſſential theſe branches of knowledge may be, it is not always the ſuperiority of number, or quality of the troops, or advantage of ground, that will ſecure the beſt diſpoſed army from being routed: it is the foreſight of the general in the precautions he has taken before the battle; it is his genius, his activity, his coolneſs, in the time of action, and the capacity of the general officers acting under him, that determine the ſucceſs.

Ground, ſeemingly the moſt advantageous, often preſents obſtacles, which do not immediately ſtrike a general, although an experienced one, and which may prove fatal in the courſe of a battle; how, therefore, will a general be able to correct theſe miſtakes, if he conſiders them as only trivial? At the battle of Cerignoli, fought on the 28th of April 1503, the enemy's front being more extended than at firſt it was ſuppoſed to be, in order to give a greater extent to that of the French army, it was neceſſary to continue the lines acroſs vineyards and thickets; by which means, the neglecting to fill up a ditch, cauſed the defeat of the French, and the death of M. de Numours their general.

A general ſhould not always purſue his own opinion, it being impoſſible for one man to ſee every thing; he ſhould, therefore, cauſe an exact account to be given to him of whatever he cannot have an opportunity of ſeeing perſonally; to inform himſelf by ſpies of the enemy's order of battle, and act in conſequence of that knowledge; he ſhould poſſeſs himſelf of all places capable of containing ambuſcades, which he ought to have had examined ſome days before the battle. Santa Cruz hath given a particular detail of all theſe preparations.

It is in theſe moments, which decide the fate of nations, that the genius and prudence of a general ought to be conſpicuous; he ſhould ſee, at the ſame time, what is doing among his own and the enemy's troops. Beſides the precautions which ought to have preceded the day of battle, thoſe which ought to be taken in the courſe of the action are ſo numerous, that it is impoſſible for them all to find a place here.

Some depend upon the general's ability, others upon circumſtances which it is almoſt as difficult to deſcribe, as to mark out the neceſſary diſpoſitions for them.

It depends upon the general's genius, and foreſight to make choice of intelligent, active, and prudent aids-de-camp, to aſſign to each particular body the propereſt commander; not, for example, to place, at the head of infantry, one who has been long accuſtomed to the ſervice of the cavalry; or at the head of cavalry, one who is more uſed to the infantry, &c.; to encourage the ſoldiers by the hope of rewards, and by motives which may ſpirit them up, and to threaten thoſe who are ſo unmanly as to tremble at the ſight of an enemy, or raſh enough to run forwards without order.

The general ſhould alſo be capable of forming new ſchemes, in order to render thoſe of the enemy abortive; he ſhould alſo take care, whatever may be the nature of the country, to diſpoſe his army after ſuch a manner, as to render it equally ſtrong in every part, that all the bodies of which it is compoſed may protect and aſſiſt one another without confuſion; that the intervals neceſſary for acting be well preſerved, and that the reſerve can eaſily march wherever it ſhall be ordered: in a word, the troops ſhould be diſpoſed after ſuch a manner, that even before the action they may perceive in what manner they are to act.

It is the work of genius to take advantage of circumſtances, and to ſubmit to them; it is impoſſible to foreſee the precautions dependent on them, as the very circumſtances muſt be themſelves unforeſeen: it is by a general's addreſs, in knowing how to profit by circumſtances, that he ſhows his ſuperiority in the day of battle. M. de Montecuculi reduces all the advantages that can be gained over an enemy to four principal heads, which, in reality, are of themſelves reduced to the knowledge of profiting by circumſtances; ſuch are the advantages of number, when the enemy is beaten in his poſts, his convoys, and in his forages; when an ambuſcade is ſurrounded, or when a whole army falls upon a ſmall, weak, and ſeparated body: the ſecond head conſiſts in the knowledge of the commander; the third in the manner of fighting; and the fourth in the advantage of the ground. A general, who properly conſiders theſe heads, will diſpoſe of a combined army after ſuch a manner, that it may, at the ſame time, receive orders without miſtake, and execute them without confuſion; a very neceſſary precaution, and one which Hanno, general of the Carthaginians, neglected to take with regard to the ſtrangers allied with them, which occaſioned the troubles related by Polybius. He ſhould have mixed the ſoldiers belonging to thoſe countries, where bravery is in a manner natural to them, with thoſe belonging to countries where it is more extraordinary.

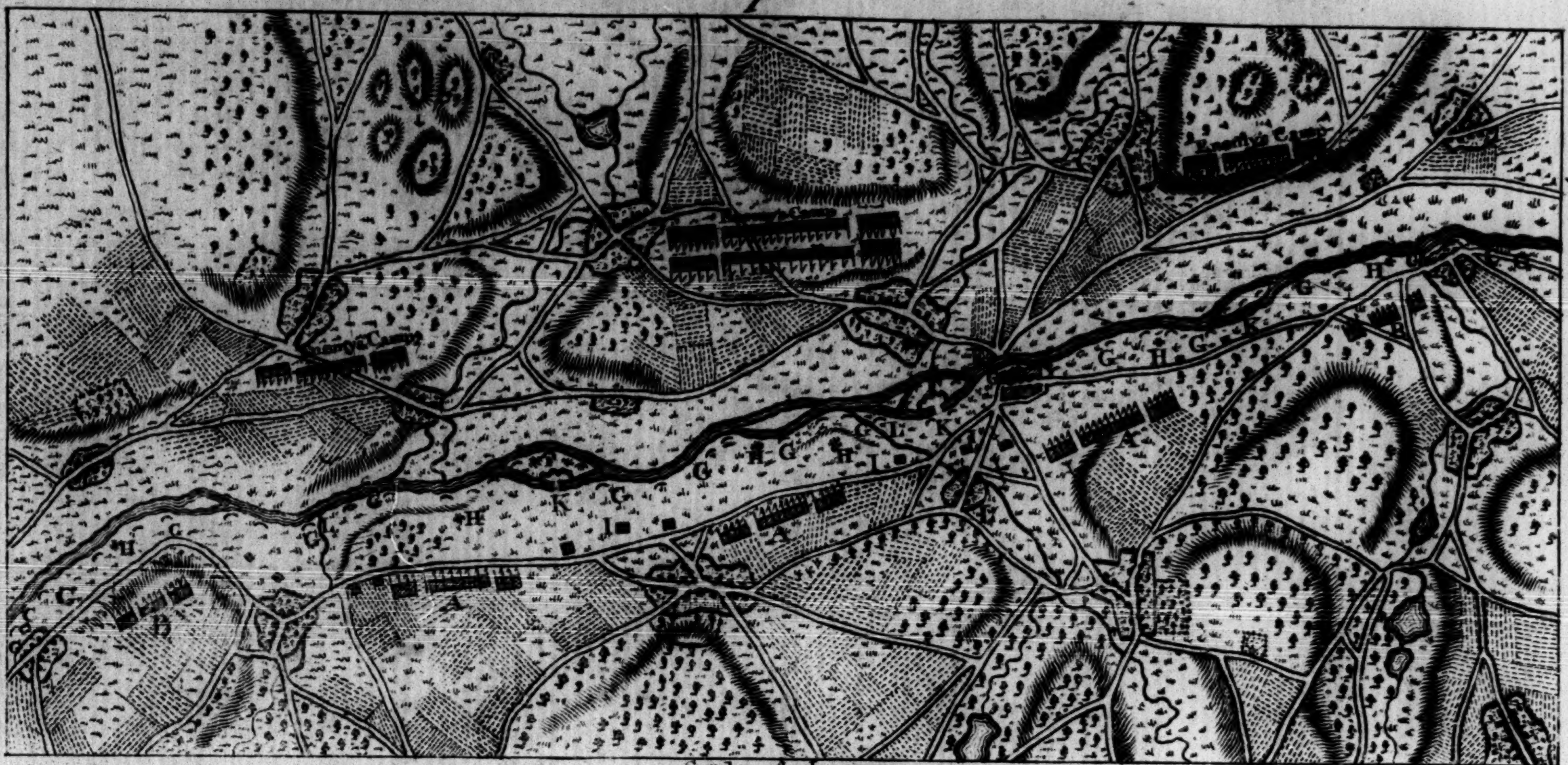
Vigetius points out the precautions neceſſary to be taken by a general, to avoid having either the wind or the ſun in his front. The wind, which raiſed the duſt, and blew it into the eyes of the Romans, contributed to the loſs of the battle of Cannæ: the ſun, on the other hand, dazzles the ſoldiers, and lays open their diſpoſitions and evolutions to the enemy: in a word, the general ſhould not neglect even

thoſe

WAR.

PLAN of the Position of an Army for the Defence of a RIVER.

I.

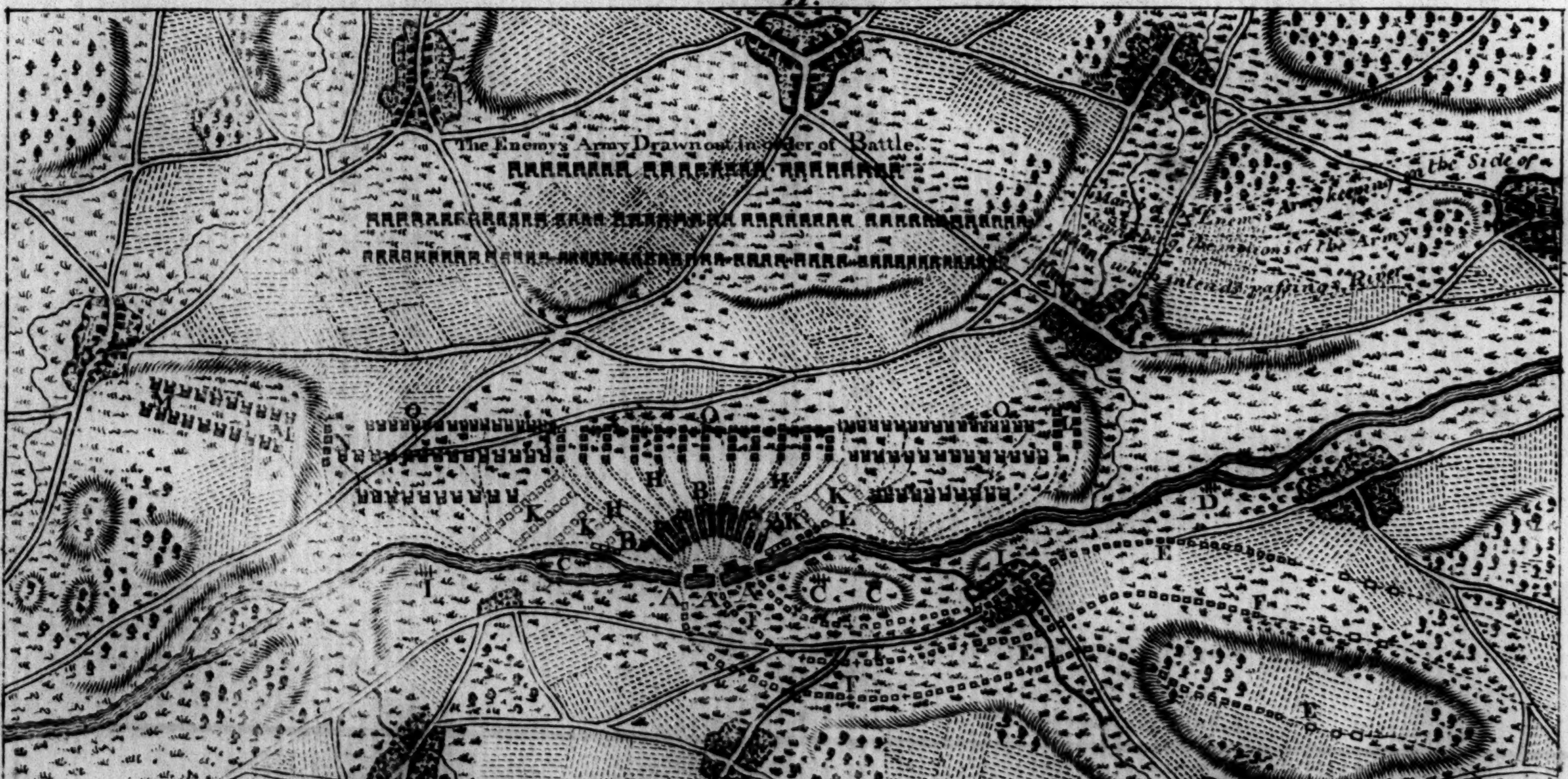


Scale of 1 League.

400 400 1200 2400 T.

PLAN of the Paſſage of a RIVER.

II.


The Enemy's Army Drawn out in order of Battle.
March of the Enemy's Army keeping on the Side of … watching the motions of the Army which intends passing a River
O
H
K
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I
D
E
F

Scale of ½ a League

30 300 600 1200 T.

Jones sc.

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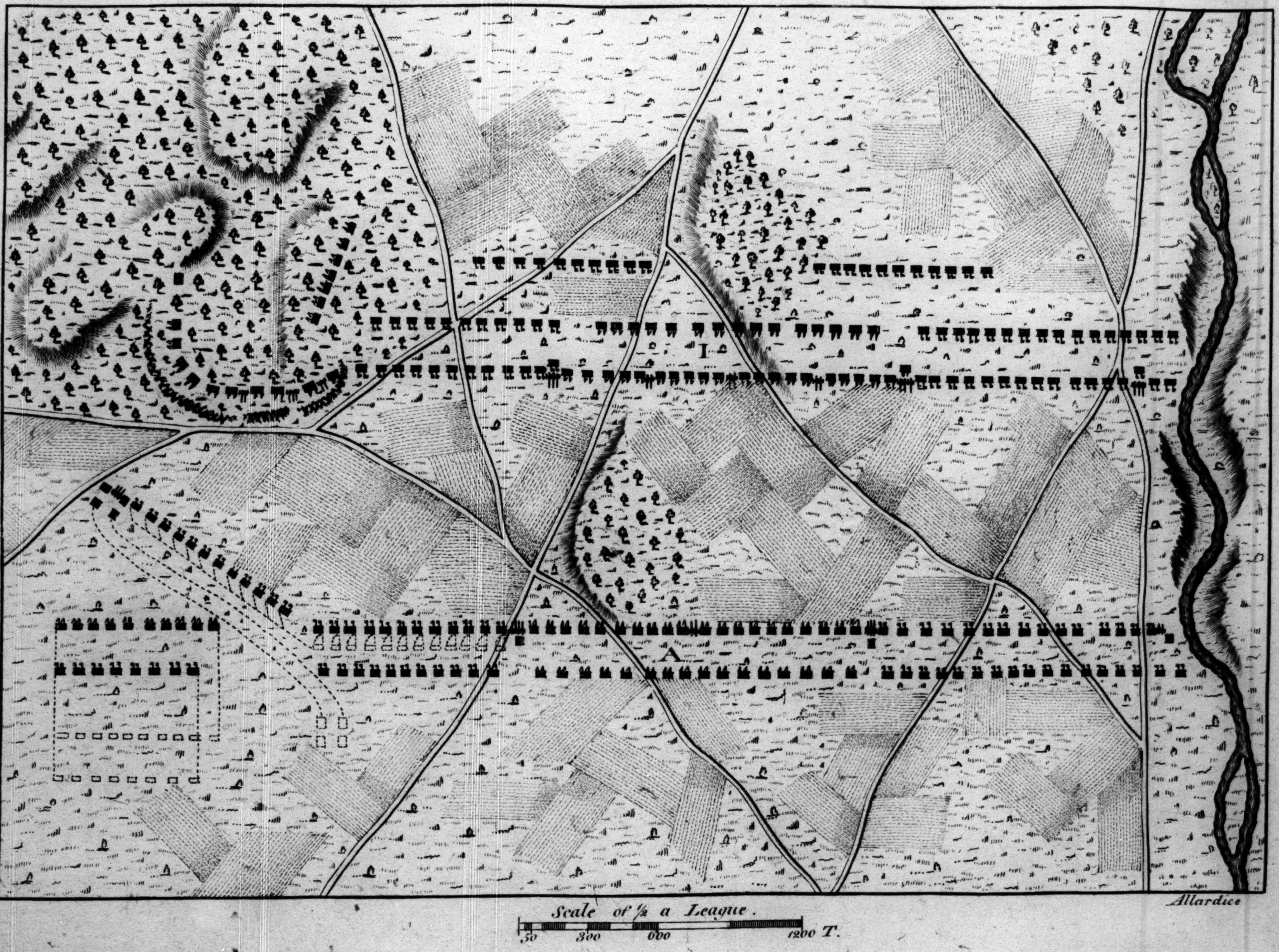
WAR.

Plan of an Order of Battle 1ſt Diſposition.

Plate DXX.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BRITISH MUSEUM

Offenſive Operations.

thoſe precautions which may be in appearance uſeleſs, whether before the battle, or at the very time they may be put in execution after the action; as the rallying the troops, the refreſhing of them, the retreating from before the enemy, or the purſuit of him, ſuppoſing the battle to be gained. A general ſhould have beforehand formed the plans of the marches and the enterpriſes he would attempt, and be almoſt certain of the means of executing them; if, on the contrary, he fails, he ſhould have determined the poſitions by which the army, fixed in a camp ſtrong by ſituation, may prevent the enemy from reaping any great advantage from his victory: he ſhould alſo have provided for the ſecurity of the priſoners, the hoſpitals, the plunder of the ſoldiers; in ſhort, for all that is neceſſary for preſerving order and diſcipline, and every thing contributing to the ſecurity of the troops: the diſtreſs of the enemy, and the glory of the ſovereign, ſhould be provided for without waiting for the event; for at that time confuſion and diſorder would prove more fatal than even the battle.

In the treatiſe written by Santa Cruz, upon the diſpoſitions before and after a battle, may be ſeen a long detail of the precautions depending upon genius, and of thoſe which are regulated by circumſtances.

The general's poſt during the action ought to be, according to Vigetius, on the right wing, between the cavalry and the infantry. Onozander fixes it upon ſome height, and Santa Cruz towards the centre, in the front of the ſecond line. Titus Livius and Polybius have obſerved, that the poſts of Scipio and Hannibal were always in thoſe parts which were leaſt expoſed: becauſe, as obſerved by Onozander, a general who runs into danger is a raſh man, fuller of preſumption than courage: neither is daringneſs, adds his commentator after Plato, always a ſign of courage; beſides, a man who is really brave, is never daring but when it is abſolutely neceſſary.

A general ſhould not always ſuppoſe that what particularly ſtrikes him is right; he ſhould reaſon calmly upon the probability of it, in order to come to a greater degree of certainty with regard to the practicability: he ought alſo, ſays Vigetius, to be acquainted with the nature of the enemy, and the characters of his generals, whether they are prudent or raſh, daring or timid; whether they fight upon principles or at hazard: in effect, a general ought to be earlier or later in making an attack in proportion to the raſhneſs of the enemy. If, ſays M. de Montecuculi, any ſign of fear or confuſion is perceived among the enemy, which will be known when the ranks are diſordered, when the troops mix together in the intervals, when the colours wave about and the pikes ſhake all at the ſame time, then he ſhould charge and purſue the enemy without giving him time for recollection: ſome dragoons, light cavalry, platoons, ſome looſe troops, ſhould be ſent forward; who, whilſt the army advances in order of battle, will go before to ſeize ſome poſts into which the enemy muſt fall. A general ought alſo, ſays Vigetius, to ſound the ſpirit of his ſoldiers, and obſerve whether they have a firmer countenance than the enemy. It is dangerous to lead an army on to action that is not thoroughly determined to do its duty. "Battles," ſays Vigetius elſewhere, "are generally won by a ſmall number of men." The great myſtery conſiſts in the general's knowing how to chooſe them, to poſt them well, conformable to his plan, and the ſervices required of them.

I cannot aſſign the reaſon (ſays he) why particular bodies fight better againſt other particular ones, or why thoſe who have beat bodies ſtronger than themſelves, have in their turn been often beaten by thoſe that were weaker: It is undoubtedly owing to want of confidence, becauſe the place of action has been different; or from other circumſtances which cannot be laid hold of, but on the very inſtant. The ſituation of the mind is ſhown in the countenance of the ſoldiers; it is declared in their diſcourſe, and by the moſt trifling of their actions. The general ſhould conſult them; he ought even to go farther—the beſt countenance is not always a ſign of the firmeſt courage. Cowardice often conceals itſelf under the maſk of intrepidity; but ſoon as the action begins, the veil falls off, and the coward ſhows himſelf, notwithſtanding all his endeavours to the contrary. Neither at this time ſhould a proper degree of fear be thought blameable; nature muſt be allowed to ſhrink in that awful and uncertain ſituation: the coward gives himſelf up to his fears; the bully ſeeks in vain to diſſemble them; and the raſh man, who cannot diſtinguiſh between danger and ſafety, is ſenſible of both; the real ſoldier is always modeſt, and contented with having done his duty. A good general turns every thing, even want of ſtrength, to advantage. Hannibal, at the battle of Cannæ, poſted his beſt troops upon the wings, that the centre, which was compoſed of thoſe on whom he had the leaſt dependence, might be the ſooner broke, in order to give the wings an opportunity of ſurrounding the Romans.

It alſo requires a very ſtrict examination in a general, in order to be thoroughly maſter of the circumſtances on which he ſhould regulate his diſpoſitions: and he will alſo find it ſometimes neceſſary to make ſome change in his original intentions. It is always proper that the corps of reſerve ſhould be compoſed of veterans, and even of part of the flower of the army; for ſhould the army happen to be broke, this reſerve alone may probably give a new face to the action: it was this method which Hannibal purſued at the battle of Zama; where Scipio, after having defeated the troops which preſented themſelves to him, was aſtoniſhed to find he had a new army to fight with. At the battle of Fontenoy, the houſehold troops placed in reſerve, with ſome brigades of infantry, determined the ſucceſs of the day. Nevertheleſs, on ſome occaſions this diſpoſition may prove diſadvantageous; as, for inſtance, where it would be neceſſary to preſent a large front to the enemy, or where it is neceſſary to prevent his getting poſſeſſion of a paſs or a defile; where a general finds himſelf too inferior, and where there are alſo poſts to be defended.

It would be unneceſſary to repeat every thing mentioned by Vigetius, relative to the precautions neceſſary to be taken before a battle; time, and the difference of weapons, have greatly altered diſpoſitions: fire-arms, which are now made uſe of inſtead of darts and ſlings, and the bayonet inſtead of the pike, have contracted the intervals which muſt neceſſarily be left between every ſoldier.

The order and diſpoſition of troops for action depend entirely upon the general, who knows how to profit by circumſtances; the juſt execution of them depends upon the capacity of the general officers. The general cannot be everywhere, or ſee every thing; he is obliged to rely upon the underſtanding of thoſe who command under him for the juſt execution of his orders; the general officers ſhould know how to vary them, in proportion as circumſtances, and the ſituation of the enemy changes. They ſhould have an exactneſs and quickneſs of eye, both to oppoſe and profit by them; and, as M. de Puyſegur obſerves, the diſpoſition of the troops being once regulated by that of the enemy, by the ſituation of the country, and the general orders that have been delivered, the only part the general can have in the action lies in thoſe places where he is within reach of giving orders himſelf.

M. de Montecuculi, with great reaſon obſerves, that there cannot be too many officers in an army on the day of battle, in order to ſupply the places of thoſe who are killed; but can a man poſſeſſed of any degree of humanity approve of what he adds, that this number ſhould be increaſed in time of war, and reduced in time of peace? What a proſpect for a ſoldier, who, after having laviſhed his blood for the ſafety of his country, and the glory of his prince, ſees himſelf expoſed to the fate of Beliſarius! Whatever were the virtues of his maſter Juſtinian, can any one, without indignation, ſee this general, after having overcome the Perſians, reunited Africa to the empire, puniſhed the Vandals, driven the Goths out of Italy, ravaged Aſſyria, ſcattered at a diſtance from both empires that throng of barbarians by which they were over-run, and preſerved the throne, and the life of the emperor; upon the bare ſuſpicion, or rather under the pretence of a conſpiracy, deprived of ſight, and reduced to beg alms of paſſengers in the ſtreets of that city which he had ſo often ſaved?

It has been already ſeen, that the diſpoſitions in a mountainous country change according to the ſituation of the ground, Vigetius repeats, ſpeaking of a field of battle, what has been ſo often eſtabliſhed in the foregoing ſections, that an open country is always moſt advantageous for an army that is ſtrongeſt in cavalry; and that an encloſed ſpot, divided by ditches and marſhes, covered with mountains and woods, is moſt convenient for infantry. In this laſt, the knowledge of the country, the art, the ability of the general, and the underſtanding of the general officers under his orders, ſooner aſcertain the ſucceſs, than a ſuperiority of troops in an open country, which preſents little or no variety of ground, and which allows the greateſt part, or indeed the whole, of the troops to act; the ſuperiority in troops is attended with great advantage, provided alſo the diſpoſition is good.

The different diſpoſitions for troops are ſo many, the circumſtances differ ſo greatly, that were it even poſſible to connect in one body only all the battles which have been fought ſince the time mankind reſolved to regulate their properties by the law of the ſtrongeſt, the number of contrivances which remained to be collected would be greater than of thoſe which have been actually executed. It is impoſſible to give a detail of every thing; for in that caſe every particular ſpot, and the diſpoſition proper for it, every country, and all the circumſtances that may oblige theſe diſpoſitions to vary, muſt be deſcribed. Thoſe now going to be mentioned, are only with the view of giving the rules, and of more clearly demonſtrating thoſe precepts which lead to the knowledge of all others.

Disp. I. Let two armies of equal force be ſuppoſed, in an open country divided by a river, conſiſting of 57 battalions and 72 ſquadrons each, cavalry, huſſars, and dragoons. The two armies are on the ſame ſide, the right of the one, and the left of the other, to the river. The left of the army whoſe right is to the river is unſupported; and that whoſe left is ſupported, has a wood on its right. By this diſpoſition may be ſeen the neceſſity of covering the wing of the army A, that is expoſed. Plate DXX.

The army I, whoſe right and left are ſupported, is formed upon two lines, and preſents the ſame front as the army A, with a reſerve in the rear. The following is therefore thought to be nearly the diſpoſition which ſhould be made by the general commanding the army whoſe left is unſupported. The firſt line ought to conſiſt of 20 battalions, with intervals of about three toiſes between each battalion; 12 ſquadrons on the right, with their proper intervals; four battalions on the right of the cavalry, 10 pieces of cannon, and a battalion in column cloſe to the river; 12 ſquadrons on the left of the firſt line, with their proper intervals; 16 battalions in the ſecond line, 300 paces diſtance from the firſt; 11 ſquadrons on its right, placed behind the intervals of thoſe in the firſt line; and on their right, ſix ſquadrons of dragoons next the river, in order to ſuſtain the infantry and cannon covering the right; 11 ſquadrons on the left, placed in the ſame manner as thoſe on the right; 10 pieces of cannon, ſupported by a battalion in column, between the infantry and the cavalry of the right; 10 others, ſupported alſo by a battalion between the infantry and the cavalry of the left; four battalions in the rear of the ſecond line on the left, with orders to tranſport itſelf obliquely, or ſidewiſe, as ſoon as the army moves to attack that which is drawn up againſt it; 12 ſquadrons of cavalry in the rear of the firſt line upon the left, to poſt themſelves obliquely upon the flank, at 100 paces diſtance from the firſt ſquadron on the left, next to the four battalions and the cannon; the reſerve, conſiſting of 10 battalions and eight ſquadrons of dragoons, in the third line upon the left flank, ſo that it may fall into the firſt line as ſoon as the ſquadrons of cavalry, which were in the rear of thoſe of the firſt line, ſhall be poſted obliquely: in this poſition, the army will move forward, the right never quitting the banks of the river.

If the enemy's army ſhould advance, the diſpoſition of the army A will become ſtill better, becauſe the army I will quit the ſupport it had on its right: but if, on the contrary, it remains in its poſt, in order to keep this ſupport, then the 10 battalions of the reſerve, followed by the eight ſquadrons of dragoons, will join the four which ſupport the flanks of the cavalry which is poſted obliquely. When marching, this line poſted ſidewiſe ſhould proceed obliquely; and when the cannon ſhall be near enough to cannonade with effect, it ſhould make ſeveral diſcharges, in order to break and beat down the entrenchments, or felled trees, which the enemy may have made, and alſo to deſtroy their diſpoſition. As ſoon as the army A ſhall be near enough to cannonade the army I with ſucceſs, it muſt halt, and amuſe it with a continual fire of the cannon. The principal attack ought to be made at the wood by the 14 battalions: in order to give more ſtrength and certainty to this attack, ſix other battalions, with 10 pieces of cannon, ſhould be detached to it from the ſecond line, always keeping up a fire from the front. If during this attack, it is perceived that the enemy weakens his line, in order to carry aſſiſtance to the wood that is attacked, then the centre and the right of the army ſhould march up and charge him briſkly. The troops who cannonade the wood ought not to advance, but ſhould only keep the troops poſted in it at bay; becauſe that part which the enemy has weakened will then become the principal object of attack: it is probable, that the enemy having weakened his front, will certainly be broke. If the enemy ſhould not weaken his front, and the attack of the wood ſhould ſucceed, as ſoon as the enemy is driven out of it, the troops which attacked it ſhould take the enemy in flank; then the body of the army, by advancing, ought to determine an affair already half gained. If by the intelligence the general hath received, and the number which he knows the enemy's army to conſiſt of, and which he ſees before him, he judges the wood is filled with infantry, and that conſequently the attack of it will be attended with difficulty, he muſt attack on the ſide of the river, by marching by degrees from the right, as if to ſuſtain the left. For the greater certainty of ſucceeding in this attack, he ſhould reinforce the five battalions upon the right with ſome others from the ſecond line: the left ſhould continue in the poſition already mentioned, to keep back the enemy. If it ſhould happen that the enemy, ſeeing his left attacked, cauſes the troops to leave the wood in order to replace thoſe of the centre, which he cauſed to march to the aſſiſtance of the left, the 14 battalions which are poſted ſidewiſe, ought briſkly to attack the wood ſuſtained by dragoons. Theſe laſt ſhould poſt themſelves upon the left flank of the infantry in order to cover it; and as ſoon as it ſhall be within 60 paces of the enemy, it ſhould march up to him with bayonets fixed; and the dragoons ought to attack him in flank at the time the infantry does the ſame in head. The wood is all this while ſuppoſed to be practicable for the dragoons on horſeback; but in caſe it ſhould not be ſo, they muſt diſmount, the infantry being ſufficiently ſupported by the 12 ſquadrons of cavalry, which are placed ſidewiſe.

The general may with eaſe, eſpecially in an open country, attack the enemy's whole army together; but this may be attended with great danger, and if the whole front of the firſt line is broken, there will not be much difficulty in breaking the ſecond: whereas, by attacking the enemy's army in one or two parts, if one of theſe attacks ſucceeds, the battle is won; becauſe the troops who are victorious, take the enemy in flank, at the ſame time that he is attacked in head by the reſt of the army. In caſe it ſhould not ſucceed, the troops who made the attack can retreat, protected by the whole army, which hath not at all ſuffered.

The general ſhould, as much as poſſible, conceal the motions he intends making from the enemy; conſequently the five battalions and 10 pieces of cannon which ſupport the right of the army next the river ought to march in the rear of the ſquadrons of the firſt line, the infantry with their arms ſecured, and not range themſelves in the order of battle intended, till the two armies are ready to march to charge each other. It is the ſame with regard to the ſquadrons of cavalry, which ſhould be poſted behind thoſe of the firſt line, to execute the deſign already laid down.

Disp. II. If the two armies are not ſupported either on their right or their left, the ſame poſition ſhould ſubſiſt that hath already been eſtabliſhed for the cavalry, which is in the rear of that belonging to the firſt line, except that it ſhould be diſtributed on the right and the left. If there is not cavalry ſufficient, huſſars muſt be ſubſtituted in its place; but if there ſhould be cavalry enough, it muſt be uſed on this occaſion; becauſe cavalry being a greater body, its charge is heavier, and it alſo makes a greater impreſſion upon other cavalry oppoſed to it, provided they execute their order with great quickneſs. This cavalry or huſſars, which are poſted ſidewiſe, ſhould not quit their poſt, but wait the ſucceſs of the attack. If the enemy is repulſed, they muſt then fall upon his flanks, and by a briſk and vigorous charge endeavour to involve the ſecond line in the confuſion of the firſt; they will be followed by part of the wing of cavalry that is victorious, in order to give a greater force to the attack of the ſecond line, taking as much care as poſſible not to leave any body of cavalry upon the wing of infantry that is in a condition of protecting it. After theſe two lines of cavalry have been broken and purſued, half of the victorious line ſhould remain in order of battle; and, by a motion to the right from the left, take the enemy's infantry in flank, at the ſame time that it is attacked in head by the infantry of the army. The ſecond line ſhould then move into the place of the firſt, in order to be near enough to aſſiſt it in caſe the enemy's infantry ſhould ſtand its ground firmly; but it is probable, that being deprived of its cavalry, it will neither have the ſame firmneſs, nor the ſame ſpirit, as if it was ſupported, eſpecially when it is attacked on every ſide.

The cavalry and the huſſars who purſue the beaten wing ſhould not expoſe themſelves too much, or break their order in the purſuit, for fear the enemy's huſſars which are behind ſhould fall upon and beat them by attacking them on all ſides; which may very probably happen, if they do not take care to keep in order of battle; which ſhould at leaſt be attended to by the cavalry. After the huſſars have purſued the enemy's cavalry ſo long as to entirely diſorder them, they ſhould return and take their former poſts, in order to march from thence to whatever place they may be ſerviceable. Although it may appear ſomething hard to make the huſſars return, there is nothing ſo difficult but what may be accompliſhed, when order and diſcipline are firmly eſtabliſhed, and when an officer has the art of making himſelf obeyed.

At the battle of Cannæ, the Carthaginian cavalry, ſuperior to that of the Romans, having broke through them, one part continued the purſuit, and the other fell upon the rear and the flanks of their infantry; at the ſame time the Carthaginian infantry charged that of the Romans in all parts, which decided the victory. Thus Hannibal owed his victory partly to his ſuperiority in cavalry, and to his attack upon the flanks. The Numidians, who were upon the right wing of the Carthaginian army, and who fought nearly in the ſame manner as the huſſars, performed on this occaſion the ſame ſervice as the huſſars would certainly do in the diſpoſition now before us; ſo true it is, that infantry, deſtitute of its cavalry, hath no longer the ſame firmneſs, nor the ſame ſpirit; and if it is alſo attacked in head by infantry, it cannot avoid being beat. The principal attention of a general, ſays M. de Montecuculi, ought to be to ſecure the flanks; experience having taught, that when the wings of cavalry are broke, the infantry is eaſily ſurrounded, and hath no longer the means, nor even the courage, of defending itſelf. The reader may ſee the principles he lays down upon that ſubject. It is ſeen by the example of the battle of Cannæ, what uſe the cavalry ought to be put to, particularly in an open country where it can eaſily act. What advantage may not be expected from it, when an army of Romans, 80,000 ſtrong in infantry, and 6000 horſe, was overcome by the Carthaginians, weaker by the half in infantry, but which derived its principal ſtrength from 10,000 cavalry, all veterans, and well diſciplined.

But if the wing of cavalry is beat, it ought to retreat with as much order as poſſible. The cavalry, or huſſars, that are poſted ſidewiſe, ſhould always continue in the ſame place; there is no reaſon to fear that the enemy will advance briſkly to the purſuit; becauſe he will be taken in flank by the body that is poſted ſidewiſe; a circumſtance which ought not only to abate the eagerneſs of the conquerors, but alſo animate the conquered. By this manner of acting they gain time to paſs through the intervals of the ſecond line, and to rally in the rear of it, which they can perform with the greater eaſe, as they are neither purſued nor moleſted, at leaſt but very ſlightly.

In order to prevent the inconveniences that may ariſe if the huſſars in charging the firſt line of the enemy in flank are charged by the ſecond, it is neceſſary to detach inſtantly from the reſerve a body of dragoons ſufficient to fill up the intervals of the huſſars, which will form a full line without taking up more ground: this can be ſo much better effected, as there would be no ground on the other ſide of the troops who are poſted ſidewiſe, and that, beſides, theſe troops would be at too great a diſtance from the main body of the army.

Again, without cauſing them to fill up the intervals of the huſſars, they may be placed in a ſecond line behind them; and when the huſſars attack the flank of the enemy's wing, the dragoons will take their place, in order to keep back the enemy's ſecond line. This method hath the ſame effect, and is performed with leſs difficulty. It is almoſt evident, that the ſecond line will not dare advance to protect the firſt for fear of being charged in flank by the dragoons, but on the contrary it will be obliged to retreat.

This diſpoſition, the performance of which appears very difficult, is not in reality ſo, if the general hath taken the neceſſary meaſures, and if his troops are well diſciplined, and know how to move with order and exactneſs. Even when this motion is not performed with all the exactneſs poſſible, it can never be dangerous, becauſe the front of the two lines will not be deſtroyed, and becauſe it is alſo made upon the rear; and that if the dragoons and huſſars are attacked and beat in marching up, their defeat cannot be any way prejudicial to the main body of the army.

When the field of battle is in an open country, all the troops generally come down, eſpecially when there is no obſtacle to prevent them. On theſe occaſions, it is requiſite that the diſpoſition of the troops ſhould be ſtrong in every part: there ſhould always be a reſerve, whether of infantry or dragoons, in order to be ready to aſſiſt the troops which have ſuffered.

If it is poſſible, in an open country, to find any hollow to ſupport the right, and a village to ſupport the left, the general ſhould make choice of that ſituation, ſuppoſing his intention is to accept, and not offer battle. If he deſigns to give battle, it would be unneceſſary to take this poſition, becauſe he muſt quit it in order to attack the enemy: but if circumſtances require his accepting it, he muſt ſeize this poſt, and place infantry and cannon in the village, and ſtation other infantry in the rear to ſupport that which is in the village.

As to the diſpoſition for the order of battle, eſpecially for the front of the line, it muſt be regulated by the ground, by the diſpoſition the enemy has taken, by the troops that can moſt eaſily act, and by thoſe that the enemy can oppoſe to them.

If the enemy has pitched upon a field of battle, and the general would attack him in it, he ſhould keep his whole front employed; but ſhould make his chief efforts on one or two parts, upon the wings, or at the centre. This was the method practiſed by marſhal Saxe in all his battles: when he accepted battle, as he was obliged to do at Fontenoy in 1745, he was in expectation that the oppoſite army would attack him on one ſide ſooner than another; in this ſituation the diſpoſitions ſhould be properly regulated, the poſts intrenched and occupied, the cannon diſtributed, and troops placed in the rear of each poſt to ſuſtain thoſe which are in it: victory ſhould then be expected from the capacity of the commanders, the firmneſs of the troops, and the aſſiſtance that is properly given them. But when a general gives battle, he may attack either the right, the left, or the centre, always conforming to the ſituation of the ground, and the field of battle which the enemy has choſen, which cannot be aſcertained but by a thorough knowledge of the country.

It is dangerous to attack the whole front of the oppoſite army with equal vivacity, becauſe, if the attack does not ſucceed, the troops are diſheartened, and are witneſſes of each other's defeat. If the firſt line is repulſed, the ſecond is ſeldom of any great uſe; whereas, by only employing the whole front of the enemy, and making a ſtrong attack upon one or two parts, if it is ſucceſsful, the troops can take the enemy in flank, and thoſe which amuſed his front will then attack him briſkly, and prevent him ſending aſſiſtance to the troops that are beat. If the general does not ſucceed in the firſt attack, he can try it again with greater force, by cauſing the troops of the ſecond line to march as was done at the battle of Lafeldt fought in 1747: the French troops being repulſed four times, M. Saxe ſent them a reinforcement; theſe troops being united, carried the village at the fifth attack, which determined the fate of the battle.

In a plain but incloſed country, a general can attack only part of an army. Antiquity furniſhes many examples of this. Epaminondas, at the battle of Leuctra, attacked only the right of the Lacedemonian army, with a large column of infantry that formed his left; cauſing the right to be ſupported, and making the left march, the whole army, according to the opinion of the chevalier de Folard, wheeled. The battle of Mantinæa, won by the ſame general, is alſo of the ſame nature; with this exception, that it was the centre of the Lacedemonian army that was attacked. Theſe examples are only propoſed as what may poſſibly happen, but which it would be dangerous to imitate on every occaſion, and which ſhould be purſued in circumſtances only where a general expects great advantage from them.

As the cavalry can eaſily act in an open country, and be of great aſſiſtance to the infantry, all poſſible means ſhould be uſed to contribute to the ſucceſs of their attack; they ſhould always be ſupported by troops in their rear. Cavalry is of great uſe, particularly where the two armies, from the ſituation of the country, find no obſtacle to prevent their joining; and if the cavalry, as M. de Puyſégur obſerves, is beat, even when the infantry of the ſame army is victorious, the beſt thing that can afterwards happen to it is, to retire in good order.

The ground ſo often varies, that even in an open country there are unevenneſſes, thickets, moraſſes, and hollows; in each of theſe ſituations the diſpoſitions ſhould be changed. If theſe thickets happen to be in the line of cavalry, and it can act there (for if it cannot, it would be a very great fault to place it in them), it ſhould be intermixed with platoons of infantry, obſerving alſo not to take them from the main body of the army, but from the reſerve, in order not to diminiſh the ſtrength of the front; which ſhould never be done on any occaſion whatever, unleſs part of the army, either by its own or the enemy's poſition, cannot act offenſively, by reaſon of ſome moraſs, hollow, or any other obſtacle that the enemy may have placed before him; if, nevertheleſs, a general can take an advantageous poſition, by cauſing theſe thickets or theſe hedges to be occupied by infantry, he ſhould give it the preference, to enable the cavalry to act with the greater facility.

The diſpoſitions vary not only according to the ſituation of the ground, but alſo according to the general's views. Some draw up the battalions without intervals, or like a wall; others, with ſmall intervals; others leave the diſtance of half a battalion between each; and others, in purſuance of the chevalier de Folard's method, place them in columns.

The firſt diſpoſition is without doubt formidable as to infantry; but, as it has been already remarked, it is defective with regard to cavalry. In the third, the interval of half a battalion is too wide: it would require an immenſe tract of ground; beſides, the battalions would not be near enough to have it in their power to protect each other. The ſecond ſeems better, becauſe the front is not ſo large, the battalions are more within reach of aſſiſting each other, and have only the diſtance neceſſary to prevent their mixing confuſedly together. The fourth is undoubtedly very good; but can a general promiſe himſelf, that the ſoldiers can always march at an equal pace together, and without ſtopping? The fire of the column is continual, it defends itſelf on all ſides; but its oblique fire does not do much execution, and there are ſituations and ſpots where this poſition in column would be faulty. When it cannot approach the enemy, and is alſo expoſed to his cannon, this diſpoſition would be dangerous; becauſe it is certain that

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cannon plays with much greater advantage upon depth than upon breadth: beſides, not being able to get near the enemy, there are only the heads of the columns able to fire, and the reſt remains inactive, expoſed to the cannon. The poſition of the column is therefore only very good, when it can get up to the enemy and charge him.

The marſhal de Puyſegur aſſerts, that an army in an open country, formed in two lines, the firſt of which is without intervals, ought of courſe to beat an army that is formed with intervals.

The reaſon he gives for it is plauſible: it being certain, that a full line keeps itſelf much cloſer in marching; and that, charging the firſt line of the army that has intervals, it ought to have broke through it before the ſecond line, which is 150 toiſes or 300 paces behind, can have time to come up to its aſſiſtance; which might very well happen, and examples of it may alſo be cited. But could not there be another diſpoſition oppoſed to this diſpoſition in wall, keeping the neceſſary intervals, not only capable of reſiſting it, but alſo ſtronger, whether by the poſition and arrangement of troops, or by the ready aſſiſtance they can give each other, without being confuſed in their motions?

Let two armies be ſuppoſed in a plain country, without ſupport to the wings of either ſide, or without any obſtacle that may prevent their getting up to each other. The enemy's army, as hath already been ſaid, is in two lines; the firſt of which is formed in wall, both infantry and cavalry; the ſecond is formed with large intervals, and a body of huſſars in the rear. The army to be oppoſed to it is of equal force, and conſiſts of 40 battalions and 54 ſquadrons, cavalry, huſſars, and dragoons. The following ſeems to be nearly the manner in which it ought to act againſt the enemy, who is ſuppoſed to be drawn up in wall.

The firſt line of infantry compoſed of 15 battalions, has the diſtance of three toiſes between each battalion, and the diſtance of half a battalion between each brigade, eight ſquadrons on the right, and as many on the left, with their proper intervals: 15 battalions in the ſecond line, 200 paces diſtant from the firſt, ſeven ſquadrons on the right, and the like number on the left, in the rear of the intervals of thoſe of the firſt line, ſupporting the infantry of the ſecond; 10 battalions in reſerve in two columns, one of which in the rear of the ſquadrons on the right of the ſecond line, and the other of the ſame force poſted in the ſame manner on the left; 12 ſquadrons of dragoons in the rear of the ſecond line, half on the right, half on the left; and 12 ſquadrons of cavalry, or huſſars if there is not cavalry, in the rear of thoſe of the firſt line.

By this diſpoſition, the army appears to be ranged in two lines, with a reſerve, and will leave no room for the enemy to doubt of the motions it may make in marching: this diſpoſition will undoubtedly have that effect, and does not appear very formidable; but as ſoon as the two armies begin to move forward, the ſecond line of infantry muſt advance as unperceived as poſſible, forming itſelf in columns by battalions, each of which, with its head to a battalion of the firſt line, will form as many T's. The 10 battalions in reſerve, which form two columns of five battalions each, will march and fill up the ſpace on the right and left, between the infantry and cavalry. The cavalry, or huſſars, which are in the rear of the firſt line, one by a motion to the right, the other by a motion to the left, will poſt themſelves ſidewiſe, at 100 paces from the wings of the army; the dragoons muſt poſt themſelves in the rear of them in a ſecond line. This will be performed much eaſier marching, becauſe it is not complicated; it is alſo performed in the rear, and the front of the firſt line is not put into diſorder; and conſequently, the enemy will not perceive it ſoon enough to change his poſition, and oppoſe the diſpoſition which is preſented to him. This firſt line, by this diſpoſition, forming as many columns as there are battalions, of courſe ought to break through the enemy's army, which is in wall, but not above four deep, becauſe the impreſſion of a column ought to be much ſtronger, than that of a battalion four or ſix deep. See Plate DXXI.

Suppoſing the wings of each T to give way, the battalions which penetrate there will find themſelves between two columns hedged in with bayonets; the 10 battalions in reſerve, which, according to this diſpoſition, ought to join the right and the left of the infantry, ſhould of courſe ſeparate the two wings of the infantry, which are on the outſide of the diſpoſition in columns. Four battalions ſhould remain in purſuit of them, and the two laſt take the line in flank, at the ſame time that it is attacked in head. The cavalry ſhould charge the line which is in wall with great vigour; and the ſecond line ſhould follow it very cloſe, but in good order: the cavalry, or huſſars, which are poſted ſidewiſe, will attack it in flank, and the dragoons muſt remain in their poſt, in order to keep back the enemy's ſecond line.

Whatever diſpoſitions are made in the drawing up of an army, they ſhould always have ſome object. A general ſhould foreſee all that may be done by the enemy, whoſe diſpoſition he ſhould always ſuppoſe to be a good one, and to which he ſhould oppoſe one at leaſt as ſtrong, and always better if poſſible; he ſhould particularly conceal from him the motions he intends making, or diſguiſe them from him in ſuch a manner, that he ſhall not have time to oppoſe them, or at leaſt not readily enough: neither ſhould a general be ſo near as to give the enemy an opportunity of diſcovering and profiting by the method he intends following.

The diſpoſition of an army in wall is good; but in general only ſo with reſpect to infantry, becauſe that body acting by itſelf requires but very little ground to retreat, or preſent itſelf to the enemy, or to make a motion to the right or to the left. But this ſame diſpoſition is defective, and even hurtful for cavalry, unleſs there is a moral certainty of its getting the better: but as, with regard to war, a moral certainty would be a real preſumption, this diſpoſition of cavalry in wall would be dangerous, becauſe it may be broke. If that which is oppoſed to it marches up to it reſolutely without confuſion, and without being afraid of that maſs of cavalry, and charges it the firſt, ſword in hand, how can it retire in order if it is broke, being as much ſtraitened in its retreat as in its diſpoſition? All the ſquadrons filling up the ground, it will neither be able to make any evolution, or to act; and if it retreats through the large intervals of the ſecond line, it will carry it away with it in its flight: were there even ſix lines behind it, they would all be carried away, the ſecond by the firſt, the third by the ſecond, and ſo on with the others.

It is true that it may give the firſt charge, and conſequently make thoſe ſquadrons which have intervals give way; but as theſe laſt have more ground to act on, they can retreat with greater eaſe than thoſe who have none, by paſſing through the intervals of the ſecond line, which is not to be done by a line that hath no interval. They can rally in the rear, while the ſecond will charge the line that is without interval, and which is already diſunited by its firſt attack; even when theſe two lines are beaten, they can retire with greater eaſe, each ſquadron having ground enough to act upon. They will never be ſo much diſordered as the line which has no interval, which cannot eſcape being cut in pieces if broke, or which can only find its ſafety in flight; whereas, thoſe that have intervals can retire one after another, and in a ſoldier-like manner, ſuſtaining each other.

Beſides, in order to prevent the impetuoſity of this cavalry in wall, it appears that nothing is to be done but to poſt huſſars, if there is not a ſufficiency of horſe, behind the ſquadrons of the firſt line, who, when the two armies begin to move forward in order to charge, will place themſelves on the right and the left ſidewiſe, 100 paces diſtant from the firſt lines of cavalry: by this poſition, they will be able to take the enemy's line in flank, whenever it comes to attack the cavalry. If a part of this line perceiving this motion divides into two, one part to attack the line that has intervals, and the other the huſſars, it is ſo much ſtrength loſt; conſequently, the line with proper intervals has fewer troops to fight, and may expect to break them by giving the firſt charge. If the huſſars ſhould be beat, it is of no great conſequence, the defeat of thoſe troops never deciding the ſucceſs of the battle: it is the body of the army the enemy muſt break, and not two regiments of huſſars, which retreat with great eaſe from before cavalry, and rally and return to the attack as readily as they retired. But if, inſtead of huſſars, cavalry can be poſted there, the enemy's line, which is divided into two, will find itſelf obliged to fight upon equal terms: the certainty of ſucceſs depends upon the quickneſs with which the enemy is attacked; and the more ſo, as he will be obliged to make a motion in the preſence of troops already poſted and ready to charge. If this line without intervals advances, without ſhowing any attention to the huſſars, in order to charge the cavalry, the huſſars, at leaſt a great part of them, ought to fall upon the flanks; and the dragoons, which are in the rear of them in reſerve, ſhould take their place, to keep back the enemy's ſecond line, and to prevent the huſſars from being taken in the rear.

Theſe two diſpoſitions are ideal. A general ſeldom chooſes to fight upon a ſpot where the wings are void of ſupport; and prevents the enemy, as much as poſſible, from getting poſſeſſion of an advantageous poſt, or at leaſt does not attack him when he cannot prevent him doing it, eſpecially if the ground which he occupies is everywhere expoſed; there are, nevertheleſs, circumſtances where a general is obliged to fight, although not in a poſt ſtrong by ſituation. By the two diſpoſitions juſt now deſcribed, the order which would be moſt proper to be preſerved for covering the wings, which may be expoſed by the ſituation of the ground, has been endeavoured to be ſhown; it has been ſeen of what conſequence it is for a general to know, and to ſecure all the heights, moraſſes, hollows, and every obſtacle he may meet with. On occaſions ſo important, a general ſhould take the ſame precautions that he would uſe under the cannon of a place, if he found heights that overlooked the works; in which caſe he would not fail of conſtructing others more advanced, to prevent the enemy from getting there, and retarding their approaches.

If the duke of Savoy, at the battle of Marſaille, gained in 1698 by the French army, commanded by M. de Catinat, had been poſſeſſed of the heights of Pioſaca, the two wings of that prince's army would have been ſupported; inſtead of which, his left wing was expoſed. M. de Catinat, profiting from this fault, extended his right to the foot of thoſe heights, of which he poſſeſſed himſelf, and outſtretched the enemy's left: it was from theſe heights that the diſorder in the duke of Savoy's army commenced; it ſoon communicated to the whole front, and got poſſeſſion of the whole army: ſo true it is, that the moſt trifling object, being neglected, changes the order of things; that the leaſt fault becomes eſſential; that confidence in the nnmber and in the courage of the troops is often dangerous; and that having a contemptible opinion of an enemy is always fatal. The enemy, although inferior in troops, will ſoon attain a degree of ſuperiority, if he has the advantage of ground.

Armies can engage in ſo many different poſitions, that it is impoſſible to particulariſe all of them. In this ſection two armies have already been preſented in an open country, without any ſupport to their wing: two others have been poſted, one of which is upon a ſpot advantageouſly ſituated, its two wings covered; the other hath only its right wing ſupported, and its left expoſed. It has been endeavoured to give to that, whoſe left wing is unſupported, the greateſt ſtrength in its whole front that is poſſible, and by the diſpoſition of the left wing it is both ſtrong and ſecure; but there are ſuch a variety of ſpots where two armies may meet, that it will ſuffice to know in general the advantages they may derive from their ſituation.

Disp. III. A third diſpoſition very different from the two former is as follows. The enemy's army is ſuppoſed to be advantageouſly poſted; it hath a hollow on its right, through which run the waters of an impaſſable moraſs, forming a rivulet. Its left is ſupported by a large town, croſſed by a rivulet. In the centre is an height, capable of containing 12 battalions; in the front of it is a plain of 700 or 800 toiſes, which extends from its left to the cavalry on its right. Oppoſite to this cavalry the plain grows narrower, by reaſon of an height which reaches to the rivulet, and which the cavalry could not occupy, becauſe the enemy hath taken poſſeſſion of it during the night. The town is entrenched, and filled with infantry and artillery; 16 battalions in two lines are poſted next the town, in order to ſuſtain the troops that are in it. Behind the town there are three bridges upon the rivulet: in the front of the town, on the other ſide of the rivulet, are poſted four battalions and five pieces of cannon, in order to flank the troops intending to attack the town: theſe four battalions are ſuſtained by eight ſquadrons of dragoons. The centre of the army conſiſts of 20 battalions in the firſt line, and as many in the ſecond; eight of which are next to the moraſs, ſuſtained by ſix ſquadrons of dragoons; 12 ſquadrons in the firſt line, and 12 in the ſecond. The cavalry on the right conſiſts of 11 ſquadrons in the firſt line, and 11 in the ſecond. Thirty ſquadrons of huſſars, diſtributed half on the right, and half on the left, and the whole front of the army lined with artillery. Plate DXXII.

The army A, which was encamped a quarter of a league from the height by which it is ſeparated from the enemy, began its march at dark; it halted at the foot of the height, and ſent ſome detachments of infantry to take poſſeſſion of the ſummit of it. The army I made the above-mentioned diſpoſitions, becauſe the army A was too near to be able to avoid a battle. The army I is compoſed of 78 battalions and 90 ſquadrons: theſe two armies are nearly of equal ſtrength.

The left of the army A hath a fine plain before it, extending from the moraſs to that part where the height commences. In that place are poſted eight battalions in two columns of four battalions each, next the moraſs, with 10 pieces of cannon between the two columns: there are 14 battalions in the firſt line, and 13 in the ſecond; four battalions towards the height, and next the cavalry. Sixteen battalions occupy the height as far as the ſmall wood; four battalions occupy the other ſide of the wood, and 32 battalions upon two lines very cloſe together; 12 battalions behind the height next the rivulet; 12 ſquadrons of horſe, and 20 of huſſars, who have orders to paſs three bridges thrown over the rivulet, and attack the town with three columns of four battalions each, ſuſtained by the 12 ſquadrons of horſe, and the 20 of dragoons. In the rear of the cavalry upon the left, are poſted 16 ſquadrons of dragoons at a little diſtance, with intervals; ſo that, if the enemy ſhould attack this left and beat it, the cavalry may eaſily retire through the intervals of the dragoons, to give them the greater facility of acting, and turn their defeat into an

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an almoſt certain victory. Fifteen ſquadrons of horſe are poſted behind the height, with their right toward the height, and their left toward the camp, in order to take the enemy in flank, whilſt he is employed in purſuing the cavalry of the left, which he has beaten. The chief object of the attack ſhould be the town, although the moſt difficult. If it is forced, the enemy will be beat without reſource: becauſe the infantry who has driven him from that poſt, will attack him in the rear; at the ſame time that the infantry which remained on the height will come down from it, and join, either to attack, or at leaſt to employ the enemy upon the height, and by that attack prevent him from ſending aſſiſtance to the troops already driven from the town and put to flight: the cavalry upon the left will advance at the ſame time to ſupport the infantry, and, if neceſſary, to charge the enemy's cavalry.

The 32 battalions which are upon the height in two lines, will be divided into ſix columns, of which four of ſix battalions will be employed in attacking the town, the laſt battalion of every column excepted; which muſt remain at the entrance of the wood, with four columns of four battalions upon the left, in order to ſuſtain the infantry attacking the town, and to keep back the enemy's cavalry upon the left. They will deſcend from the height under the protection of the wood by which it is covered, and which ends at about 400 toiſes from the town. Theſe troops will be followed by artillery, which muſt be poſted between the columns; they muſt halt on leaving the wood, and will begin by making a continual fire of cannon upon the town and the cavalry: during this fire of the artillery, the 12 battalions on the other ſide of the rivulet ought to attack the four battalions and the eight ſquadrons of dragoons belonging to the enemy; and when they have forced them to give way, they will amuſe them by a conſtant fire of muſquetry. When the artillery ſhall have played long enough to have broken down the enemy's entrenchments, and deſtroyed the order of the troops, the four columns, formed of 20 battalions, will march up, and with their bayonets endeavour to penetrate at ſome part; the 12 battalions on the other ſide of the rivulet will charge at the ſame time; the two columns of four battalions each, as well as the four laſt battalions belonging to the columns which attack the town, will remain at the entrance of the wood with the artillery, in order to keep back the enemy's infantry and cavalry which was next the town. If any one of the columns can penetrate as far as the bridge that is in the town, it will take poſſeſſion of it, as well as of the market place; the others following it will take poſſeſſion of the hedges and gardens. One column only will be ſufficient to ſecure the banks of the rivulet, and take poſſeſſion of the bridges. As ſoon as the bridges are free from the enemy, the 12 ſquadrons of horſe and the 20 of huſſars will paſs and attack every thing they find to oppoſe them; then the left ought to advance; the battalions which have remained upon the heights ſhould come down from them, and all together attack the front of the army, whoſe left wing is already broken and taken in flank.

But if the enemy, after having examined the diſpoſition of the army A, imagining that the principal attack will be directed againſt the town, inſtead of remaining in his firſt diſpoſition, changes it entirely, and cauſes a part of his ſecond line of infantry to march to the town; and if he ſtrengthens his right by the cavalry of the left (a ſpot more favourable for cavalry than infantry), the attack of the town will then become impracticable, becauſe of the great ſuperiority of the troops defending it; therefore it would be uſeleſs to perſiſt in it; but his right ſhould be vigorouſly and briſkly attacked. It is true, that it is reinforced by the cavalry from the left; but as the ground between the height and the eight battalions which are next the moraſs can contain but 12 ſquadrons, thoſe which the enemy hath drawn from the left can only be poſted behind the height, or in the third line; if they are behind the height, nothing can prevent their being attacked: but ſuppoſing the firſt line broken, it ſhould not be too warmly purſued, for fear of ſeparating, and being taken in flank by the cavalry behind the height. The 16 ſquadrons of dragoons which are behind, ought to remain in that ſituation; the 15 ſquadrons of horſe, which are with their right to the height, and their left to the old camp, ought to take the place of thoſe who have attacked the enemy; and then the 20 battalions which are upon the height will come down into the plain and attack the enemy's infantry, at the ſame time that the 15 ſquadrons of cavalry and the 16 of dragoons attack the cavalry which is poſted behind the height. If they ſucceed in beating it, or whether they do or not, if the enemy ſends aſſiſtance, he will weaken his left, and then the 44 battalions, who till this time have remained inactive, may come down from the height and attack the town, not ſo much with a deſign of forcing it, as to oblige the enemy not to take any troops from it; if no aſſiſtance is ſent to the right wing, it will be undoubtedly beaten, being attacked by forces ſo greatly ſuperior to it: the whole of the cavalry being thus put to flight, the moſt prudent part the enemy can take is, to endeavour to paſs the rivulet by the three bridges behind the town, and by ſo doing ſecure himſelf from farther inſult: if the enemy does this, the 12 battalions, the 12 ſquadrons of horſe, and the 20 of dragoons, will retire by the ſame road they marched up, and they will be in ſecurity as ſoon as they are in the wood: beſides, a beaten army is ſeldom to be feared; therefore, they may retire unmoleſted, and in order.

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But if it happens that the enemy, without changing his poſition, is not to be forced in any of theſe attacks, the general had better retire to the height, where there will be no danger of the enemy's endeavouring to attack him: but if he ſhould attempt the attack of the left wing of the army A, it muſt be reinforced by all the cavalry that can be employed without cauſing confuſion, and two brigades of infantry ſhould be joined to the two which are next the moraſs.

Disp. IV. The fourth diſpoſition is ſuppoſed in a country mixed with thickets and plains. The enemy's army hath its right to ſome mountains, and its left to a river; in about a third part of the length of his front, there is a village a little behind its right. His diſpoſition is, four battalions and ſix pieces of cannon upon an height which overlooks the plain, to which is alſo added the cavalry of the right. Behind are two paſſes entrenched and guarded by four battalions; upon the heights of theſe paſſes there are four more, to prevent the enemy penetrating at the flank. There are eight ſquadrons in the firſt line, four battalions poſted at the village, and 12 in it with cannon: 16 battalions on the left of the village, 14 ſquadrons and four battalions next the river. The ſecond line conſiſts of 11 ſquadrons upon the right, eight battalions behind the village, in order to carry timely aſſiſtance to it; 12 battalions in the rear of the 16 of the firſt line; 15 ſquadrons and four battalions to the river. The reſerve conſiſts of 18 ſquadrons of dragoons next the mountains (in order to diſmount and be within reach of aſſiſting the battalions guarding the paſſes), and of 24 ſquadrons of huſſars on the left next the river. An iſland is ſuppoſed a little in the front of the firſt line: in this iſland are placed two battalions and ſix pieces of cannon. A ſtone bridge is alſo ſuppoſed between the two lines, behind which is poſted two battalions, to ſupport thoſe in the iſland, and to facilitate their retreat. It ſeems impoſſible to attack an army thus ſituated; all the troops are a mutual ſupport to each other: the flanks are ſecured and well guarded; artillery is planted along the whole front; and the paſſes are entrenched, and troops poſted in them.

In the front of the enemy's army is a large plain, which runs from the mountains as far as the river; but the largeneſs of it is broke into by ſome thickets, where nevertheleſs cavalry may act: in order to attack this army, thus advantageouſly poſted, a diſpoſition muſt be made, entirely different from that which it is in. If the village, which is entrenched and well furniſhed with troops and artillery, is attacked, the forcing it will be doubtful: but ſuppoſing it ſhould be forced, it will not be without loſing a great number of men; which ſhould be avoided, becauſe it is the duty of a general to ſpare the blood of his ſoldiers as much as poſſible. and even, if practicable, to employ but few of his troops againſt a greater number of the enemy's. If the paſſes only are attacked in order to take the enemy in flank, it is very certain he can ſend aſſiſtance to it without weakening his front, having it in his power to cauſe the eight battalions in reſerve behind the village to march there, and to cauſe the 18 ſquadrons of dragoons to diſmount. If only the left wing next the river is attacked, it is true that attack is more practicable, there being no obſtacle or entrenchment to prevent coming up with the enemy: but ſtill there is but one wing beaten; and that, by falling back upon the troops in the village, can retreat by the mountains of which the enemy is maſter. There is great reaſon to imagine it will be beat; but the general muſt endeavour to reap as much profit from that victory as he can: it is therefore thought that, not to loſe the fruit of it, the enemy ſhould be attacked on the left wing, from the centre to within about 200 toiſes of the river, at the ſame time that the entrenched paſſes are attacked. During theſe two attacks, a briſk cannonade ſhould be kept up upon the village, the infantry and cavalry upon the right, the infantry that is poſted in the iſland, and that which is next the river: by theſe two attacks the enemy's front and right wing will be equally annoyed; he will not know where to ſend aſſiſtance, and in that ſtate of uncertainty may probably ſend it to a part where the danger is not ſo preſſing. But ſuppoſe he ſhould act in the moſt proper and prudent manner, as it ſhould always be imagined he will, the aſſiſtance which he will ſend to that part, cannot be effected without unfurniſhing or weakening ſome other: if he ſtrengthens the paſſes and the heights with the eight battalions behind the village, they perhaps will not be forced; but he will ſcarcely venture to take any troops from the village, in order to ſend them to the aſſiſtance of the front that is attacked. But if he ſhould unfurniſh the village, it muſt then be attacked, and that vigorouſly; which may be the eaſier done, as it hath been for ſome time cannonaded, and conſequently the earth hath been tumbled down, and openings made, at leaſt large enough for the infantry to enter it: this attack will not at all prevent that at the front from going on.

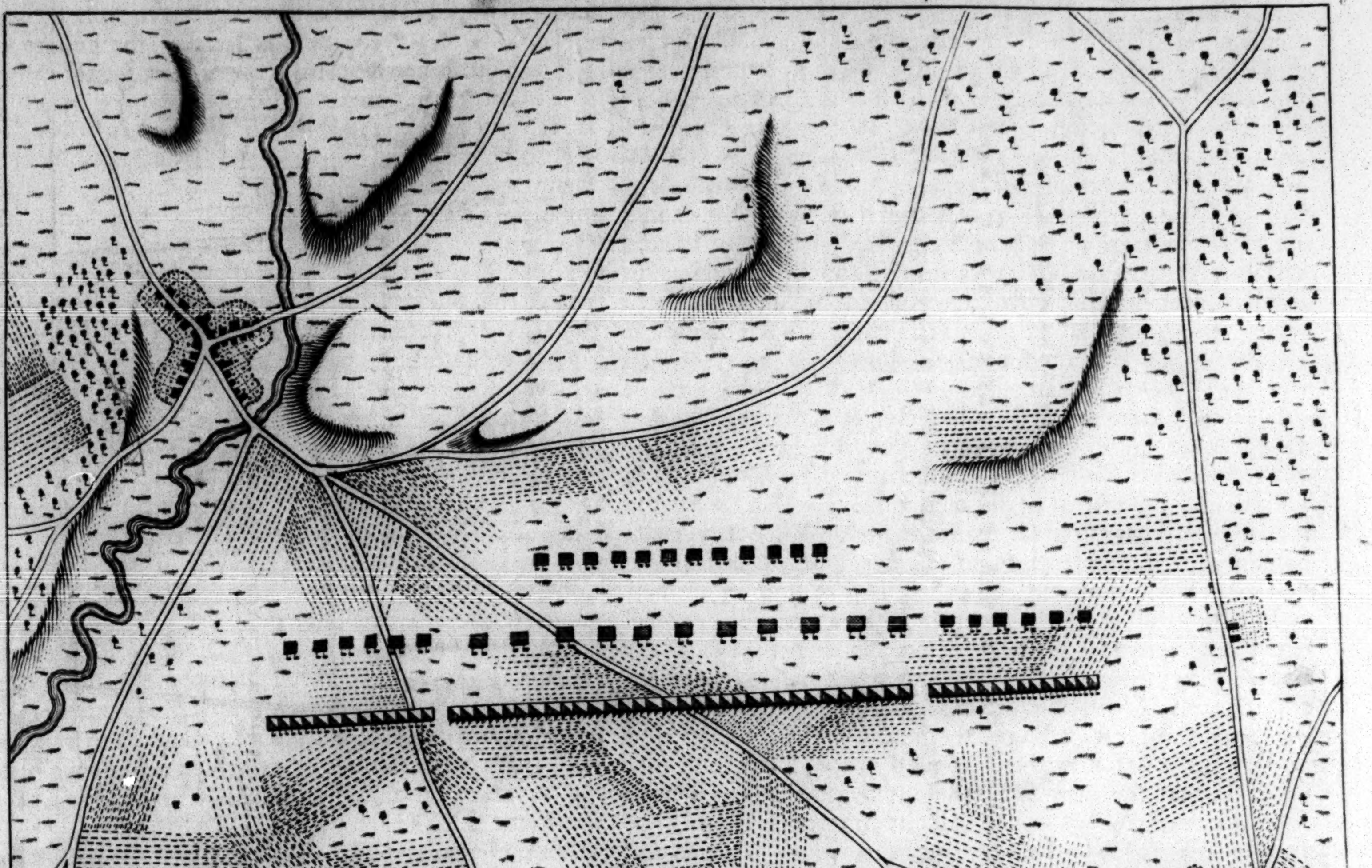
In order to execute the attack upon the enemy's army, it is imagined the troops ought to be diſtributed after the following manner: all the infantry ſhould be placed in the firſt line, excepting that of the reſerve, which ſhould conſiſt of 20 battalions; the ſecond line ſhould conſiſt of the cavalry; and the third ſhould be formed of the dragoons and huſſars, The 20 battalions on the left, forming five brigades, ſhould remain in order of battle at the coming out of the thickets, with artillery diſtributed between the intervals of each brigade; the 28 battalions, after making ſeven brigades as ſoon as they come out of the thickets, will form in column: then the 24 ſquadrons which are in the rear of the infantry, formed in column, will poſt themſelves, four ſquadrons in the intervals of each brigade. The brigade ſupporting the right flank will advance on the ſide of the river: and then the ſeven columns and the 24 ſquadrons will march up to the enemy and attack him with their bayonets, without loſing time in firing. As ſoon as the columns have broken or ſtaggered the enemy's firſt line, the cavalry will fall furiouſly upon them, ſword in hand; a part of the dragoons and huſſars ſhould follow, in order to be within diſtance of ſuſtaining the troops who have attacked, or to join themſelves to the cavalry who have broken in among the enemy: it ſhould be obſerved, that as ſoon as the huſſars are engaged and purſuing the enemy, the cavalry ſhould rally in order to ſuſtain them, or to flank the infantry which may ſtill make reſiſtance. The brigade of infantry which ſupported the right, followed by the ſeven ſquadrons, ſhould attack the four battalions on the left of the firſt line, and the ſeven ſquadrons will take them in flank; which they can with the greater eaſe effect, as the cavalry hath been put to flight. The ſeventh column ſhould, with four ſquadrons, attack the four battalions of the ſecond line, at the ſame time that this attack is executed from the front as far as the river; 16 battalions of the 20 in reſerve ſhould attack the paſſes, and alſo the heights; the remaining four will march under cover of the mountains, ſuſtained by a brigade of infantry and eight ſquadrons, in order to attack the cavalry on the right; thus of the whole front of the enemy's army, there will remain only the village that hath not been attacked, unleſs there hath been ſuch a number of troops drawn from it, as to render the carrying of it not difficult. It is to be ſuppoſed that one of theſe attacks will ſucceed; that made by the columns ſooner than the reſt: the diſpoſition of columns intermixed with cavalry is very formidable, becauſe each body is ſupported without confuſion: beſides, it is to be ſuppoſed that a column four battalions in depth, and from 18 to 20 men in front, ought to break through a line that is only four deep, and which being once penetrated, the cavalry will find no difficulty in breaking through it. See Plate DXXIII.

The movement of the infantry to form itſelf in column, and the evolutions of the cavalry to fill up the intervals of each column, ought to be performed with great quickneſs, and near enough to the enemy to ſurpriſe him, but not at ſuch a diſtance as to give him time to remedy it.

The nature of the ground, which is continually changing, cannot be followed through all its various ſhapes; the author from whoſe work we take this article hath therefore endeavoured to form his diſpoſitions in thoſe ſituations which moſt ordinarily occur, in order that theſe general diſpoſitions may be aſſiſtant to the ideas in more particular and critical ſituations. Mountainous countries have not been mentioned, becauſe it is very rare that they preſent an opportunity of coming to a general action: the affairs which happen among them are generally with regard to ſome poſt, which can never decide the fate of an army, however briſk they may be. The four diſpoſitions now mentioned are ideal; and although the propriety of them may be defended, it would be very imprudent to anſwer for their ſucceſs; becauſe with regard to the buſineſs of war, the whole depends upon circumſtances, and the leaſt accident often renders a diſpoſition, ſeemingly the beſt, the moſt prejudicial that can be taken. A motion of the enemy's troops ill conducted by their commanders, too much ſloth or too much eagerneſs in the execution of orders, an accidental word falling from the mouth either of an officer or a ſoldier, and which is always increaſed when told again, may occaſion the defeat of an army, however well diſpoſed or advantageouſly ſituated. The epithet "beſt" ſhould be given to that general who commits the feweſt faults; for

WAR.

Plan of an Order of Battle II.nd Diſpoſition.



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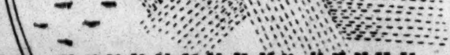

Scale of ½ a League

50
300
600
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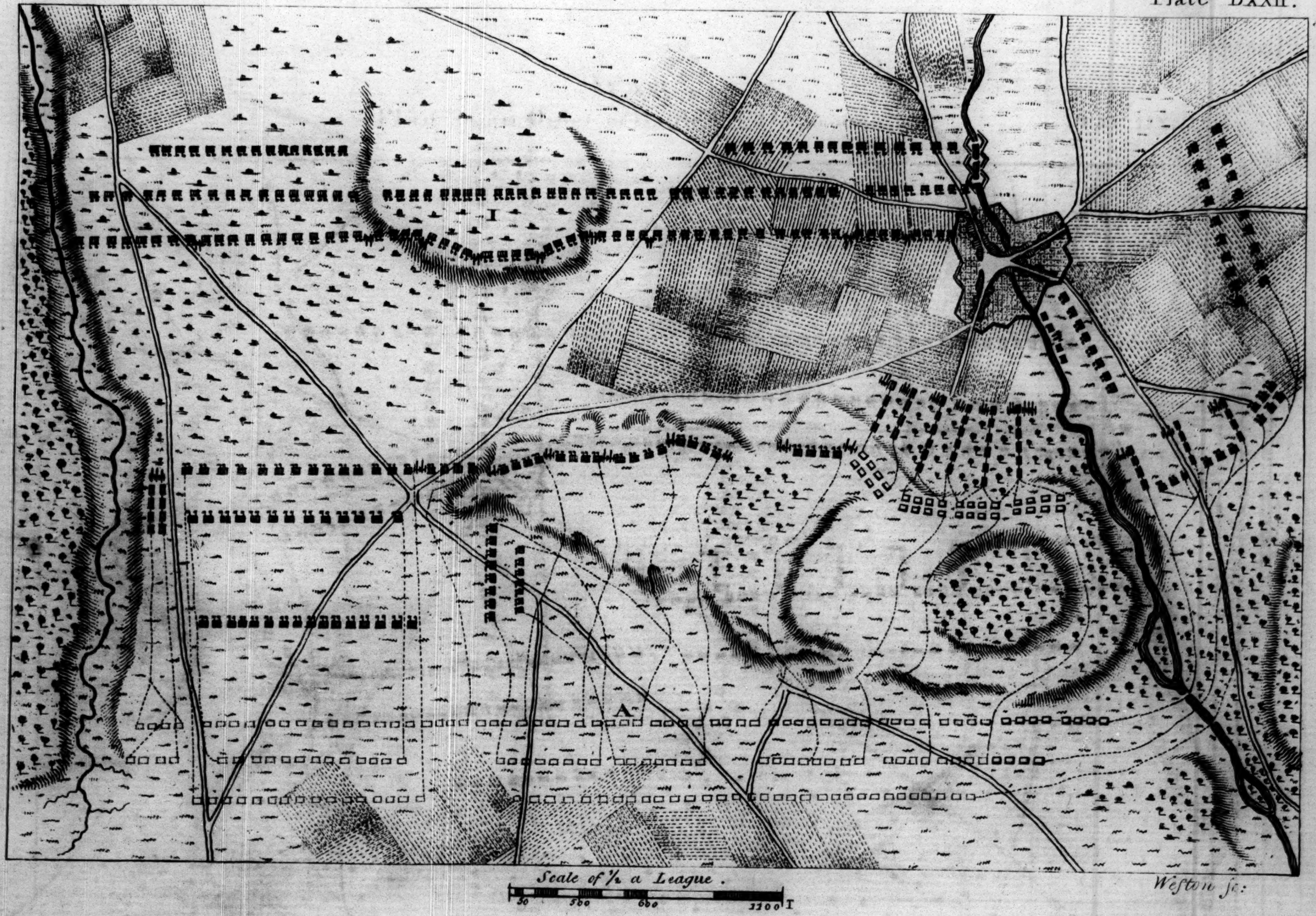
War.

Plan of an Order of Battle. III.^{d} Disposition.

Plate DXXII.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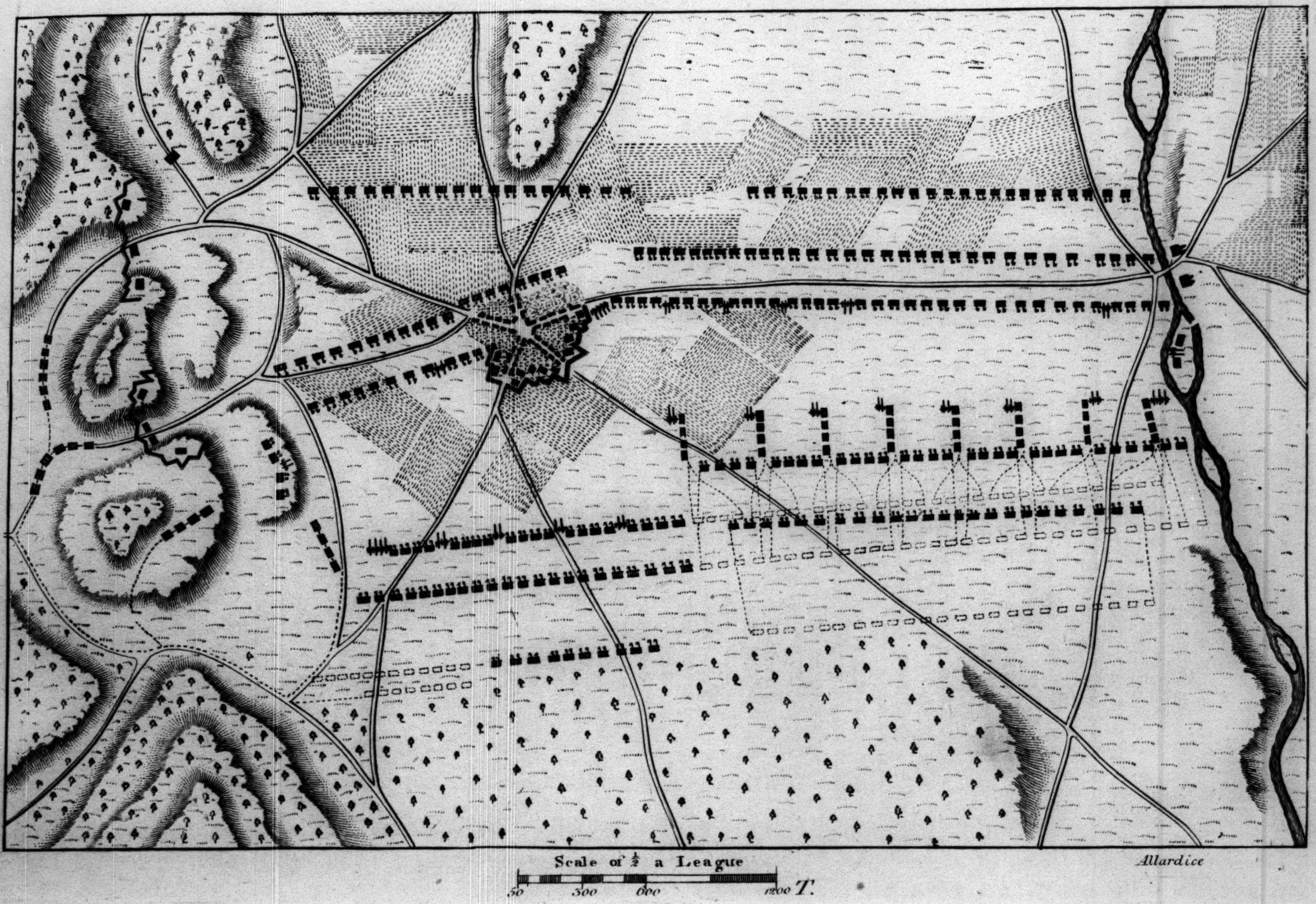
WAR

Plan of an Order of Battle IV.th Disposition.

Plate DXXIII.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Petite Guerre.

there is no man who can flatter himſelf with having committed none: it is impoſſible for a general to ſee every thing himſelf, or to remedy any unforeſeen accident that may happen, if he is not aſſiſted by his general officers, who ſee things which it is impoſſible he can: they ought not only to be the means of putting his orders in execution: but even, in certain circumſtances, they ſhould prevent them, and make the ſame diſpoſitions which the general ought to make, and would certainly order, were he in their ſituation.

Part III. Of the PETITE GUERRE.

The Petite Guerre conſiſts in the manœuvres of the Partiſan in ſecret marches, occupying, defending, or attacking poſts, reconnoitring countries or the enemy, placing of ambuſcades, &c.

Sect. I. *Of the Qualifications of a Partiſan, and the Nature of his Corps.*

They generally call every officer a partiſan who is deſtined to go at the head of a detachment, whether draughted from the body of the army, or of a party which he belongs to, and for that reaſon has no other name than that of a partiſan.

Of all military employments, there is none which requires more extraordinary qualities than that of a partiſan. A good partiſan ought to have an imagination fertile in projects, ſchemes, and reſources; a penetrating ſpirit, capable of combining the whole circumſtances of an action; a heart intrepid againſt every appearance of danger; a ſteady countenance, always aſſured, and which no ſigns of diſquiet can alter; a happy memory, that can call every one by his name; a diſpoſition alert, to carry him through every thing, and give a ſoul to the whole; a piercing rapid eye, which inſtantly catches faults or advantages, obſtacles and dangers of ſituation, of country, and every object as it paſſes; his ſentiments ought to be ſuch, as to fix the reſpect, confidence, and attachment of the whole corps. Without theſe diſpoſitions, it is impoſſible to ſucceed.

A partiſan ought to ſpare nothing to be aſſured by his ſpies of the march, force, deſigns, and poſition of the enemy. As chief, he owes the example of an irreproachable conduct to his corps, by which he will inſpire reſpect, love, zeal, and vigilance, and gain the hearts of the whole to his ſervice. It is extremely dangerous for ſuch an officer to contract the leaſt attachment to women, wine, or riches. The firſt makes him neglect his duty, and frequently occaſions the moſt ruinous treacheries: the ſecond leads to dangerous indiſcretions, and is ſure to draw down contempt: the third leads to guilt, and deſtroys all ſentiments of honour. The partiſan muſt be content without the delicacies of the table, as he may be often expoſed to want proviſion; his bed the ſame with the mens, a cloak and ſtraw, never ſtripping but to change linen. Nothing animates ſoldiers ſo much as the preſence and vigilance of a commanding officer ſharing with them the fatigues of the ſervice: the officers follow his example; the men are aſſured, encouraged, and content.

A corps capable of carrying on the Petite Guerre to advantage ſhould be compoſed of infantry and cavalry; and as it is inconteſtable that the cavalry ought to be the moſt active in carrying on the Petite Guerre, it were to be wiſhed that they were likewiſe the ſtrongeſt, ſo as to have 600 cavalry and 400 infantry in a corps of 1000 men, making four companies of infantry and twelve troops of cavalry.

The commanding officer ſhould have the naming of the officers of this corps, or at leaſt have liberty to reject ſuch as he is convinced are not qualified for ſuch ſervice, as every officer who may be ambitious to ſerve in the corps, tho' poſſeſſed of great military merit, may not have the talents requiſite for the duties of the partiſan.

To ſupport the honour of this corps upon a ſolid and reſpectable footing, the ſtricteſt ſubordination muſt extend from the chief to all the officers, and the moſt rigid diſcipline inſpire vigilance, patience, bravery, and love of glory, to the whole corps.

It is of the utmoſt importance for the officer that commands, to have the chooſing his men and officers whom he knows to be fitteſt for his enterpriſe, and thereby preventing many difficulties, contradictions, and dangers, which jealouſy and diſtruſt always occaſion among ſtrangers.

No recruit for the corps of a partiſan, either cavalry or infantry, ſhould exceed 30 years of age; but the younger they are, if they can carry arms, ſo much the better for ſuch a ſervice, to which youth is particularly inclined. In the choice of recruits for the cavalry, it were not unworthy the attention of officers to prefer men that are lovers of horſes, and to recruit chiefly in thoſe countries where ſuch are moſtly to be expected.

As for arms, the firelock and bayonet are ſufficient for a foot ſoldier; and in the corps of the partiſan, barrels of 36 inches, with a long bayonet, but to have the caliber the ſame as that of the reſt of the army, which, for the ſake of having ammunition made up to ſuit the whole, ought to be invariably the ſame. A helmet likewiſe is preferable to a hat, as the ſword is almoſt the only thing to be dreaded from the enemy's cavalry. Four ſpades and four pick-axes ſhould be given to each company of infantry.

The preſent manner of equipping the light dragoons is ſo perfect, it is unneceſſary to ſay any thing on that head; but no white horſe, ſtone-horſe, or mare, ſhould be ſuffered in the corps of the partiſan, as the leaſt neighing or perceivable colour may make enterpriſes fail. No horſe ſhould be mounted for ſervice till ſix years old. The ſize of the light dragoons is very proper for the partiſan; and while they have firm ground to act upon, and plenty of forage, none can excel them; but when they come among moraſſes, and feel the ſeverity of want, perhaps the Hungarian huſſars may be found more equal to the duty: poſſibly, therefore, in forming the corps of the partiſan, 200 horſe, ſuch as are bred in the mountains of Wales or Scotland, mounted by the lighteſt men, might be found of good ſervice.

The principal attention of an officer of cavalry ſhould be, to ſee that the men feed and dreſs their horſes well. During the whole campaign, they ſhould have dry food only, as green weakens them. When the exigency of the ſervice requires the horſes to be kept ſaddled day and night, every horſeman ſhould ſeize ſome moment to turn the ſaddle-cloth, which greatly comforts a horſe, keeps him at eaſe, and leſs apt to gall; and care ſhould be taken to keep the cloth ſoft, and clean from ſweat and duſt.

Sect. II. *Of Poſts, &c. and the different Works with which they may be fortified.*

Posts are generally ſuch places as bodies of troops can fix in when detached from the army, to cover and ſecure the frontiers; and upon the vigilance and reſiſtance of the parties that are detached there, depends the ſafety of the army. Whatever the abilities of a general may be, it is ſcarce poſſible that he can have an eye to every detail that contributes to their defence; it is ſufficient if he knows that the guards are properly placed, and the line that they make properly eſtabliſhed. It is then the buſineſs of the particular officers who command them, to make the beſt diſpoſition for a vigorous defence, and anſwering the views of the general.

An officer who is detached to a poſt, is either to relieve a party, or to take poſſeſſion for the firſt time. In the firſt caſe, if the guard which he relieves, happens to be entrenched, as ſoon as he arrives at the poſt, and has taken his inſtructions from the officer who commands, he ſhould prepare himſelf for his defence, as ſhall be mentioned in that article. In the ſecond, if an officer who is detached is to entrench himſelf, he muſt examine if the place is advantageous for the execution of his projects, the defence of his people, and the ſecuring a retreat.

He muſt conſult, 1ſt, Whether the ſituation be convenient for ſending parties to diſcover the enemy; whether to give intelligence of their ſituation and march, or to diſturb and ſurpriſe them. 2d, If it has ſome natural defence on its front or flanks, ſuch as a river, rivulet, moraſs, or ſmall wood that can be eaſily penetrated. 3d, If he can preſerve his communication with the army, and if there are ſome covered places to favour his retreat. 4th, If he can diſcover all the approaches; becauſe if the enemy can come within a ſmall diſtance of the poſt without being ſeen, he will place himſelf under cover there, and reſt while the beſieged are obliged to remain continually under arms, and will watch the moment for making an attack. If then he finds hollow roads, clumps of wood, or any place where the enemy can ſecure himſelf in the neighbourhood of his poſt, he muſt fill them up, or guard them with detachments of ſix or ſeven men. 5th, He muſt take care not to be commanded by any neighbouring heights, or muſt prevent the enemy from profiting by that advantage: becauſe if they can take his ſoldiers in the rear, it will be impoſſible for them to defend themſelves. 6th, The extent of the work muſt be proportioned to the number of men that are to defend it. Good ſenſe and numberleſs examples prove, that too large entrenchments can only be defended by conſiderable bodies. 7th, He ſhould take care to have all the parts of his entrenchment nearly of an equal ſtrength, ſo as to be able to make an equal reſiſtance everywhere; and, laſtly, He will take care to fulfil exactly the intention of the general in poſting a guard in that place.

There are ſome places ſo advantageouſly poſted by nature, that though they are not fortified, they may in a ſhort time, and with little charge, be made ſo ſtrong, that it will require as much art to beſiege them as many others that are perfect fortifications; ſuch as iſlands, peninſulas, and places ſeated on eminences of difficult acceſs, or in moraſſes.

If the poſt is in a level country, or upon a height that may be ſurrounded, as happens almoſt always to ſmall detachments, they ſhould conſtruct a redoubt, or ſmall ſquare fort, compoſed of a parapet with its banquette and ditch.

Plate DXXIV.

The ground being choſen, you muſt trace a ſtraight line AE (fig. 1.), and raiſe the perpendicular BC, as directed in practical geometry; obſerving to give to each of theſe lines which mark the interior ſide of the parapet but two toiſes, or two and a half for 30 men, four toiſes for 50, and eight for 100; which will leave a ſpace of two feet at leaſt againſt the parapet for each man. Having traced the two firſt lines A, B, you muſt put the cord over the picquet C of the perpendicular B, and with the ſame length trace the arch D, then put the cord over the picquet E of the line A, and trace the arch F. The point where the arches interſect each other, is the point to end the lines EH and CG. Theſe four lines mark the interior ſide of the parapet.

Then trace four other lines at the diſtance of two or three feet parallel to the firſt, as I, L, M, N, to mark the ſize of the banquette, which ſhould be greater or leſs according to the number of ſoldiers you would place in a file. Then trace a third parallel ſquare on the outſide of the firſt, as O, P, Q, R, to mark the exterior ſide of the parapet, and to determine its thickneſs, which is uſually eight or nine feet, or 18 if it is to reſiſt cannon, which you ſhould always be prepared to do.

Then trace a fourth and laſt ſquare STVX, to determine the width of the ditch, which is the ſame or two feet more than the thickneſs of the parapet; leaving a picquet planted at all the angles, as likewiſe at the lines already traced, ſo as not to loſe the points from whence the lines were drawn.

While you are employed with two or three men in tracing, five or ſix men ſhould be ordered to cut down the trees that are in the neighbourhood of the poſt, not only to open the approaches, but to ſerve for conſtructing the intrenchments. The ſmalleſt branches ſerve to make faſcines, which are a ſort of faggots about ſix feet long, two feet thick, and of the ſame ſize all over, tied in the middle and at the two ends, to ſerve for ſupporting the earth, which would tumble down without that ſupport. The middling branches ſerve to make picquets proper for mixing with the faſcines, and fixing them in the ground, or one above another to raiſe the parapet. The trunks to which the large branches are left, ſerve to increaſe the ſtrength of a poſt, as ſhall be mentioned afterwards.

Having traced all in the manner directed, fix a row of faſcines upon the ſmall ſquare ILMN, to ſupport the earth of the banquette; then fix a ſecond row upon the ſquare ABGH, to ſupport the interior ſide of the parapet; then a third row on the third ſquare OPQR, to ſupport the exterior ſide of the parapet. You ſhould obſerve in the beginning to picquet the faſcines, to leave a paſſage of three feet PB, on the ſide leaſt expoſed to the enemy, to ſerve for an entry to the redoubt; but if this paſſage can be taken in a ſtraight line, it ſhould be made like a mortoiſe, as you ſee at Y, fig. 2.

After having picqueted the three rows of faſcines as directed, you muſt dig the ditch AB, as in the profile, fig. 3. a foot diſtant from the exterior ſide of the parapet. This diſtance or breadth is called *berme*, and ſerves to ſupport the earth, or receive what falls from the parapet by the enemy's cannon. This *berme* is more or leſs according to the ſolidity of the earth; the earth to be thrown into the intervals C, D, E, marked for the parapet and banquette, taking care to make the men tread it well down, and obſerving to leave a *talus* or ſlope on the two ſides of the ditch FG, more or leſs according to the conſiſtence of the earth, ſo that it may not tumble down. The ſlope F, which is on the ſide of the redoubt, is called the *ſcarp*; and the oppoſite ſlope, which is next the country, is called the *counterſcarp*. Care muſt be taken in picqueting the faſcines with which the parapet is raiſed, to bring them nearer one another by degrees in raiſing it as at H, ſo as to leave the ſame ſlope on each ſide. The diſtance DE marks the banquette; the diſtance DC the thickneſs of the parapet at the bottom; the diſtance IL the thickneſs of the parapet at the top; MN the width of the ditch at bottom; AB the width of the ditch at top.

If the ground is level, the banquette of this work muſt be raiſed two feet; but in low places two banquettes are neceſſary, the one above the other like ſteps: but if this banquette is raiſed on account of ſome neighbouring heights from whence you may be taken in the rear, the parapet muſt be raiſed to ſuch a height, that the enemy's ſhot can no longer plunge down upon you. A ſlope muſt be left on the top of the parapet, as IL, ſo that the ſoldiers may ſee round the poſt, and fire eaſily towards the country at O.

Though the ſquare form of a redoubt, which we have given the method of conſtructing, is almoſt the only one uſed in the field, yet it has its faults, which ought to make it be rejected, at leaſt for thoſe poſts which ought to defend the environs equally. Experience ſhows us, that we ought never to depend on the oblique firing of muſquetry, as the ſoldiers almoſt always fire right forwards, as at A, fig. 4. and often even without taking aim. This being the caſe, there are large ſpaces oppoſite to the angles of the redoubt at B that are not defended, and where we may ſay that the enemy remains in ſafety. The chevalier Clairac propoſes an excellent method to prevent this inconvenience, by conſtructing the interior edge of the parapet like the edge of a ſaw, in form of ſmall redans, to hold a man or two in each ſide, fig. 6. which by the croſs fire takes the enemy on the two flanks, ſo that there are no approaches but what are defended; but the conſtruction of this redoubt is too tedious and complex to be executed by ſmall detachments.

The ſame author prefers conſtructing circular redoubts as at C, fig. 5. becauſe all the points of the circumference being equally diſpoſed, the ſoldier poſts himſelf indifferently over all; and the exterior ſpaces D which are defended, varying every moment, the enemy is nowhere in ſafety.

The circular redoubt, then, is the moſt perfect that can be conſtructed: but where a road or the edge of a river, is to be defended, the ſquare, or long, or triangular redoubt, is preferable, becauſe they ought the oppoſe the faces of the intrenchment as parallel as poſſible to the places they are to fire at, obſerving always to round the angles.

To trace a circular redoubt, after fixing the central point of the poſt, let a picquet be fixed in that point, and draw from it as centre the circle EE, with a length of cord in proportion to the number of the party, to mark the interior ſide of the parapet; then trace another within the firſt, at the diſtance already given, to mark the banquette; then trace a third FF, to mark the exterior edge of the parapet; then trace a fourth GG, to mark the width of the ditch; which being done, picquet the faſcines, and make them take the bend of the circle, finiſhing as in a ſquare redoubt.

If an officer is poſted with a detachment on a paſſage or before a bridge, in a defile, or oppoſite to a ford, he may make a parapet either bending or ſtraight, with a banquette or ditch which ſhould ſhut up the whole entry; or he may make a redan, which is a work with two faces, and in ſuch a ſituation ſhould be made with a re-entrant angle (that is, the angle pointing from the enemy); taking care when he is to guard a ford, to conſtruct it ſo near the river that the enemy cannot have room to form after they have paſſed. A deep ditch may be dug oppoſite to the ford, into which they ſhould let the water of the river paſs; they may likewiſe make the banks ſteep; throw trees acroſs, and ſcatter chauſſetraps, which are inſtruments of iron with four ſpikes, made ſo as to have always one point erect.

The ſtrength of a redoubt or any other work may be augmented by blocking up the paſſage that leads to it, ſurrounding the poſt with felled trees, and ſinking their trunks three or four feet deep in the earth, which muſt be dug on purpoſe, leaving a number of large branches on them, which muſt be ſharpened at the ends, and the leaves taken away, and placed as near to one another as poſſible, ſo that the branches may mix, and taking care that they incline towards the enemy. Two or three rows may be made in this manner; but they ſhould be at leaſt two toiſes diſtant from each other, that the enemy may not burn them all at once to approach the entrenchments. M. Saxe in his Reverie ſays, that redoubts are proportionably advantageous as they take leſs time in conſtructing, and are proper for numberleſs circumſtances, where one often may ſerve to ſtop an army in a cloſe country, hinder them from troubling you on a critical march, or to occupy a large ſpace of country when you have but few troops.

There is no need to mention large works which require engineers to conſtruct, and great bodies to defend them, as theſe have been deſcribed under the article FORTIFICATION; but a redoubt, ſuch as A, fig. 7. may be ſtrengthened by filling the ditch with water, by turning a rivulet, or cutting a river or pond. If the ground is uneven, ſo that the water cannot be put equally in all parts of the ditch, dams ſhould be left in digging at C; or little traverſes of earth to form banks proper for keeping the water in the upper part of the ditch D, from whence it may be let run into the lower E. Theſe banks ſhould have but half a foot in thickneſs at the height D, which ſhould be raiſed ſharp; but a good deal more muſt be left below at E, by ſloping the two ſides pretty much. Dams likewiſe are made of planks or boards, as at F; but they muſt be ſtrong, and ſupported by large ſtakes, ſo that the body of water above may not overturn them; and then they are reckoned preferable to thoſe that are of earth; but a more particular explanation of this figure may be of uſe.—A therefore is the ground within the redoubt. B, The bottom of the ditch. C, D, E, Dam of earth. F, Dam of planks, boards, or faſcines. G, Upper part of the redoubt conſtructed of faſcines, and the earth dug out of the ditch. H, The lower part of the redoubt dug in the earth. I, The berme or ſpace left at the bottom of the parapet to ſupport the earth. L, The entry of the redoubt. M, The inſide of the parapet. N, The upper part of the parapet. O, The banquette. P, The glacis. Q, Rivulet from whence water may be let into the ditch of the redoubt.

BUT it is not with the works alone which have been already mentioned that an officer may fortify a poſt; there are an infinity of ways to ſtop an enemy, to tire him, and even to repulſe him, with which it is neceſſary that every commander ſhould be acquainted.

All the ſchemes for oppoſing the enemy, of which we have given a detail, ſerve only to add to the exterior ſtrength of poſts; there are others which have ſome natural fortifications, ſuch as churches, church-yards, mills, or farm-houſes, &c. An officer who is ſent to a poſt of this kind, which is detached from other buildings, ought, before he begins to work, to make the inhabitants go out, and the magiſtrates of the neareſt place receive and lodge them. He ſhould then entrench the houſe with a turning parapet, if he have people enough to defend it; but if he have only a few, he ſhould make a breaſt-work of felled trees round the houſe, eſpecially oppoſite to the angles, to prevent the enemy from undermining it. He muſt likewiſe take off the tiles and ſlates, leſt the enemy ſhould get up by ladders, and cruſh his people that are within. If the houſe is covered with thatch, it ſhould be pulled off and burnt, as well as every thing combuſtible that can be found in the neighbourhood, leſt the enemy make uſe of it againſt the houſe.

Though the houſe is ſurrounded with a parapet of felled trees, yet the walls ſhould yet be pierced with loop-poles, about a foot from the ground, ſo as to diſcover the enemy's legs, that they may not get footing on the outſide. Theſe loop-holes ſhould be four inches wide, and three feet diſtant from one another; and a little ditch ſhould be made a foot and a half from the wall within the houſe, to place the ſoldiers in who are to defend it. Other loop-holes ſhould likewiſe be pierced ſeven or eight feet from the ground, oppoſite to the interſtices of the lower ones, and of the ſame width, placing the ſoldiers that are to defend them upon tables, planks, or ladders; and taking care to pierce a greater number oppoſite to the avenues, before, and at the ſides of the gate, and the angles of the houſe, becauſe theſe are the places where the enemy uſually makes his greateſt efforts. If the houſe has an inner court, the walls ſhould be pierced which incloſe it, ſo as to fire upon the enemy after he has made himſelf maſter of it. If there are ſeveral gates, they ſhould all be blocked up except one, to be left for an entrance to the poſt, which ſhould be made ſo as to admit but one man at a time.

If there is a broad ſtaircaſe for going up to the firſt floor, it ſhould be broke down, or blocked up with ſtones or caſks filled with earth. If it is a winding ſtair, the wall ſhould be pierced in different places with loop-holes, to fire upon the enemy that are already entered, keeping ladders for the troops defending the houſe to get up to the firſt floor, which ſhould have the boards pierced with a number of holes about four inches diameter, to fire down upon the enemy, obſerving to pierce them only where there are no trees below, but to have a greater number over the door and other weak places which the enemy can force. A poſt entrenched in this manner may reſiſt a great while, and even tire out the beſiegers if defended by reſolute men.

Captain d'Enferney of a French regiment, with a company of volunteers, in the campaign of 1748, took poſt in the church of Bevera, two miles from Ventimiglia. It is detached from other buildings, and he fortified it with a parapet and ditch full of water; but his entrenchment was commanded by ſome houſes in the village, ſo that the enemy could fire down upon his party. He remedied this defect by covering the commanded part with a kind of blind made with rafters, leaning with one end on the wall of the church, and the other upon poſts raiſed a foot higher than the top of the parapet, which left room to fire through. This blind, covered with faſcines and earth, prevented the enemy's fire from piercing, and did not prevent his firing upon them, ſo that they durſt not attack him.

This example is mentioned to ſhow how to ſecure a poſt that is commanded by a height. When there is no redoubt or entrenchments of earth, the interior ſide of the parapet which is commanded ſhould be raiſed, or a ſort of penthouſe ſhould be made with rafters, placed perpendicularly againſt the inner ſide of the parapet, upon which planks or faſcines are nailed, taking care to leave room between the bottom of the penthouſe and the top of the parapet for the men to fire through.

If an officer has not time to oppoſe all the ſchemes which have been mentioned to the enemy, when the general wants to make a forage, and throws infantry into the houſe to form a line, he ſhould immediately place a couple of trees acroſs before the door, pierce the boards, ſhut the windows, and prepare for his defence, which gives time to the foragers to retire, and the ſupporting parties to advance.

The fortification of villages, if they conſiſt of ſcattered houſes, differs nothing from the fortification of a few contiguous poſts, between which a communication is to be preſerved. If they conſiſt of houſes collected, the commander muſt proceed upon the principles laid down in another article. See FORTIFICATION.

SECT. III. *Of going on Detachments and Secret Marches.*

DETACHMENTS are particular bodies of ſoldiers detached from a greater body, to guard a poſt, or to go on an expedition.

When an officer is ordered on a detachment, he ſhould provide himſelf with a cord regularly divided, in caſe he has occaſion to entrench; and be at the parade by times, to get information from the brigade-major, whether he is deſtined to relieve a detachment, or to occupy a poſt for the firſt time. If to relieve a party, he is only to know where the guide is who is to conduct him; the guide is a ſoldier, ſent by the officer who is to be relieved, as orderly-man to the major-general, who by having been at the poſt before can lead a new detachment to it.

If it is a poſt that is to be occupied for the firſt time, the officer is to aſk the brigade-major for inſtructions relating to its defence; which being got, he muſt inſpect his party, and take care that every ſoldier is properly equipped; his firelock loaded, freſh primed, and a good flint well fixed; his cartouch-box filled with cartridges: and that he carries proviſion for 24 hours, which is the time that detachments commonly continue, and are not allowed to go away to eat. Care muſt be taken to have ſpades, pick-axes, hatchets, and wood-bills, one or two of each kind; and if any thing is wanting, to apply to the brigade-major for it, that they may have every thing neceſſary for entrenching.

When an officer has inſpected his party, he ought to get information from his guide whether the way is broad or narrow, open or incloſed; if the enemy's poſts are near; if they go on patroles, or ſee their parties in the day; and, laſtly, if he is to paſs mills, farms, manors, &c. and from theſe informations take the neceſſary precautions for his march.

When the whole are ready to march, the advanced guard A (fig. 8.), which ſhould conſiſt of cavalry only, ſhould ſet out. It is ſurpriſing that all the authors who have written on this part of the art of war, having neglected to ſhow ſufficient attention to ſo eſſential a point: the greateſt part are ſilent, and the reſt paſſing ſlightly over the different duties of this corps, are content that it ſhould be compoſed of infantry; though, on the leaſt reflection, in the moſt ordinary caſes of a ſecret march, reaſon muſt determine that none but cavalry ought to be placed there, whether it be to ſtop paſſengers who may diſcover your route, or ſuddenly to attack an advanced guard of the enemy whom they meet face to face, or to haraſs their corps, in order to gain time for your own to form: it is inconteſtable, that for all theſe purpoſes, cavalry has greatly the advantage of infantry: who are by no means capable of running here and there to ſeize paſſengers, or of pouring ſuddenly on an advanced guard of the enemy; or of reſiſting their cavalry a moment in caſe of a ſudden rencounter, when they muſt expect to be thrown down and trod under the horſes feet, and the corps attacked before the commanding officer has had a moment to prepare for his defence.

Plate DXXIV.

As examples ſerve beſt to illuſtrate opinions that have been ſeldom declared, the ſpirited behaviour of Cornet Nangle of the 15th regiment of light dragoons merits our particular notice, and will ſerve as a proof of the great advantage of having the advanced guard of cavalry. In the campaign of 1761, when the French army under the command of Marſhal Broglio and the prince of Soubiſe were retiring towards Hoxter, where they paſſed the Weiſſer, Prince Ferdinand followed cloſe after them for ſeveral days, and on the evening before they gained the paſs over the river one of Prince Ferdinand's German aid-de-camps deſired the grenadiers and Highlanders who were in front, to puſh on and take ſome of the enemy's baggage, which was a little way before them and but weakly guarded. They were immediately formed, and marched in a hurry over a plain with a thick wood in front, which they were told was clear, and had got within 400 paces of the enemy's baggage, when ſeveral ſquadrons of French dragoons ruſhed ſuddenly out upon them from the ſkirts of the wood upon both flanks, and were hewing them down without mercy, when Cornet Nangle with an advanced guard of 20 men coming up the hill, got ſight of the attack, and inſtantly ruſhing on, charged the French cavalry, who, ſtartled at the briſkneſs of an attack which they were not expecting, immediately reined back; when the reſt of the regiment getting in view, came on; and attacking the French, drove them off, having killed and wounded a few, and taken ſome priſoners. The determined bravery of this young officer with his 20 men ſaved a great number of the grenadiers and Highlanders from being cut to pieces, and ſhows what may be effected by the ſudden attack of an advanced guard of cavalry.

An advanced guard by night ſhould be of double the force of one by day. In an open country, it is a matter of indifference at what diſtance they advance, provided they keep in view of the commanding officer, who ſhould continually obſerve them: but in covered places, and in the darkneſs of the night, they ſhould not be more than 50 paces diſtant.

This advanced guard ſhould have an advanced corporal B, with ſix horſemen divided into three pairs; one in the centre B, the two others out of the road on the right and left at CC, to examine as wide as poſſible, ſilently and attentively ſearching all hollow and covered places, taking care that there is nobody lying on the ground, or hid in dry ditches, behind trees or buſhes. At the ſame diſtance of 50 paces upon the flanks of the corps, ſhould march two wings DD, conſiſting of eight or twelve horſemen, each according to the ſtrength of the corps, led by a non-commiſſioned officer. They can haraſs an enemy who may happen to ruſh ſuddenly out of ambuſcade, and give time to the corps to form. Each wing to detach two men EE, keeping 50 paces wide from the others, and preſerving the ſame route as exactly as the face of the country will permit. At the entrance of the wood NN, the horſemen ſhould ſpread, and cloſe again at coming out, and do the ſame at meeting any little hills, to examine them on both ſides. When they perceive any traces of a party, they ſhould immediately communicate it from one to another, till it comes to the commanding officer.

The advanced guard ought to march ſlowly, and the commanding officer at the head of the corps ſhould follow at the ſame rate, ſo that the rear of the detachment may not be obliged to gallop. As the rear-guard H is only eſtabliſhed for form, there is no need of its being numerous. The officers and quarter-maſters ſhould be careful to keep the men from ſleeping, as a horſe is eaſily hurt under the irregular motions of a ſleeping rider, which retards the march. The whole corps ſhould be forbid to ſmoke or ſpeak; and if any one is obliged to cough or ſpit, let him cover his mouth ſo as to make no noiſe.

When the corps is numerous, the cavalry ſhould march by ſquadrons, the infantry by platoons, to follow alternately, ſo that each platoon of infantry FFF may march at the head of a ſquadron of cavalry GGG; which diſpoſition will preſerve the whole at an equal pace, and keep them readier to form in caſe of meeting the enemy, or being ſuddenly attacked, as we are about to mention.

When the advanced guard perceives an enemy at a diſtance, whether it is day or night, they ſhould not purſue them, for fear of falling ſtupidly into ſome ambuſcade, if it is not in a country that has been well examined; but if they meet them ſuddenly face to face, as may happen at the entrance of a hollow way I, opening obliquely upon them, then the advanced guard, without deliberating about their ſtrength, ſhould inſtantly ruſh upon them. This manœuvre cannot fail againſt infantry, and gives a great advantage in a rencounter with the cavalry; but if the advanced guard falls back, they expoſe the whole body to be defeated with them.

When the commanding officer ſees the action of his advanced guard, he will inſtantly turn the infantry on the ſide of the road moſt proper to protect them from the enemy's cavalry, and will form them quickly at the ſide LLL, or on ſome neighbouring height MM. If it is day, they ought to face the cavalry, ſtooping down till the inſtant of the attack, while the firſt ſquadron advances to ſuſtain the advanced guard. If the enemy appears deſirous to renew the charge, and obſtinate in diſputing the paſſage, he may make uſe of a feint, and by falling back bring them oppoſite to his infantry, who will have them in the flank, and by a well placed fire put them inſtantly in diſorder. His cavalry profiting by this, muſt immediately face about, and fall upon them with all poſſible violence; which cannot fail to complete their defeat.

All villages, hamlets, and houſes, ſhould be avoided, eſpecially by night (which is the moſt common time for the partiſan), to avoid being diſcovered by the barking of dogs, or being ſeen by peaſants who can inform the enemy. You will ſee equally how dangerous it is to keep the great roads by day, or to croſs places that are too open in an enemy's country.

If you cannot avoid paſſing through a village, it ſhould be done in a hurry, marching confuſedly, very cloſe, and filling up the whole breadth, by which you will conceal your ſtrength from the peaſants; ſome officers ſhould remain at coming in, and in the rear, till the whole are paſſed, taking care that no one ſtops or withdraws. The ſame care ſhould be taken at every road that opens upon your route. At the approach of every place that is covered or hollow, ſuch as houſe, wood, gully, &c. they ſhould halt till it is well examined, and continue attentive in paſſing it.

At the paſſage of defiles, bridges, or fords, the advanced guard ſhould ſtop at 100 paces, and form till the whole corps is paſſed and in order. The ancients employed dogs to diſcover the enemy in ambuſcade; but it will be well to diſtruſt ſuch ſpies, and to ſuffer none with the corps, as there is nothing more dangerous; their diſpoſition leading them to bark at meeting the leaſt animal, they will furniſh the enemy with a thouſand opportunities of obſerving you, before you can know where they are.

You ſhould always detain the guides that were taken at ſetting out; but if neceſſity requires another, the quarter-maſter ſhould go and take one without making a noiſe, and lead him a round-about way, that none of the peaſants may diſcover either your party or route. If any of the party diſcover paſſengers in ſight of the march, they ſhould be ſtopped and brought to the corps, and care taken to prevent their eſcape.

The party ſhould never refreſh in a village, but in a wood by day, and open country by night, cauſing every neceſſary to be brought to them from places in the neighbourhood, which ought to be received from the peaſants at a diſtance, ſo that they can neither diſcover the number nor quality of your corps. During the whole time of ſtopping, you ſhould not be ſparing of ſentries, and have always ſix horſemen ready to ſecure any perſon by whom you imagine you are perceived; when their number becomes conſiderable, they ſhould be tied together, and great care taken that none eſcape till the ſtroke is ſtruck. The officers ſhould be equally attentive that no ſoldier gets out of ſight; and if they meet a deſerter from the enemy, he ſhould be conducted immediately to the corps, and then to the army, under the care of a non-commiſſioned officer.

When neceſſity obliges you to ſtop in the neighbourhood of ſome farm or hamlet, you muſt take poſſeſſion of it, and carry off the farmer or chief of the place at going away, threatening to kill him and ſet his houſe on fire if any one ſtir from the place before he is releaſed. Every horſeman ſhould take care to have a ſpare fore ſhoe, and a peck of oats.

If an officer of the infantry marches a detachment to relieve a poſt at a diſtance, he ſhould not mount his horſe till out of ſight of the camp, and ſhould diſmount on coming in ſight of the poſt; but if it is only about a league diſtant from the army, and near the enemy, it is better to go on foot, ſo as to be leſs encumbered in caſe of engaging with any parties of the enemy. The men ſhould not be preſſed too much for fear of lagging in the rear, but ſhould march cloſe without ſtopping, and in as many files as the roads will permit, keeping profound ſilence, that they may hear any orders that are given.

An officer who marches at the head of a party, ought to keep exact order and profound ſilence, that they may be in a ſtate to execute whatever he may order for their defence; but in giving his orders, he ſhould take care to do it with a firm and determined countenance, ſo as to make the ſoldiers think that he is ſure of what he is about, and that nothing better can be done. When the men ſee their officer heſitating, or varying in his orders, they imagine he does not know what to do; and ſeeing him diſordered, they become ſo. It is upon ſuch occaſions that an officer ſhould be ſteady to reſtrain his party, and make them inſtantly obey. The danger is greater on a march than in an attack. Here the ſoldiers have their arms in their hands; and, ſeeing the enemy before them, are ready to engage. It is otherwiſe on a march; they are leſs upon their guard, and have not their arms in readineſs: then, ſays Vigetius, an attack confounds them, an ambuſcade diſorders them. An officer ought therefore to take every precaution in examining, by his advanced guard, all places that may conceal any of the enemy.

But as the greateſt precaution cannot prevent an officer on a march from being attacked, it is neceſſary, as ſoon as he perceives the enemy, to obſerve if the party is ſuperior to his detachment; whether it conſiſts of cavalry or infantry, or both together. If it is cavalry, and ſuperior, there is no neceſſity of being diſcouraged; but, on the contrary, he ſhould profit by every advantage that offers, by gliding into land that is furrowed, uneven, cut, and difficult or inacceſſible to cavalry; or if the country is incloſed, he ſhould line the hedges, and cheer up his ſoldiers by ſome encouraging language, while he diſpatches a truſty fellow with advice of his ſituation to the general. If the enemy march up to him in this ſituation, he muſt do all that he can to ſuſtain the attack, by ordering his party not to preſs upon one another, to keep up their fire, and not to diſcharge their pieces till they are at the muzzles.

When you have the advantage of rocks or other obſtacles to the acting of cavalry, continue the route as near as poſſible, keeping the party cloſe, and always ready to receive the enemy. If the number of the enemy's cavalry do not exceed your party, you may continue your route; and keeping your men cloſe together and prepared, they will not venture to attack you. If an officer ſees no means of poſſeſſing an advantageous poſt, or of getting to the poſt he was detached to, he can do nothing better than retreat to the camp, along ſome river or wood, to prevent being broken: but if he is ſo cloſely purſued that he cannot avoid being beat or taken, there is no better manœuvre to imitate than that of the Barbets (A); who ſcatter themſelves, and retire from tree to tree, from rock to rock, and deſtroy a party, who can neither beat them, nor take one of them.

The moment of taking poſſeſſion of a poſt is the moſt critical that a detachment can have; officers have been frequently attacked at the very time they thought they had nothing to do but quietly take the neceſſary meaſures for remaining in ſafety.

If the party which arrives at a poſt is to relieve another, the officer that is to be relieved gets under arms as ſoon as his ſentries give notice of the approach of the relief. The detachment being known, they are permitted to enter and occupy the poſt in the room of thoſe that are to depart; at the ſame time, the corporals go to relieve the ſentries, and the officers and ſerjeants give the counter-ſign, with the detail of all that is to be done at the poſt by day or night. He ought likewiſe to get information from the officer he relieves, if the enemy make incurſions in the neighbourhood; if their guards are diſtant, whether cavalry or infantry, and whereabouts placed. After theſe precautions let him guard againſt his poſt being ſurpriſed.

The ſentries being relieved, the officer that is to go out muſt form his detachment, and return to camp with the ſame precautions as in coming. The new detachment remain under arms till the other is gone 50 paces: then the officer is to make them lay down their arms againſt the parapet, putting their havre-ſacks againſt the gun-locks, to prevent duſt from ſpoiling them, or the dew of the night from wetting the powder. In an open country without fortification, the men muſt not go to any diſtance from their arms when they lay them down in the day, and keep them between their knees when they ſit round their fires in the night, with the locks inward to prevent accidents.

SECT. IV. *Of Reconnoitring.*

PARTIES ordered to reconnoitre, are to obſerve the country or the enemy; to remark the routes, conveniences and inconveniences of the firſt; the poſition, march, or forces of the ſecond. In either caſe, they ſhould have an expert geographer, capable of taking plans readily: he ſhould be the beſt mounted of the whole, in caſe the enemy happen to ſcatter the eſcort, that he may ſave himſelf more eaſily with his works and ideas.

All parties that go for reconnoitring only, ought to be but few in number. They ſhould never conſiſt of more than 12 or 20 men. An officer, be his rank what it will, cannot decline going with ſo few people under his orders; the honour is amply made up by the importance of the expedition,

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(A) They are peaſants ſubject to the king of Sardinia, who abandon their dwellings when the enemy take poſſeſſion, and are formed into bodies to defend the Alps which are in his dominions.

pedition, frequently of the moſt intereſting conſequence, and the propereſt to recommend the prudence, bravery, and addreſs of any officer that has the fortune to ſucceed.

It muſt be evident that the ſucceſs of ſuch a commiſſion depends upon ſecrecy, and that it is impoſſible to fulfil the intention without keeping out of ſight of the enemy. It is inconteſtable, that a numerous party cannot glide along ſo imperceptibly as a ſmall handful of men. As theſe detachments muſt finiſh their courſe quickly, it is neceſſary that they ſhould conſiſt of cavalry only; but if they are to go far, they may increaſe each with 30 foot, to remain in ambuſh about half-way in a wood or covered place, with whom the cavalry can leave their proviſion they brought with them.

An officer charged to reconnoitre in front, ſhould take his inſtructions in writing, and ſet out at ſuch time as to arrive at the place proper for beginning his obſervations at day break. Every time that he has occaſion to ſtop, the party ſhould face toward the enemy, and ſend a non-commiſſioned officer with two horſemen to run over the neighbouring heights, and cloſely examine the environs. When near the enemy, avoid ſtopping in a village.

The officer, and geographer who is ſuppoſed to be preſent, ſhould remark every intereſting particular: The heights, woods, ponds, moraſſes, rivulets, rivers, fords, bridges, roads, croſſings, difficult and dangerous paſſages, by-ways, meadows, fields, heaths, gullies, hills, and mountains; the diſtance and ſtrength of villages, hamlets, houſes, farms, and mills; what ſovereign the country belongs to, and what are its productions.

If the enemy comes in ſight, the officer ſhould quickly aſſemble his party, though his reconnoitring be not finiſhed, and let him retire to his infantry, if he placed any; but if not, let him gain ſome other place that he has choſen for a retreat. After being refreſhed, let him go back with the cavalry to finiſh the reconnoitring; but if he was obliged to return quite to the poſt, he ſhould not go back till next day. Mid-day is the time of being leaſt incommoded, as detachments are leſs frequent at that hour. The commanding officer ought always to avoid coming to blows, even though he thinks himſelf ſecure of ſucceſs, unleſs he happen to be on his return, and near to his poſt, ſo that he foreſees the grand guard, hearing the firing, cannot fail to run to his aſſiſtance. If obliged to engage with a party who are cutting off your retreat, and that no other means is left of turning them, you muſt riſk all without heſitating, by ruſhing on, and try to ſave the geographer with the fruits of his commiſſion, eſpecially if the reconnoitring was of importance to the general of the army, and merits the ſacrificing a dozen men, which they can eaſily retrieve on another occaſion.

When a party goes out to obtain news of the enemy, it ought to approach as near as poſſible, but cautiouſly: daybreak is not the time proper for ſuch a purpoſe, becauſe at that time the enemy ſend their different parties and patroles to make diſcoveries; you ſhould therefore prevent them by approaching in the night. You may eaſily reconnoitre their poſition and extent by their fires, which they never extinguiſh at the head of the guards and picquets; and you may eaſily remark if they are about to change their poſition, by hearing a more than ordinary noiſe; beſides, as it is eaſy to approach by night, you may diſcover a number of things by the light of the fires.

A partiſan ought not to neglect to reconnoitre every place round his poſt for two or three leagues, or farther, if it is poſſible on the ſide of the enemy; and for that purpoſe he ſhould employ the method of Mr Jeney; who, during the campaigns that he made, often examined the enemy's poſts without approaching, in the following manner, which he recommends as infallible.

Plate DXXV.

I ſuppoſe myſelf, ſays he, with my party at Soeſt in Weſtphalia A (fig. 2.), and the enemy poſted at Bervick B, two leagues from me. To know the ſituation of this place without ſtirring from Soeſt, I take the map of the country: and from Soeſt as centre, I draw a circle whoſe circumference paſſes half a league beyond Bervick. I draw a circle of the ſame ſize upon a leaf of paper, to make my plan as in fig. 2. and then place Soeſt in the centre A; and I mark all the villages which I find in the map near the circumference, upon my plan, with the diſtances and bearings as they are repreſented in the map, making uſe of a pencil to mark the places DDD, ſo as to correct the errors more eaſily which the map may have led me to make.

Having thus formed my plan, with a ſcale of two leagues (which is the diſtance I ſuppoſe Bervick), I go to the burgomaſter of the town of Soeſt, where I cauſe ſome of the moſt intelligent inhabitants to come, ſpeaking to them freely, and openly induce them to communicate all the information I have occaſion for.

The better to conceal my deſigns, I begin my reconnoitring by Brokhuſen, a village diſtant from the enemy. I aſk the diſtance from Soeſt to Brokhuſen; if they ſay it is ſeven quarters of a league, I correct the diſtance of my plan which made it two leagues: then I inform myſelf of all that is to be found on the road from Soeſt to Brokhuſen; chapels, houſes, woods, fields, orchards, rivers, rivulets, bridges, mills, &c. If they ſay that at half a league from Soeſt they paſs the village of Hinderking, I mark that place upon my plan. I aſk if the road from Soeſt to Hinderking is croſſed by any other road; if there is any moraſs or heath; if the road is incloſed, paved, or ſtraight; if there is any bridge to paſs, and at what diſtance. I take care to mark every thing in my plan, forgetting nothing, even to mills, buſhes, gibbets, gullies, fords, and every thing that can be got from their informations; which will probably be perfect, becauſe one always knows more than another. I continue my queſtions from Hinderking to Brokhuſen; and advancing by little and little, obſerve the ſame method on the roads of the other villages round, marked DDD. In this manner I cannot fail to acquire an entire knowledge of all the places; beſides, I find myſelf imperceptibly inſtructed in the poſition of the enemy, by ſeeing the different routes by which I can approach moſt ſecretly.

It is plain that ſuch a plan muſt be very uſeful to regulate ſecret expeditions. It is chiefly uſeful, not to ſay neceſſary, for a commander of a party, who can give more ample and preciſe inſtructions to his officers, by accompanying them with a copy of the routes marked out, which they can conſult even in the night, if it happens to be clear; by which they will be guarded againſt being deceived by ignorant or treacherous guides, which occaſion the miſtakes of ſo many who go unprovided with ſuch helps.

There is ſtill another means to ſecure a reconnoitring party; which is, to compoſe them of people who ſpeak the language of the enemy, and give them ſurtouts of the colour of a regiment of the enemy, and cockades the ſame. This ſcheme may be carried ſo far as to line the ſurtouts with the colour of another regiment of the enemy, provided that by turning the ſurtouts, they appear to be a different corps, and deceive guard, ſpies, and peaſants, and confound their reports.

Sect. V. *Of the Defence of Poſts.*

When a partiſan has taken every precaution that prudence ſuggeſts in reconnoitring a place where he would fix a poſt, he is to take poſſeſſion in the following manner. The infantry remain under arms in the middle of the place, the cavalry to patrole without, while the commanding officer, eſcorted by a dozen horſemen, goes to examine the environs to make his arrangements; having ſent ſeveral ſmall detachments before, to cover him in time of reconnoitring.

Plate DXXV.

Having remarked the places proper for his guard, defence, and retreat, as well as the dangerous ones by which the enemy can make approaches ſecretly to ſurpriſe him, he ſhould chooſe the moſt convenient in the front of his poſt to fix his grand guard D (fig. 1.), which muſt face the enemy. He muſt mark the heights for this guard to place their vedettes EEEE, and regulate the number according to the exigencies of the ſituation. In a covered country you muſt not be ſparing of them, and muſt reinforce every guard. At 50 paces before the front of the grand guard, a ſubaltern or non-commiſſioned officer with eight horſemen ſhould be always ready to ſet out at K, to go and reconnoitre, when the vedettes have obſerved any party.

The grand guard being fixed, you ſhould form another in the middle of the village, called the *ordinary guard*, compoſed of cavalry and infantry, placing ſentries at the entries and vedettes all round: the laſt at ſuch diſtance as to ſee one another. A picquet ſhould likewiſe be fixed before the quarters of the commanding officer, which ſhould be near the ordinary guard and the whole corps. In the day, half the cavalry of the picquet muſt keep their horſes bridled and ready to mount; but if the enemy is near, they muſt remain on horſeback, the other half to unbridle till the hour of relief.

According to the arrangement we have given for compoſing the corps of a partiſan, the grand guard may conſiſt of a captain, a firſt and ſecond lieutenant, a quarter-maſter, two ſerjeants, four corporals, a trumpeter, farrier, and 52 private horſemen. The ordinary guard to have cavalry equal to the grand guard, with a captain, a firſt and ſecond lieutenant of infantry, two ſerjeants, and 60 men, including four corporals, two lance-corporals, and a drummer: the picquet to conſiſt of the ſame number of cavalry and infantry as the ordinary guard.

If there is any dangerous place capable of covering the approaches of the enemy in the environs of the poſt, and out of the circuit of the patroles, there ſhould be a guard placed there, more or leſs ſtrong according to the importance of the place, and care ſhould be taken to preſerve the communication. The guards and picquets being placed, the detachment that was ſent out on the roads muſt be called in, and then go to work to lodge the party in the gardens that open upon the country, and the commanding officer's quarters; beating down hedges, filling up ditches, and levelling a piece of ground large enough to draw up the whole corps. The horſes to be put under cover in barns contiguous to the gardens; but in caſe there are no barns, they may ſubſtitute ſheds open on one ſide, that the horſes may go out altogether in caſe of an alarm.

The officers ſhould occupy the houſes in the neighbourhood of the ſheds, and one of each company remain day and night with the company, to prevent any of the men from entering the village without leave, upon any pretence. The commanding officer muſt acquaint the officers of his having choſen the place M for the rendezvous in caſe of a retreat: which ought to be at ſome diſtance from the village, and on the ſide he judges moſt convenient for retiring to the army. At ſunſet the grand guard are to return to the poſt and join the picquet, the one half of each to mount alternately till day break, and then the grand guard to return to the place they poſſeſſed the day before. The ſentries and vedettes ſhould be doubled, and all the paſſages ſhut up with waggons placed in two rows, except one for ſallying out at, in caſe of a retreat, made wide enough for the paſſage of the patroles or the whole cavalry.

The corporals of the ordinary guard ſhould lead the relief of the vedettes every hour, ſetting off together; but when they come to the paſſage of the poſt A, they muſt ſeparate into two parties, the one to the right to relieve the vedettes BBB, the other to the left for the vedettes CCC; then each of them with the parties they have relieved ſhould go on at their head a quarter of a league, by the two routes pointed out in the plan, to examine the environs, ſuppoſing an hour to each. Beſides this reconnoitring, the captain of the grand guard ſhould ſend two patroles in the night. To fill up the intervals, they ſhould ſet one about half an hour after the corporals, and make the ſame round. At returning to the poſt, the corporals to make their report to the officer of the ordinary guard; the conductors of the patroles to the captain of the grand guard.

A little before ſunriſe or ſunſet, a grand patrole detached from the corps ſhould be ſent under the conduct of an officer to ſearch the whole environs of the poſt minutely, eſpecially the dangerous places, becauſe at theſe times the enemy are moſt likely to attempt a ſurpriſe. If the patroles diſcover them, they will be in a ſtate to repulſe them, or at leaſt to haraſs them till the commanding officer, upon the firſt notice, draws up the whole corps. The officers ſhould take great care to inſtruct the ſentries in their duty, explaining it to them every time of their mounting, and forbid them to ſmoke, as the leaſt fire can be eaſily perceived in the dark, and ſerve to direct the approaches of the enemy. No ſentry to move more than 50 paces to the right, and as many to the left of his poſt: and let the weather be ever ſo bad, he muſt not get under cover. No one to be allowed to go out of the poſt without leave of the commanding officer; and to prevent deſertion or marauding, the ſentries and vedettes muſt be charged to let no ſoldier paſs.

The vedettes muſt ſtop all paſſengers, and take them to the next ſentry, who muſt call a corporal to conduct them to the commanding officer. If there are a great number paſſing at once, the vedette at the challenge muſt haſten to ſtop them at 100 paces, till the officer has ſent to reconnoitre them; but if he finds them to be a party of the enemy, he muſt fire upon them and retire. At the firſt alarm, the grand guard and picquet ought to mount, and each of them to detach a ſubaltern officer immediately at the head of the beſt mounted horſemen, to go quickly to encounter the enemy. The reſt of the grand guard and cavalry of the picquet to follow immediately, led by their captains to ſuſtain the firſt detachments, to repulſe or keep back the enemy as long as it is poſſible, and give time to the commanding officer to form the whole corps.

If the commanding officer obſerves that the enemy are of no very extraordinary force, he muſt without heſitating put himſelf at the head of his cavalry, and inſtantly charge them, pouring upon them with his whole force, which is the beſt way to ſucceed; and in the mean time, the infantry ſhould form to ſuſtain the cavalry. One eſſential circumſtance ſhould not be forgot here, which is, that at the going of the detachments of the grand guard and picquet, all the infantry of the picquet ſhould march immediately to the place appointed for the rendezvous in caſe of a retreat, and a ſtrong detachment of cavalry ſhould follow to occupy the place. If it is at the entrance of a wood or ſome covered place which the enemy may occupy, and thereby cut off your retreat, you muſt prevent it by fixing the infantry of the picquet in the poſt, to remain day and night, with a lieutenant

WAR.

Plate DXXIV.

Fig. 1.

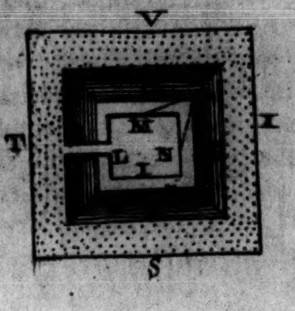

Fig. 2.

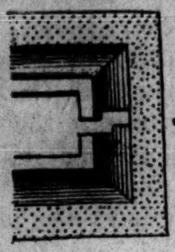

Fig. 4.

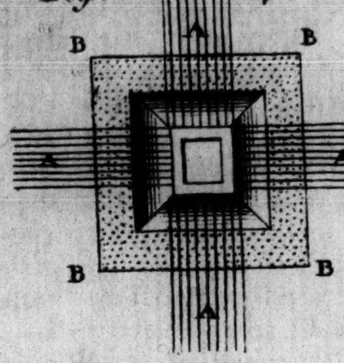

Fig. 6.

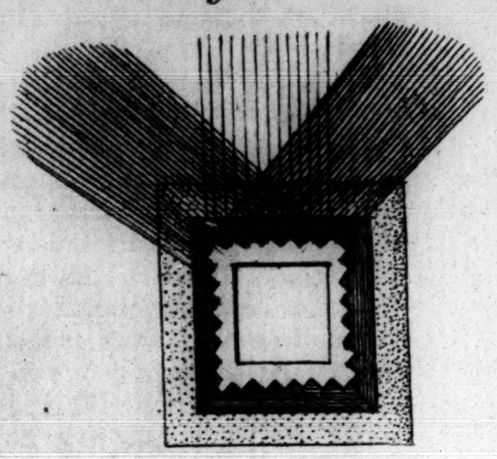

Fig. 3.

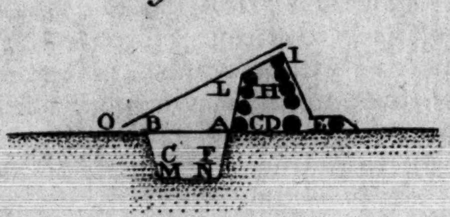
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Fig. 5.

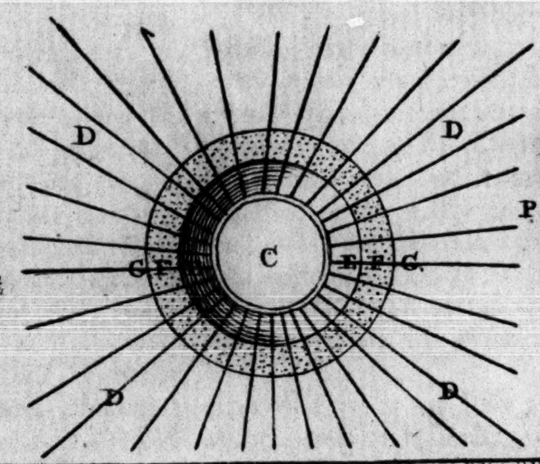
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Fig. 7.

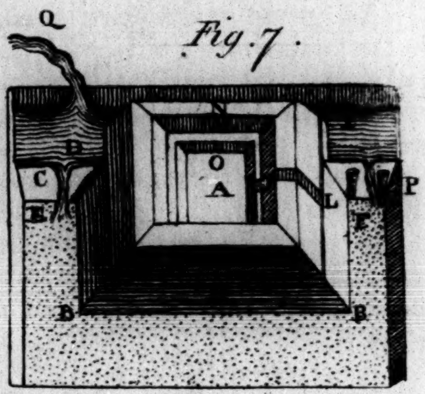
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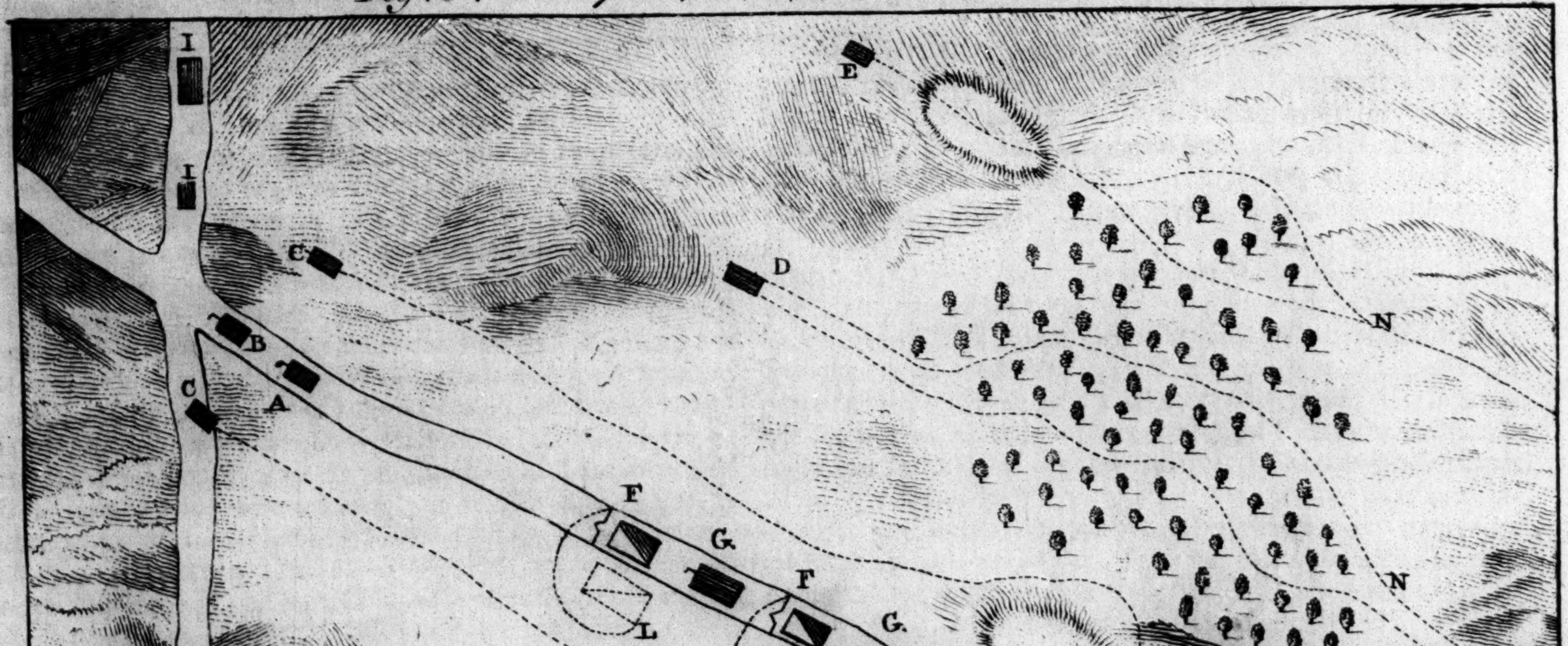
Fig. 8.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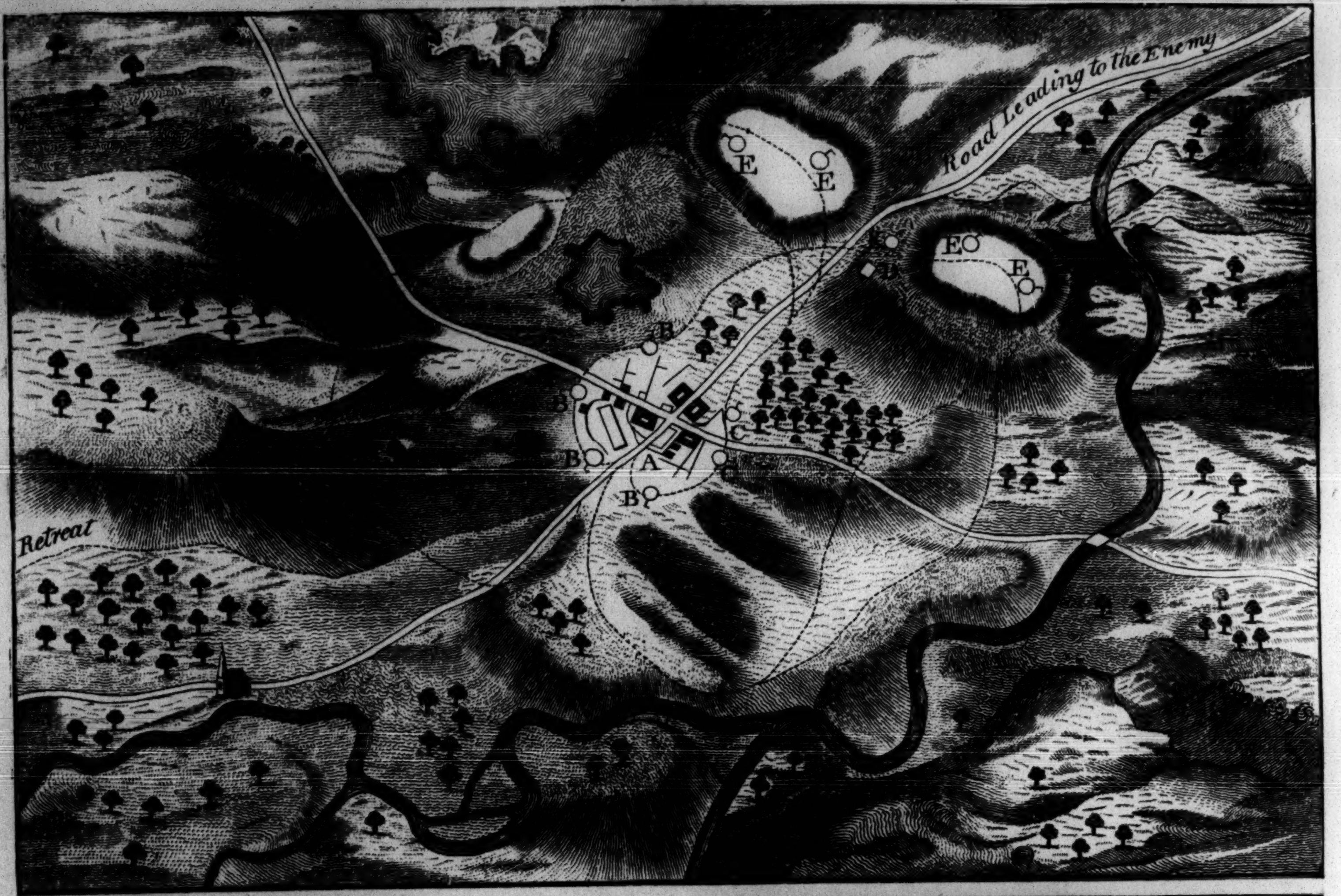
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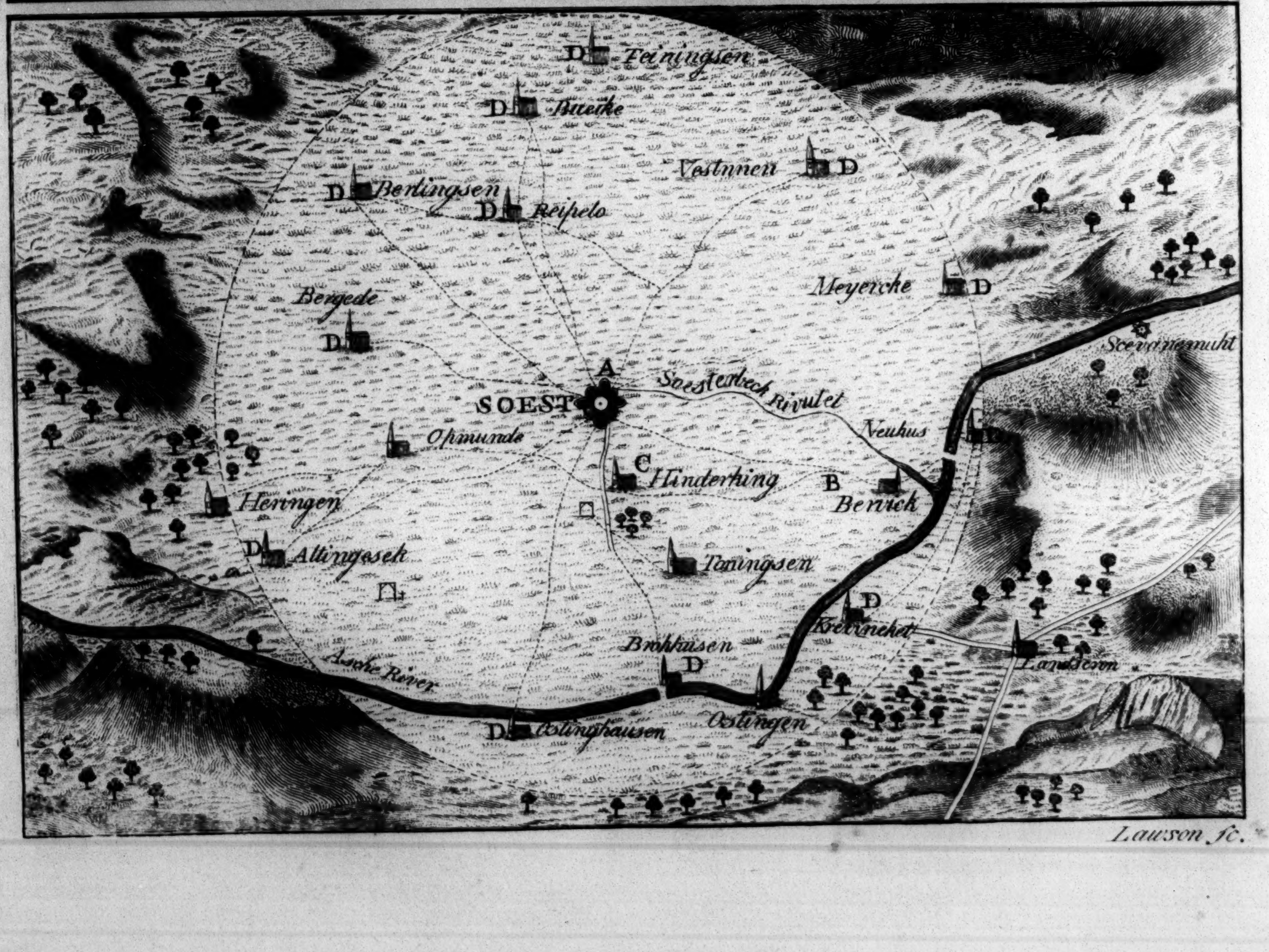
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Neuhus
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Opmunde
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Hinderking
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Herringen
D Altingesek
Toningsen
D
Kerneheel
Landsorm
Asche River
Brokhusen
D
D Oslinghausen
Ostingen

Lawson sc.

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Petite Guerre.

lieutenant at the head of 20 horſemen to clear round it. If the enemy is too ſuperior, and appears to form an attack on that ſide, the commanding officer ſhould get there before with all his force to oppoſe them, till all his detachments join, and then regulate his retreat, as will be ſeen in the ſection of the Retreat.

To be better ſecured in a poſt which you expect to remain in for ſome time, and where you find that the enemy will not fail to diſturb you, it will be proper immediately to employ ſome of your people with the peaſants, to form ſome intrenchments in a hurry in the moſt dangerous places, to have breaſt-works of felled trees in the woods; herſes placed in the fords (ſee Herse); pits dug at the entries and plains without defence; ſo that the cavalry coming full ſpeed to charge you, may tumble in. If there happen to be a bridge either in the front or on the flanks of the poſt, as at N, by which the enemy can facilitate their approach or retreat, it muſt be inſtantly deſtroyed, unleſs you find it may be of uſe, and neceſſary to fix a good guard on it.

To regulate the attack and defence moſt advantageouſly, you ſhould take care to obſerve the places by which the enemy can approach, and form a plan of operations for cutting off, or taking in flank, the different routes which he can attempt. You ſhould inform your officers, and not fail to hearken to the advice of thoſe whoſe talents, genius, and experience, render them competent judges of your deſigns. Theſe arrangements will be of great uſe in ſurpriſing the enemy's parties, who will come from time to time to reconnoitre the poſt. If the enemy approaches in the night, take care how you attack him; you cannot reconnoitre his force, and you ought to ſuppoſe that he is informed of yours.

Do not ſuffer any ſuſpected women to approach the ſoldiers; their viſits are dangerous in debauching your people, and the enemy frequently employ them to diſcover your ſtrength. Let no deſerter ſtop in your poſt; and if he comes in the night, keep him till day-break is near, and then ſend him to the army. Every party that approaches your poſt will profeſs belonging to you; but if they are not provided with a proper paſſport from the general, or if you do not know any of the officers, truſt neither to their word nor uniform.

Theſe inſtructions may ſerve for the corps of a partiſan according to the propoſed arrangements; but partiſans of leſs force muſt regulate their precautions according to their ſtrength; and detachments of 30, 50, or 100 men, will ſeek to poſt themſelves in redoubts proportioned to their number, or in mills, farms, hamlets, detached houſes, churches, church-yards, &c. obſerving that the more a poſt is extended, the more care and fatigue it requires.

The principal object for an officer that is detached, ſays Monſieur Vauban, is to foreſee every troubleſome event. The want of exactneſs, and the ſmalleſt relaxation in the ſervice of out-poſts, may have the moſt fatal conſequences; and hiſtory furniſhes a thouſand examples of camps being ſurpriſed, and armies cut in pieces, by the negligence of detachments that ought to have watched for their preſervation.

The manner of relieving detached poſts has been mentioned; but if an officer is detached to a mill or houſe, let him draw up his party about 15 or 20 paces from the poſt, and ſend a ſerjeant or corporal with five or ſix men to ſearch the chambers, cellars, and barns: which being done, the ſentries muſt be placed, the poſt taken poſſeſſion of, the arms ranged ſo that every one can find his own without confuſion, and the inhabitants lodged in ſome other houſe; and then intrench himſelf according to the rules given.

If an officer is to fix in a village where it is difficult to examine every place where the enemy may lie in ambuſh, he ſhould ſend for the magiſtrates to come and ſpeak with him, while his party remain drawn up at the end of the village, that they may declare if they know whether there are any of the enemy's parties, ſuſpected perſons, or concealed arms in the place; which being done, the ſentries are to be placed, and the party to take poſſeſſion; putting ſmall detachments of five or ſix men, more or leſs according to the ſtrength of the party, at the avenues; and examining the church, or any detached houſe, to make the principal poſt in caſe the advanced poſts are forced. The men beſt acquainted with the duty ſhould be planted on the moſt expoſed and diſtant places, ſo as to ſee all the approaches; and ſometimes in trees, that they may ſee at a diſtance, and remain concealed from the enemy.

If he finds any place near him where the enemy can lie concealed, he ſhould place a corporal with ſix or ſeven men there, with orders to fall back upon his poſt if attacked, or remain till they find themſelves diſengaged. The ſoldiers of this leſſer poſt ſhould take care to make no fires, becauſe it would ſerve for a guide to the enemy to avoid them when they want to fall upon the principal poſt; but fires may be lighted in the places where they have no guards, to make the enemy think they have them every where, at the ſame time placing ſoldiers in ambuſh where there are none lighted. This ſcheme may ſerve for all poſts in a level country, where two or three ſoldiers ſhould be kept going all night to ſtir up the fires.

The exterior arrangements being made, and ſentries placed on the avenues, bridges, and ſteeples, the works for fortifying the poſt ſhould be marked out, and executed by the workmen, and the magiſtrates ordered to ſend ſtraw to the neareſt houſes for lodging the ſoldiers, who muſt never abſent themſelves. The officer muſt always be in readineſs to go where his preſence may be wanted, and make his ſerjeants and corporals frequently go the rounds. Monſieur Vauban ſays, that if an officer is to remain but four hours in a poſt, he ought to intrench. If he is to paſs only ſome hours in a poſt, it is a good way to make a parapet of felled trees; or if it is in a village, to intrench a detached houſe.

The way to guard againſt being ſurpriſed, betrayed, or made priſoner, is to take precautions againſt all that the enemy can undertake; and whatever diſtance he may be at, we ought not to found our ſecurity on probabilities, but extend them even to poſſibilities. Neither ſtranger nor ſoldier of any other party ſhould be admitted into the poſt; and the roll ſhould be called three or four times a-day, that the men may not abſent themſelves: the commander ſhould likewiſe examine the ſentries, to ſee whether they are acquainted with the detail of their duty, and ſhould ſhow them how to defend themſelves in caſe of being attacked; obſerving to them, that if the enemy make ſuch a manœuvre, they ſhould oppoſe ſuch another; if they try this ſcheme, to reſiſt with that, and deceive them at every ſtep. He may make ſome of them try to ſcale the intrenchment, to ſhow the difficulty of mounting it; and by exerciſing them in this manner, he will prepare them to reſiſt the enemy; it will flatter their vanity, and give them a confidence in him.

An hour or two before day, the men ſhould be kept alert, ſitting on the banquette near their arms; and the patroles ſent at that time, rather than in the night, to march ſlowly, to liſten attentively, and examine every place round the poſt where a man can conceal himſelf.

It frequently happens that two armies are encamped oppoſite to one another, and have ſeveral poſts on the ſame line, and two patroles meet in the night. As it is impoſſible to diſtinguiſh whether they are friends or enemies, they who firſt diſcover the others, ſhould conceal themſelves on the ſides of the road, behind buſhes, or in a ditch, to examine if they are ſtronger; and in that caſe to let them paſs in ſilence, and return another way to the poſt to tell what they have ſeen: but if they find them weaker, he who commands the patrole ſhould make the ſignal which is ordered for the patroles of the night, which is commonly a ſtroke or two on the cartouch-box or butt-end of the firelock, which is anſwered by an appointed number; but a word is the ſafeſt. If the patrole does not anſwer, they ſhould advance upon them with fixed bayonets, fire upon them if they ſee them retiring, and make them ſurrender.

If detached oppoſite to the enemy, it is to be preſumed that you may be attacked: therefore ſmall detachments ſhould be advanced between the ſentries in the night, about 30 or 40 paces from the poſt, with their bellies on the ground, in thoſe places where they imagine the enemy may come; with orders to thoſe who command them, to make a ſoldier reconnoitre any parties that are ſeen, ſo as not to confound their own patroles with the enemy's parties, and to retire to the poſt on the firſt firing.

In villages there ſhould be great care taken of ſuſpected perſons, or of the peaſants revolting; and for this purpoſe, you ſhould make the magiſtrates order two peaſants, the beſt known in the place, to be put on duty with the ſentries of the party, at the paſſages left in intrenching. Theſe peaſants, whom the magiſtrates muſt cauſe to be relieved every two hours, ſhould be charged to recollect all who paſs in or out of the village; and both one and the other muſt be told, that they ſhall be anſwerable for all the accidents that may happen from the treachery or negligence of thoſe ſentries who have let enemies in diſguiſe enter the village.

They muſt likewiſe order the ſoldiers who guard the intrenchments, to let no peaſant approach, and to ſhut up the paſſage, with two trees acroſs in the night, and not to open them till day, except for the paſſing of the patroles. They muſt examine with iron ſpits, or their ſwords, all carts that paſs loaded with hay, ſtraw, or caſks, or any thing that can conceal men, arms, or ammunition.

An officer cannot watch too carefully to prevent ſchemes that may be contrived againſt him; and the attempt on Briſac, in the month of November 1704, is ſo much to the purpoſe, that it ought not to be paſſed in ſilence. The governor of Fribourg having formed the deſign of ſurpriſing Briſac, ſet out in the night of the 9th or 10th of November, with 2000 men, and a great number of waggons loaded with arms, grenades, pitch, &c. and ſome choſen ſoldiers: all theſe waggons were driven by officers diſguiſed like waggoners, and were covered with perches, which had hay placed over them, ſo that they appeared like waggons loaded with hay coming in contribution. They arrived at the new gate by eight o'clock in the morning, under the favour of a thick fog: three waggons entered the town, two full of men, and one with arms, when an Iriſhman, an overſeer of workmen, obſerving 30 men near the gate, who, though they had the dreſs, had not the manner of peaſants; aſked them what they were, and why they did not go to work like other people? Upon their not anſwering, and appearing confounded, he ſtruck ſome of them with his cane; upon which the diſguiſed officers run to the arms which were in the waggon next them, and fired 15 or 20 ſhot at him within half a dozen paces, without wounding him. The Iriſhman leaped into the ditch, where they likewiſe fired ſeveral uſeleſs ſhot at him, while he called *To arms, to arms,* with all his might.

At this noiſe, the guards of the half-moon and the gate run to arms, and would have pulled up the draw-bridge, but were prevented by the waggons which the enemy had placed upon it. The officers and ſoldiers who were in the waggons, ruſhed out with their arms, and having joined the reſt, attacked the guard commanded by a captain of grenadiers; but being repulſed, and five of them killed, the reſt were diſmayed, and fled either into the town, or out into the country. The captain of the guard made the firſt gate, which was a grate, to be ſhut, acroſs which the enemy, who were upon the bridge, fired at all who appeared; and having left the half of his guard, he mounted the rampart with the other half, and continued firing upon the enemy. A lieutenant who commanded 12 men of the advanced guard, was attacked at the ſame time by an officer who preſented a piſtol to his breaſt; but ſnatching it from him, he fired it at him, and killed him: this lieutenant defended himſelf to the end of the action; but having received ſeveral wounds, he died that day.

Upon hearing the noiſe of the ſurpriſe, the commanding officer of the place diſtributed his garriſon to their proper poſts: and having made every diſpoſition neceſſary for his defence, the enemy ſaw that their deſign had failed, and retired in diſorder, leaving a number of waggons behind them, and more than 40 ſoldiers who were killed or wounded. Such was the enterpriſe on Briſac, which failed by a trifling accident.

This example, and many others which might be cited, ſhow that an officer who commands in a poſt cannot be too much on his guard to prevent his falling into the ſnares which the enemy prepare for him, as the ſeizing of a poſt, of however little importance it may ſeem, may be attended with the moſt troubleſome conſequences.

In an enemy's country, the inhabitants are always ready to revolt and betray; therefore the commanding officer ought to take one or two of the magiſtrates children, or three or four of the moſt conſiderable families of the village, and keep them in the principal poſt as a pledge of the fidelity of the inhabitants. The children (to whom they ſhould take care to do no manner of hurt) ſhould only be kept half a day each, and changed for ſome others. The commanding officer ſhould forbid the inhabitants to aſſemble in taverns or public walks, or any place whatever, and cauſe theſe orders to be fixed up at the door of the church. If they are ſeen to ſtop and converſe at coming out of church, or in the market-place, let the patroles oblige them to retire. The tavern-keepers and all the inhabitants muſt be forbid to receive any ſtranger without acquainting the commanding officer. None to be permitted to ſtir abroad after retreat beating, on pain of being killed by the ſentries who ſee them, or ſtopped and conducted to dungeons by the patroles; who ought to march ſlowly, ſtop from time to time to hearken if they hear any noiſe, go over all the quarters that are marked out to them, and give an account of every thing that they have diſcovered that can cauſe any alarm in the poſt.

If fire breaks out anywhere, or the inhabitants quarrel among themſelves, an officer ſhould take care how he ſends a party to their aſſiſtance, becauſe theſe are frequently ſnares of the enemy to divide the ſtrength of a detachment on purpoſe to attack them; he ſhould therefore ring the alarm bell, make all the different poſts get under arms, and order thoſe who command them, to make the ſoldiers remain armed againſt the parapet, ſo as to obſerve what paſſes without the village. The ſoldiers of the principal poſt ſhould likewiſe get under arms, and the officer detach four or five men with a ſerjeant or corporal to part the fray, or ſet the inhabitants to work in extinguiſhing the fire.

As all the neceſſary precautions for the ſafety of a poſt are too many to have them executed by giving them verbally, the commanding officer ſhould give his orders in writing, and have them fixed up in all the leſſer poſts. One thing to which officers who are detached to a village ſhould give particular attention, is, not to vex the inhabitants by making them furniſh too much: whatever they are allowed by the general to exact, ſuch as firing, forage, candle, &c. for the guards, ſhould be demanded in proportion to the abilities of the inhabitants; and an officer cannot be too delicate in preſerving the character of a gentleman in ordering contributions, and preſerving the inhabitants from being robbed or treated ill by the ſoldiers.

It is not ſufficient for the preſervation of a poſt, to raiſe intrenchments, nor to take every precaution againſt being ſurpriſed. As the enemy muſt attack with a ſuperior force, your diſpoſitions muſt be made in ſuch a manner as not to confuſe one another, and every one being properly placed, contributes to the common ſafety. If it is a redoubt, or other entrenchment of earth that is to be defended, ſeven or eight trees with their branches ſhould be kept in reſerve, to throw into the breaches the enemy may make, and the parapet kept well lined with men, who ought not to fire till the enemy are on the glacis. They ſhould be provided with grenades to throw in the midſt of the enemy who have jumped into the ditch, nay even aſhes or quicklime, whoſe burning duſt cannot fail to blind the enemy, ſhould be had if poſſible. If the ſtrength of your detachment will admit of it, eight or ten ſoldiers ſhould be placed in the ditch (on the oppoſite ſide from the enemy), ſo divided as to take the enemy on the flanks, who have jumped into the ditch. This kind of ſally, by running round upon the right and left at the ſame time, muſt aſtoniſh an enemy who could not dream of being attacked.

If there are heights from whence the enemy can cruſh your people with ſtones, they muſt be occupied with eight or ten men covered with a breaſt work, to prevent the enemy from poſſeſſing them, or guard againſt them, as has been formerly directed.

In the defence of houſes, mills, &c. as well as regular fortifications, the men ſhould be made acquainted with the different manœuvres they may employ for their defence; without which they do not foreſee the intentions of their officer, and may counteract one another by their being in diſorder.

The obſtinate defence of a poſt is the action where an officer detached ſingly can acquire the greateſt glory; the reſiſtance not proceeding from the number of ſoldiers deſtined to defend it, but from the talents of the officer who commands. It is in him that the ſtrength in the intrenchment lies; and if he joins to determined bravery the abilities neceſſary on theſe occaſions, and can perſuade his ſoldiers that the lot the enemy prepares for them is a thouſand times worſe than death, he may be ſaid in ſome ſort to have rendered his poſt impregnable.

In the defence of detached buildings, there are ſo many different retreats, that it becomes an arduous taſk to ſucceed in an attack, when brave people are to defend them They have the loop-holes on the ground-floor to defend, when beat from the entrenchments without, and may reſiſt great numbers, by retiring gradually to the different floors of the houſe, where they ſhould have large buckets of water provided to throw upon the enemy, which, though it may appear trifling, is one of the moſt diſagreeable that can be oppoſed to the aſſailants; for at the ſame time that it wets their powder, arms, and clothes, it hinders them from ſeeing what is doing above, prevents every ſcheme for ſetting fire to the houſe, and may oblige them to deſiſt from the attack.

Having obſerved that the defence of a poſt does not depend upon the ſoldiers who are deſtined for that ſervice, but upon the officer who commands, the following example may ſerve to confirm the obſervation, and will at the ſame time ſhow the utility of having ſtones collected to throw over upon the enemy, as formerly recommended.

In the month of September 1761, captain-lieutenant Alexander Campbell of the 88th regiment, with 100 men under his command, was pitched on to defend the remarkable poſt near Caſſel in Heſſe, called the *Hercules*. Monſieur Roziere, the celebrated partiſan and engineer of marſhal Broglio's army, with 600 infantry and four ſquadrons of cavalry, arrived in the neighbourhood of the poſt the morning of the 22d; and having beat a parley, ſurrounded and carried off the two men who were ſent out to receive the meſſage. After having examined them ſeparately, he cauſed a detachment, under cover of his muſquetry from a hill that was oppoſite to the principal paſſage, to advance and mount the ſtair, three men abreaſt; which they did ſo ſlowly and without any interruption, that the whole ſtair of about 100 ſteps was full of men, when Captain Campbell (who had made an excellent diſpoſition for the defence of all the parts of his poſt), having ſome choſen men at each ſide of him, waited to receive thoſe who advanced firſt upon their bayonets, and firing at the ſame time, gave the ſignal for the reſt to throw over large ſtones which he had collected and diſpoſed for that purpoſe; which made ſuch havock, that Monſieur Roziere, ſtartled at the unexpected reception, and deſpairing of ſucceſs, wiſhed to get his party off. Captain Campbell ſeeing the deſtruction of the enemy without a man of his being hurt, and that he could renew the reception as often as they choſe to repeat the attempt, was elated with his ſucceſs, and encouraging his men, when he happened to move from the wall that covered him, and received a muſket ſhot from the oppoſite hill, which entered a little below the left temple and came out at the ſame diſtance below the right; upon which he fell, and the party beat the chamade and ſurrendered. After two hours poſſeſſion the French retired, carrying off the priſoners, and leaving Captain Campbell, whom they thought dead, to be ſaved by our troops, who ſoon took poſſeſſion again, and ſent him to be recovered, and to diſplay new merits in his profeſſion.

If the enemy take cannon to force the poſt, it does not appear how it can be reſiſted, unleſs the houſe is low, and they cannot range round the intrenchments, as every ſhot can make a large opening in bad built houſes, and may cruſh the beſieged. The only means then to ſhun being maſſacred is to capitulate, or to ruſh out briſkly upon the enemy when they leaſt expect it. The firſt is not reſolved upon but when the honours of war can be obtained, which is to march out with drums beating to return to the army with a proper eſcort. But if this capitulation cannot be obtained, the beſieged have nothing left conſiſtent with true bravery, but to ruſh out ſword in hand, and cut their way through the enemy. The neceſſity of conquering changes the brave man into the determined ſoldier, which gives him the means of retiring to the army or ſome neighbouring poſt.

If a poſt is to be abandoned when it can be no longer held, and you are going to make the ſally, you ſhould continue to fire with ſpirit, taking away barricadoes from the door through which you are to paſs with as little noiſe as poſſible. When they are aſſembled, the whole party ſhould go out cloſe together, ruſhing with their bayonets to the place the officer thinks the leaſt guarded. You ought never (ſays Mr Folard) to wait for day to execute theſe ſallies, which cannot ſucceed but in a dark night, by which you eaſily conceal from the enemy the road you have taken; for which reaſon you ſhould not fire, but open to yourſelves a paſſage ſword in hand, leſt the enemy come where they hear the noiſe.

Officers ſhould be attentive to diſtinguiſh between the true and falſe attacks, and not deſpair when beat from their firſt entrenchments. The defence of poſts is ſo eaſy, that it is ſurpriſing they do not hold out longer than they commonly do. There wants only reſolution and vigilance, taking every advantage of the ground, and perſuading the ſoldiers that nothing but the moſt manifeſt baſeneſs can let the enemy penetrate. The example of Cremona, ſurpriſed by prince Eugene in 1702, will remain a proof to poſterity of what determined bravery can do; and ſhow, that though an enemy is maſter of half the ramparts, and part of the town, he is not maſter of the whole.

Prince Eugene having formed the deſign of ſurpriſing this town, which was defended by a garriſon of French and Iriſh, got ſome thouſand Auſtrian ſoldiers admitted at a ſecret paſſage by a prieſt. Theſe troops ſeized the two gates, and a great part of the town; the garriſon buried in ſleep, were awaked by the aſſault, and obliged to fight in their ſhirts; but by the excellent manœuvres of the officers, and reſolute bravery of the men, they repulſed the Imperialiſts from ſquare to ſquare, from ſtreet to ſtreet, and obliged Prince Eugene to abandon the part of the town and ramparts of which he had been in poſſeſſion.

Poſts have often reſiſted the firſt and greateſt efforts of the aſſailants, and have yielded or been abandoned to ſubſequent attacks, though much leſs ſpirited. How comes this? It is owing to an officer's not daring to abandon his poſt at the firſt attack: he repulſes the enemy, becauſe if forced they will be put to the ſword with their whole party; but when the enemy comes back, he thinks he has nothing to reproach himſelf with, having defended it for ſome time, ſo retires, or ſurrenders. Since he could repulſe the enemy when in good order and quite freſh, how much more eaſy and leſs to be dreaded when they return haraſſed with fatigue?

Is not the great cauſe of miſconduct among military men the want of encouragement to excite emulation? An officer who is not protected, who is never ſure of the leaſt favour, neglects himſelf, and takes leſs trouble to acquire glory, rarely heard of, though merited by the braveſt actions, than to enjoy the tranquillity of an ordinary reputation.

It is not expected that an officer who is placed in a poſt ſhould ſeek to engage; but that he ſhould ſteadily reſiſt when he is preſſed, and die rather than abandon his intrenchment.

Hiſtorians have been very ſilent about poſts being well defended; though the leſſons to be drawn from them may be more generally inſtructive, and as agreeable to read, as thoſe left us of the beſt fortified places of a ſtate. We are aſtoniſhed at the account of 100,000 men periſhing before Oſtend in 1604, and their general, the archduke Albert, with the ruins of his army, not making himſelf maſter of it, till after three years ſiege: nor is our wonder leſs, to ſee Charles the XII. of Sweden, in the year 1713, with ſeven or eight officers and ſome domeſtics, defend himſelf in a houſe of wood near Bender againſt 20,000 Turks and Tartars.

Several hiſtorians mention the defence of this houſe becauſe it was done by a crowned head; but brave actions, whoever are the authors, ſhould never be buried in oblivion, as they excite emulation, and are full of inſtruction.

SECT. VI. *Of the Attack of Poſts.*

ALTHOUGH the taking of a poſt is alway difficult when you have to do with people who know how to defend it, nevertheleſs you may ſucceed in attacking them by ſurpriſe and ſtratagem. We ought never to form a ſcheme for an attack upon ſimple ſpeculation, becauſe from reaſoning we often think that things are feaſible, which we find impoſſible in the execution. When you intend to undertake an action of this kind, you ought to form a juſt idea of it, by examining all the branches ſeparately, and the different means you can uſe, ſo that, by comparing them together, you may ſee if they concur, and anſwer to the general purpoſe; and laſtly, you are to take ſuch meaſures as may in a manner render you certain of ſucceſs before you begin.

As it is not the practice of the army to chooſe a particular officer for the attack of an intrenched poſt if he does not offer himſelf, ſo an officer ſhould not embark in ſuch an enterpriſe, without having examined the means of ſucceeding, and being capable of ſhowing the general a plan of what he has projected, to ſee if he will conſent to the execution of it. If the general approves the plan, he muſt beg leave to go to reconnoitre the poſt with a man or two, that he may take his meaſures more juſtly.

When he has been to reconnoitre, as is directed in a former ſection, and has got every neceſſary information, he ſhould go to give the general an account of his diſcoveries, and receive his laſt orders for the attack, for the ſoldiers of his party, and for thoſe who are to march to ſuſtain him.

The choice of men that are to go upon the attack of a poſt, is ſo much the more eſſential, as the ſucceſs of the enterpriſe depends on it. None but volunteers of determined bravery ought to be taken, men, who are not ſtupid, and have no colds upon them; becauſe he who does not attend to the orders of his officers, runs on with blind zeal; and he who coughs or ſpits, may diſcover the party to the enemy's ſentries, and cauſe the beſt concerted ſcheme to fail. As to thoſe who are to ſupport them, they may be taken according to their rank in the guard or detachment, as the general judges proper.

The diſpoſition for an attack muſt depend on the diſcoveries that are made, ſo as not to be obliged to return in the midſt of the execution. The men being choſen, they muſt be inſpected, to ſee that nothing is wanted which can contribute to their ſucceſs; becauſe, if the poſt is fortified with an entrenchment of earth or faſcines, the two firſt ranks ſhould be provided with ſpades and pickaxes beſide their arms; if fraiſed or palliſadoed, they muſt likewiſe have hatchets; and if covered with maſonry, they muſt have ladders.

The men ſhould be in their waiſtcoats, to be leſs conſtrained. If they propoſe to make one or two true, and as many falſe attacks, ſo many platoons muſt be formed of the choſen party, as they are to make true ones, and the ſuſtaining party to make the falſe attacks, ſo as to divide the enemy and ſhare their fire. A man muſt be placed at the head of each platoon, who is capable of commanding them, and, if poſſible, the ſame who had been employed before to make diſcoveries, as he may more eaſily guide the diviſion. The orders which ſhould be given to thoſe leaders, are to march together to the place where they are to ſeparate, and then each to go to the ſpot which is appointed for him in the neighbourhood of the poſt, and wait there, with their bellies on the ground, for the ſignal to jump into the ditch and ſcale the poſt.

If you are to be conducted by ſpies or guides, they ſhould be examined about every thing that can be of uſe, before they are employed, eſpecially about the road by which they propoſe to conduct you. The reaſon of this

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is, becauſe we often ſee ſimple people, animated with the hope of gain, imagine they can eaſily lead a party, when they have only a great deal of good-will; but if you find in thoſe who offer all the neceſſary qualities, you muſt immediately ſecure them to you as much as poſſible, by makking them dread the deſtruction of their houſes, and pillaging their goods, if they lead the party into a ſnare; you may likewiſe aſk their wives and children as pledges of their fidelity, and, the moment of ſetting out, place them between the corporals of the firſt rank, tied with a ſmall chain; which precaution is the more eſſential, as traitors have often been known, on pretence of conducting a party to ſeize a poſt, to have led them where they have had their throats cut in the middle of the night, and have diſappeared at the very moment of its execution. If you make your guides hope for a recompenſe proportioned to their ſervices on one ſide, on the other you muſt make them fear the cruelleſt puniſhment if they betray you.

The night being the moſt proper time to march to the attack of a poſt, you ſhould ſet out ſoon enough to be ready to make the attack an hour or two before day. Care muſt be taken that it is not moon-light when you propoſe making the attack; the ſoldiers ought to march two and two, with the leaſt noiſe poſſible, eſpecially when paſſing between the enemy's ſentries: you muſt likewiſe recommend to them, neither to ſpeak, ſpit, nor ſmoke. The detachments muſt get as oppoſite as poſſible to the ſalient angles of the intrenchment, as it is probable that they will be the leaſt defended by the enemy's muſketry. If a patrole of the enemy comes while you are on your march, or ambuſhed in the environs, you need not be alarmed, nor make the leaſt motion which may make the enterpriſe fail, but remain concealed in the profoundeſt ſilence, that the patroles may paſs without perceiving any thing, and afterwards purſue your deſign.

If the poſt which you want to carry is a redoubt with a dry ditch and parapet of earth, your two firſt ranks muſt have ſpades and pick-axes, with their arms ſlung, and, on the ſignal being given, jump into the ditch together; becauſe it ought to be a general maxim in attacking a poſt, to ſtrike all at once. When the firſt rank have jumped down, the ſecond muſt ſtop a moment, that they may not fall upon the ſhoulders or bayonets of the firſt. The two firſt ranks having got into the ditch, they ſhould immediately run to ſap the angles of the ſcarp and the parapet of the redoubt, to facilitate the mounting of the reſt of the party; the leaders of each diviſion ſhould obſerve at the ſame time, that the ſoldiers who remain armed with their firelocks, and who have likewiſe leaped into the ditch, do not interrupt thoſe who are demoliſhing the ſcarp of the redoubt, but protect them by preſenting their bayonets to the right and left, and be ready to repulſe any of the enemy that happen to be placed in the ditch.

If the parapet is fraiſed, they ſhould break as many of the fraiſes with hatchets as is neceſſary to let the men paſs. When the breach is made, the workers ſhould drop their working tools; and taking their arms from the ſlings, mount up with fixed bayonets, and ruſh upon the enemy huzzaing.

When you march to attack a redoubt or ſuch poſt, where the enemy have a connection with more conſiderable poſts, the commanding officer ſhould charge on that ſide, ſo as to cut off the communication. People who ſee themſelves briſkly attacked without hope of ſuccour or retreat, will very ſoon beg for quarter.

When the ſcarps and parapets are of ſtone, they can only be carried by ſcaling; but you may ſucceed by being briſk in ſurrounding and ſuſtaining the attack. An officer who is to attack a poſt of this kind, ſhould take care that his ladders are rather too long than too ſhort, and to give them in charge only to the ſtouteſt of the detachment. The ſoldiers ſhould carry theſe ladders with the left arm paſſed through the ſecond ſtep, taking care to hold them upright at their ſides, and very ſhort below, that they may not diſlocate their ſhoulders in leaping into the ditch.

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The firſt ranks of each diviſion provided with ladders, ſhould ſet out with the reſt of the ſignal, marching reſolutely with their firelocks ſlung at their backs to jump into the ditch. When they are arrived, they ſhould apply their ladders againſt the parapet, obſerving to place them towards the ſalient angles rather than the middle of the curtain, becauſe the enemy have leſs force there. They muſt take care to place their ladders within a foot of each other, and not to give them too much nor too little ſlope, that they may not be overturned or broken by the weight of ſoldiers mounting upon them.

The ladders being applied, they who have carried them, and they who come after, ſhould mount up and ruſh upon the enemy ſword in hand. If he who goes firſt happens to be overturned, the next ſhould take care not to be drawn down by his comrade; but on the contrary, help him to paſs between two ladders, and immediately mount himſelf, ſo as not to give the enemy time to load his piece.

As the ſoldiers who mount the firſt may be eaſily tumbled over, and their fall may cauſe the attack to fail, it would perhaps be right to protect their breaſts with the fore-parts of light cuiraſſes; becauſe if they can penetrate, the reſt may eaſily follow.

The ſucceſs of an attack by ſcaling is infallible, if they mount the four ſides at once, and take care to ſhower a number of grenades among the enemy, eſpecially when ſupported by ſome grenadiers and picquets, who ſhare the attention and fire of the enemy.

During the ſiege of Caſſel, under the Count de la Lippe, in the campaign of 1762, a young engineer undertook to carry one of the outworks with a much ſmaller detachment than one which had been repulſed; and ſucceeded with eaſe, from the uſe of grenades; which is a proof that grenades ought not to be neglected, either in the attack or defence of poſts.

If the ditch of a poſt is filled with water, and but middle-deep, that ſhould not hinder you from jumping into the ditch to attack, in the manner that has been mentioned; but if there is a greater quantity, and you cannot paſs, the ſoldiers of each platoon ſhould carry faſcines, or faggots of ſmall branches well bound, and made as large as poſſible, to fill up the ditch, and make a kind of ford, ſo as to get at the parapet, either to demoliſh or ſcale it.

Many ways of filling up the ditch, recommended by different authors, might be mentioned; but the faſcines are preferable to them all, as the ſoldiers can eaſily carry them before them, and march quicker, and make uſe of them as a defence againſt muſketry, and reaching them from hand to hand, ſoon make a ford.

If the approaches of the poſt are defended by chevaux de friſe, the firſt and ſecond rank of each platoon muſt break them down with hatchets; or with iron graplings tied to ropes, they may pull them to them, and ſeparate them. If it is a breaſt-work of felled trees, you muſt have faſcines thrown againſt the points, or upon the branches, upon which the ſoldiers can eaſily paſs. If there are two or three rows, you may burn them with dry faſcines lighted at one end and thrown in the middle row. In caſe of trying this laſt ſcheme, the ſoldiers muſt retire to a little diſtance after throwing the faſcines, that the enemy may not ſee to fire at them by the light of the fire, but place themſelves ſo that they can fire upon any who may attempt to extinguiſh it. If there are chauſſe-traps, they muſt be ſwept away, by dragging a tree or two over the ground where they are ſcattered.

In the attack of detached buildings, you muſt ſeize the approaches, and ſtrive to ſcale them; to get on the top, and cruſh the people who are below, with the tiles or ſlates; but if the enemy has uncovered the houſe, you muſt throw as many grenades as you can in at the windows and doors; or dry faſcines, with lighted faggots dipped in roſin; or fire-balls, to endeavour to ſet fire to them, and ſmoke them out. If the weather is windy, you ſhould profit by it to ſet fire to the houſe, and try to ſhut up the loop-holes which the enemy have pierced near the ground, with bags of earth ſo as to ſap the corners. If you have ſome cannon, you may ſhorten the ceremony, by planting them againſt the angles of the poſt. If you have none, you may ſucceſsfully ſuſpend a large beam by a rope, to three bars placed in a triangle in imitation of the Roman battering ram: this beam puſhed violently againſt the walls, will ſoon make a breach; but you muſt obſerve, in ſuſpending it, to do it in a dark night, ſo that the enemy cannot prevent it by firing at the ſoldiers who are employed in the work. If it is glorious to get out with honour on ſuch an attack, it is no leſs ſo to make it ſo as to coſt but few people. The blood of the ſoldiers is precious, and cannot be too much prized, and an able chief will neglect no means that can contribute to their preſervation. The comparing of two examples will ſhow the importance of what is advanced.

During the two ſieges of Barcelona, by Monſieur de Vendome in 1697, and Monſieur de Berwick in 1713, the firſt of theſe generals cauſed the convent of Capuchins, ſituated out of the place, to be attacked ſword in hand by ſeveral detachments of infantry, and carried it in three hours, with the loſs of 1700 men. Marſhal Berwick cauſed the ſame convent to be attacked in the year 1713. They were equally intrenched, and reckoning to make him pay as dear as Monſieur de Vendome had done; but this general having opened a ſort of trench before the convent, they not expecting to be attacked in form, ſurrendered at diſcretion, after having held it 24 hours. The reader is left to judge which example to follow.

You ſhould prepare for the attack of a village, or ſuch like poſt of large extent, as has been directed in the ſection for detached poſts: but as theſe ſorts of attacks are always more difficult than others, on account of the multiplicity of ſchemes they have to encounter at every ſtep, an officer ſhould not march there till he is acquainted with the ſtrength of the intrenchments; the ſituation of the ſmaller poſts; the obſtacles to be met with in every ſtreet or ſquare; and even what terms the inhabitants are on with the ſoldiers of the garriſon.

While the aſſailants have penetrated into the village, the commanders of each diviſion ought to take care to leave ſmall detachments at all the churches and ſquares they find; to ſtand firm and ſuſtain the main body in caſe they are repulſed. You muſt watch very carefully that the ſoldiers do not withdraw to pillage the houſes of the inhabitants, as whole detachments have been driven from towns and villages where they had penetrated, from having neglected this precaution.

Three days after the ſurpriſe of Cremona, in 1702, ſome Germans were found in the cellars, where they had got drunk, and were aſtoniſhed when they were told that they muſt quit theſe agreeable retreats. An officer who would ſhun a diſorder ſo fatal, ſhould forbid his ſoldiers to ſtir from their party on pain of death; and by placing a ſerjeant in the rear of each diviſion, take care that no one falls behind.

If you find cavalry drawn up in the ſquares or open places, the aſſailants ſhould remain firm at the entrance of the ſtreets that meet there, while ſome go up to the houſes that are at the corners, and fire upon them from the windows; if this cauſes any diſorder among them, they ſhould be charged with fixed bayonets to make them ſurrender. If the interior part of the village is defended with cannon, you ſhould march quickly to the place where they are, and take them, or nail them up, or turn them againſt the enemy or principal poſt of the village.

Polybius, in his ſeventh book, gives an account of an attack full of inſtruction for military men. The blockade of Sardis by Antiochus the Great, had laſted two years, when Lagoras of Crete, a man of extenſive knowledge in war, put an end to it in the following manner. He conſidered that the ſtrongeſt places are often taken with the greateſt eaſe, from the negligence of the beſieged, who, truſting to the natural or artificial fortifications of their town, are at no pains to guard it. He knew likewiſe that towns are often taken at the ſtrongeſt places, from their being perſuaded that the enemy will not attempt to attack them there. Upon theſe conſiderations, though he knew that Sardis was looked upon as a place that could not be taken by aſſault, and that hunger only could make them open their gates, yet he hoped to ſucceed. The greatneſs of the difficulties only increaſed his zeal to contrive a means of carrying the town.

Having perceived that a part of the wall which joined the citadel to the town was not guarded, he formed the deſign of ſurpriſing it at that place: he obſerved that this wall was built on the top of a rock which was extremely high and ſteep, at the foot of which, as into an abyſs, the people of the town, threw down the carcaſſes of their dead horſes, and other beaſts of burden; at which place great numbers of vultures and other carnivorous birds aſſembled daily to feed; and after having filled themſelves, they never failed to reſt upon the top of the rock or wall, which made our Cretan imagine that this place was neglected, and without any guard upon it.

On this thought, he went to the place at night, and examined with care how he could approach it, and where he ought to place his ladders. Having found a proper place for his purpoſe, he acquainted the king with his diſcovery and deſign; and the king, delighted with the project, adviſed Lagoras to purſue it, and granted him two other officers whom he aſked for, and who appeared to him to have all the neceſſary qualities for aſſiſting him in his ſcheme.

The three having conſulted together, they only waited one night, at the end of which there was no moon; which being come, they choſe 15 of the ſtouteſt and braveſt men of the army to carry the ladders, to ſcale the walls, and run the ſame riſk that they did. They likewiſe took 30 others to place in ambuſh in the ditch, and to aſſiſt thoſe who ſcaled the wall to break down a gate into which they were to enter. The king was to make 2000 men follow them, and favour the enterpriſe by marching the reſt of the army to the oppoſite ſide of the town. Every thing being prepared for the execution, Lagoras and his people approached ſoftly with their ladders; and having ſcaled the rock, they came to the gate which was near them, and having broke it, let in the 2000 men, who cut the throats of all they met, and ſet fire to the houſes, ſo that the town was pillaged and ruined in an inſtant.

Young officers who read this account, ought to reflect on this attack. The attention of Lagoras, who went himſelf

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to examine the places proper for fixing the ladders; his diſcernment in the choice of the officers and ſoldiers who were to ſupport him; and the harmony of the whole means that were employed on the occaſion, afford very excellent leſſons for any officer who may attempt ſuch an attack.

SECT. VII. *Of Surpriſes and Stratagems for ſeizing Poſts.*

ALL the environs that have any relation to the place the enemy occupies muſt be known; on what ſide lie the avenues, moraſſes, rivers, bridges, heights, woods, and all covered places that are in the neighbourhood, without which it is ſcarce poſſible to regulate approaches prudently. It is equally neceſſary to know nearly the number and kind of troops with which he poſſeſſes the poſt, that you may not attack him with inſufficient force. It is likewiſe neceſſary to know if the enemy is careful or remiſs in carrying on his duty. The knowledge of theſe circumſtances contributes infinitely to form a project of ſurpriſe well, and to conduct the whole expertly.

As to the manner of ſurpriſing a poſt, it is impoſſible to eſtabliſh certain rules on the ſubject; becauſe, among a thouſand means which chance offers, there are rarely two alike. It muſt, however, be obſerved, that there are ſtratagems with which it is impoſſible to ſucceed without a proper force to ſuſtain them. A town or village, for example, where we are introduced by a ſecret correſpondence, cannot be carried unleſs we be well ſeconded. The only means of managing the ſurpriſe of poſts well, is to divide your force inſtantly, to ſeize the caſtle, church, church-yard, or public ſquares. It has been ſaid, that troops ſo divided can act but weakly, and run a riſk of being defeated ſeparately. But by making as many detachments as the enemy has poſts, in the diſmay cauſed by ſurpriſe, it is eaſy to carry theſe poſts before they who defend them have time to diſpute them or even look round them. The enemy being likewiſe obliged to divide, and not knowing what ſide to prefer, there is almoſt a moral certainty, that, ſtupified with the noiſe which they hear all round, they are ready to let their arms drop out of their hands: beſide, the horrors of a dark night, and the dread that cannot fail to ſeize a party who are ſurpriſed, repreſent objects much greater than what they are, ſo that they imagine they have to do with a whole army.

The bad ſucceſs of the affair at Cremona mentioned in Sect V. makes nothing againſt this opinion. If inſtead of ſtopping to make priſoners, a detachment had gone directly to the citadel, which ſhould be the way in all ſuch actions, it would have been impoſſible for theſe brave officers who drove out the Imperialiſts to have made ſo glorious a defence.

M. de Schower did otherwiſe when he ſurpriſed Benevar in Spain in 1708, and did not fail. He learnt that the Spaniards neglected the guard of an old caſtle which was at the entrance of the place; and marching in the night he took it, and detached ſeveral parties to attack the town. Surpriſed with ſuch a viſit, they ſought for ſafety in flight, and ran to take ſhelter in the citadel, but were ſcarcely entered when they were made priſoners. The enemy did not think of the attack being begun where they were ſtrongeſt; but it is the beſt way, as it is to be preſumed they have divided their forces to be able to defend every where.

M. Menard, in his hiſtory of Niſmes, gives an account of the ſurpriſe of that town, which merits our attention. Nicholas Calviere, called Captain St Coſme, having reſolved to make himſelf maſter of this place, engaged a miller whoſe mill was ſituated within the walls, at the ſide of the gate, to file the bars of a grate which ſhut up the entry of an aqueduct through which the water paſſed into the town, and to receive 100 men armed into his mill, while a conſiderable body of cavalry and infantry ſhould arrive from different places to ſuſtain the enterpriſe.

The day for the execution of his project being fixed for the 16th of November 1569, and proper orders given for the rendezvous of the troops, St Coſme came out of the mill with his party at three o'clock in the morning, and advancing to the guard at the gate, put them to the ſword, and opening the gate let in 200 horſemen, with each a foot ſoldier behind him. Theſe troops having entered the town, formed ſeveral detachments immediately: one of which went to block up the citadel; while the reſt, ſcattering over the ſquares of the place, and ſounding their trumpets, inſtantly made themſelves maſters of the town.

There are a number of circumſtances mentioned in this ſurpriſe, which convey a great deal of uſeful inſtruction. Captain St Coſme knew how to profit by the negligence of the governor, who omitted to guard the entrance of the aqueduct: to make a proper choice of cavalry for advancing ſo readily with the infantry from different quarters; the juſtneſs of the orders given the troops, which brought them 15 leagues from Niſmes at the hour and place appointed for the rendezvous; the precaution with which he inveſted the citadel, to prevent his having to do with the garriſon in the ſtreets; his attention in dividing his troops into the different quarters of the town, and making them ſound their trumpets, that the inhabitants might imagine they were very numerous.

But the active corps of the partiſan, without truſting to the ſtratagems that others have ſucceeded by, muſt find other reſources than thoſe againſt which people are ſo prepared now-a-days; and as the ſurpriſing of the enemy is the great buſineſs of the partiſan in carrying on the Petite Guerre, he muſt ſee what can be effected by his hardineſs and activity.

The expedient which appears to be the moſt proper for an officer who has 400 infantry under his command, and is certain that the garriſon is only 200 (for ſurpriſes ſhould be always attempted with a double force), is to chooſe very bad weather; the ſtrong winds, for example, and fogs in winter; or the ſtorms and tempeſts in ſummer, when, after exceſſive heats, violent winds riſe ſuddenly, and agitate the air.

When you have meditated ſuch a ſcheme, then is the time to put a part of your infantry in covered waggons, which ſhould be kept ready for the purpoſe. The whole party ought to be provided with dog-ſkin covers for their gunlocks and cartouch-boxes, to take off readily when there is occaſion; and the reſt of the infantry to be mounted behind part of the cavalry. Both parties to aſſemble at ſome place a league diſtant from that which you would ſurpriſe, and there to ſtop; when, if you ſee the bad weather diſſipating, you muſt retire till another occaſion. If you renew it ten times, you need not deſpair; a ſtrong place deſerves this trouble, and ſucceſs will overpay every fatigue.

But on the contrary, if the ſtorm forms, and the wind increaſes, direct your approaches in ſuch a manner, that you may always have the wind on your back; becauſe if you have it in your face, the enemy's ſentries can look forward and diſcover you; and likewiſe if it is in your face, your horſes cannot be made to advance without a great deal of trouble. Theſe precautions being taken, you advance more quickly as the ſtorm increaſes, the horſes and waggons going with great ſpeed before the wind. You need be in no uneaſineſs about the enemy's ſentries ſeeing you, or hearing the noiſe of your march; becauſe the ſeverity of the weather obliges them to enter their boxes, and turn their backs to the wind, to ſave their eyes from the duſt and ſharpneſs of the air.

At 300 paces from the place, the foot and part of the cavalry ſhould diſmount and fix their bayonets, the reſt of the cavalry to remain with the waggons near ſome trees or houſes, the waggons turned for a retreat. Divide your infantry into five detachments, and inſtantly run at a great rate, keeping your men as cloſe as poſſible, and paſſing the barrier and gates, ſeize all the centries and the guard without firing or making the leaſt noiſe, which may be executed with an extreme quickneſs, to be acquired by practice. While the firſt detachment ſeizes the gate and all the ſentries of its environs, the reſt muſt run rapidly into the town. One muſt go quickly to ſeize the main guard: another to ſeize the governor or commanding officer; the fourth, which ſhould be the ſtrongeſt, ſhould fly to the caſerns or mens barracks, to ſeize their arms; the fifth to remain in the ſtreet near the gate for a corps de reſerve.

Every detachment muſt be conducted by priſoners made at entering; and orders ſent with all ſpeed, to cauſe half the cavalry to advance and patrole the ſtreets, as the infantry get forward.

As this kind of ſurpriſe can ſucceed only under favour of a ſtorm, which rarely continues any time, it is evident that the march and execution muſt be conducted with inexpreſſible ſwiftneſs, and the orders be perfectly underſtood. It is true, that rain is inconvenient for the infantry, whoſe feet ſlip on clay-ground; but they muſt do their beſt, and frequently it is found that the roads which are moſt uſed are not therefore the moſt ſlippery.

If it happens that you are perceived in taking poſſeſſion of the gate, and they take the alarm, you muſt quickly divide your party into two wings, mounting them on the rampart, the one to the right, the other to the left; and ſeizing the loaded cannon, turn them upon the town; and at the ſame time ſummon the garriſon to ſurrender. If you happen to fail, and are obliged to retire, you do not riſk much, as they will not care to moleſt your retreat.

There may be a reluctance in attempting ſuch a ſurpriſe; it may appear to be hazardous and raſh, and a conduct too nice not to deſpair of ſucceſs: but Mr Jeney ſays that experience convinces him of the validity of the means propoſed, and relates what happened to him upon two occaſions, to prove that the cold eaſt winds or ſtorms are the moſt proper times for attempting ſurpriſes.

Being at the head of 30 huſſars, ſays he, and willing to ſhun a ſtorm which was gathering behind us, I puſhed to get to a place which was well fortified and occupied by a numerous garriſon: the wind was ſtrong, and I paſſed the barriere and all the gates with my horſes, which made a great noiſe, without any ſentry either ſeeing or hearing; and though I called to the firſt guard to declare myſelf, no one perceived me. I croſſed the whole town without ſeeing a ſoul in the ſtreet; and hurrying to an inn in the other ſuburbs, I went out at the gallop, and ſaw only the ſentry at the laſt barriere, to whom I anſwered without our comprehending one another; nevertheleſs the rain had not begun to fall, but the wind was violent. I experienced the ſame during the winter, when the eaſt wind was very proper to facilitate the ſurpriſe of a fortified town or poſt. On Chriſtmas night 1757, I paſſed through the country of Hanover with 80 horſe between two guards of the enemy without being perceived. I marched over the middle of a plain when the night was clear, with a violent eaſt wind, which prevented any ſentry from turning his head to look at me, and I went quietly to carry off horſes in the rear of their army. The following night at my return, I paſſed two different poſts of our army; the one guarded by a party of huſſars, the other by a regiment of dragoons, without being ſeen but by one ſentry in the middle of the dragoon poſt, who durſt not challenge, becauſe it was no longer time, having paſſed the firſt guards.

You may likewiſe take the advantage of bad weather to ſcale all ſorts of poſts ſurrounded with walls, as towns, abbeys, caſtles, &c. to do which, you muſt approach in the dark, and ſeize the moment of a great ſquall, or when a cold eaſt wind obliges the garriſon to take ſhelter from the rigour of the ſeaſon: then there is no one upon the ramparts, and the ſentries turn their back to the wind, or remain in their boxes, while your people are warm with marching, and animated with the hopes of ſucceſs. You need not be apprehenſive of the enemy ſeeing you if you advance on the ſide next the wind to place your ladders, becauſe the ſentries will cover their faces, and bend down their heads to ſave them from cold.

The time of a thick fog is not leſs favourable for approaching and forcing an intrenched poſt. When the fog is low, the infantry ſhould creep on all fours, the better to conceal them from the enemy's ſentries. Theſe ſorts of ſurpriſes are the leaſt dangerous, you run ſcarcely any riſk; but if you cauſe ſome falſe attacks, the garriſon will not fail to run to arms, and ſometimes make you pay dear for failing.

When you would ſurpriſe the enemy in a village, farm, monaſtery, or ſome place detached from the army, you ſhould divide your party in two bodies, each compoſed of cavalry and infantry; the one to take the enemy in the rear, the other in front, taking care to cauſe ſome waggons to follow, which may carry off the wounded in caſe of need. You muſt calculate exactly the time it will take the firſt detachment to go round the enemy. The two commanders ſhould agree on a word for rallying, and the time of making the attack, which ſhould be in the night, eſpecially if the poſt is ſo diſtant from the army that they can receive no aſſiſtance; for in that caſe the time is favourable till day-break. They muſt regulate their departure according to the diſtance they have to go; and the detachment which goes round the enemy, ought to take no more infantry than can be carried behind the horſemen. This detachment having got round, ſhould form about a quarter of a league from the poſt, and 100 paces out of the road.

When the other detachment has arrived within a quarter of a league of the poſt, your cavalry ſhould form out of the road with the waggons and drums near them, who are not to advance till ten minutes after the departure of the infantry, who muſt advance towards the fires of the enemy, ſtooping as much as poſſible. They muſt take care to conceal themſelves from patroles, as has been directed; and when they ſee them paſſed or entered the poſt, the infantry muſt hurry on to gain the village, and clear the entry by which the cavalry muſt paſs, in caſe it has been barricadoed with waggons. You muſt run rapidly to the place where you ſee the fires lighted, and make as many detachments as you ſee fires, in order to ſurpriſe the whole at once.

The cavalry who followed ſlowly, muſt inſtantly join to the noiſe of your arms and cries their trumpets and drums, advancing with all ſpeed, and leaving only a non-commiſſioned officer with ſome horſemen near the waggons. The detachment, which is advanced on the other ſide of the village to turn the enemy, on hearing the alarm, muſt immediately advance, ſounding trumpets, beating drums, and attacking all who would ſave themſelves on that ſide. You may rely on it as certain, that the enemy, ſeeing all his guards ſurrounded by your infantry ſcattered in the village, and hearing the march of different bodies of foot and horſe who arrive on all ſides, will not delay to ſurrender, or ſeek to ſave himſelf by a diſorderly flight: it will be eaſy then for your cavalry to fall upon the flying, and ſtop them. The party ſhould be forbid to purſue the enemy more than a quarter of a league in the night; but no purſuit at all ſhould be attempted, if it is in an incloſed country. The poſt being taken, the booty and priſoners ſhould be ſent off immediately under the care of the infantry, putting the wounded in waggons, or on the horſes that are taken, the cavalry making both the front and rear-guard and taking care to have the laſt the ſtrongeſt.

There is no time more precious for a partiſan, or that merits ſo much attention, as that of a battle, when every one is attentive to the great firing which they hear on all ſides; to the manœuvres of the armies that are engaging; to the deciſion of an affair of the greateſt importance, upon which the fate of each depends. It is then that he can employ his ſkill to the greateſt advantage; ſtrike the ſevereſt blow that is poſſible; cauſe the ruin of the enemy; pillage the quarters of their generals; carry off their equipages; defeat their guards; ſet fire to their camp, and ſpread an alarm over all, which may contribute to the defeat of an army.

But meaſures muſt be taken to execute ſo great, ſo brilliant a project with ſucceſs; and it ſhould not be engaged in, till after having prudently regulated the deſign on three principal circumſtances, viz. the ſituation of the enemy's camp; the means of approaching it; and the hour of engaging. When the enemy's camp is in the middle of a great plain, or on a height with an extenſive view on all ſides, it is certain that one cannot approach without being ſeen at a diſtance: and in that caſe, prudence will put a ſtop to zeal, and prevent raſhneſs from attempting impoſſibilities; but when their poſition extends over a country covered with mountains, woods, or villages, the occaſion is more favourable, and may almoſt enſure ſucceſs.

It is then very advantageous for a partiſan to be perfectly acquainted with the ſituation of places that are in front of his army; eſpecially when he foreſees that the enemy will ſooner or later come to encamp there. What aſſiſtance would it not give for the direction of his project, if he knew how to take a plan of that part of the country which he propoſes to invade beforehand? Then, without the weak and dangerous aſſiſtance of ſpies and deſerters, he can by his own proper knowledge think of every means for executing a deſign, which ought to be regulated and conducted with impenetrable ſecrecy.

When he perceives by the motions of the armies that they are on the eve of an action, he muſt not delay to acquaint the general with his project. If he conſents, he will regulate the reſt, and the time of departure, according to the advices which he receives.

As theſe ſorts of expeditions cannot be made but by long circuits, they muſt take the time neceſſary for the march. In the campaign of 1757, the duke of Richelieu cauſed his army to advance near Zell to attack our army; and ſent a partiſan with 100 horſe to the rear of the camp the day before, who, having made a march of 22 leagues, arrived without any accident: but the prudence of the prince of Brunſwick defeated his deſign, and left him to admire his retreat; nevertheleſs, they picked up ſome ſtragglers, horſes, and waggons.

Among the meaſures that ought to be taken to ſecure he blow, and ſtrike it more effectually, it ſhould not be forgot to diſtribute cockades like the enemy's to all the cavaly; and to give a ſtick of ſix feet long to 20 of each deachment, with a bit of torch fixed on the end, and covered with a little dry ſtraw or hemp, to kindle inſtantly.

The whole party to ſet out from the camp A (fig. 1.), marching under the conduct of a good guide by covered ways, at a diſtance from the enemy. Being come to the place C, which ought to be in the environs, and as high as the field of battle, the infantry ſhould be concealed out of the road far from the ſight of paſſengers. This muſt be the centre of correſpondence with the army; the rendezvous of the booty; and ſupport the retreat of all the cavalry, of which there ſhould be as many detachments formed as you purpoſe to make attacks. We ſhall ſuppoſe ſix of a hundred men each, and they muſt go ſecretly by particular routes to their reſpective poſts E, D, F, G, H, I. Neither trouble nor expence ſhould be ſpared to procure good guides. Each detachment ſhould lie in ambuſh half a league, if neceſſary, from the object of the attack, BKKKK.

The noiſe of the muſketry of the armies to be the ſignal for their irruption; and then bravery, intrepidity, and courage, will give wings to your people. The ſecond detachment D will glance imperceptibly between the villages, and fall like thunder upon the camp B; and while 80 attack all whom they meet, the other 20 ſhould light their torches at the fires that are to be found everywhere, and ſpread the flames rapidly to the ſtraw of the tents. As they cannot fail to have the picquet of the camp ſoon at their heels, they muſt ſtrike their blow with all poſſible quickneſs without ſtopping to plunder; being content with the glory of having excited a general alarm, capable of confounding the whole army, and contributing to the gaining of a battle.

At the ſame time that the detachment D attacks the camp B, the others E, F, G, H, muſt with equal violence attack the villages K, K, K, K, which they have in front, doing the ſame the firſt did in camp, except that they may plunder every thing which they can eaſily carry off of the generals equipages, with which theſe villages are commonly filled; ſeizing the beſt horſes, hamſtringing others with the ſtroke of a ſword, and ſetting fire to all the places which contain the enemy's baggage. Each detachment ſhould cauſe ſome horſemen to advance beyond the village, to obſerve the motion of the troops that will not fail to run to their aſſiſtance. As ſoon as they perceive them, they muſt make their retreat as faſt as poſſible by the routes which the commanding officer has premeditated, and which are propoſed to be repreſented by the coarſer hatched lines. The ſixth detachment I, in ambuſh on the ſide of the road leading from the camp, ſhould remain there, to ſeize all the enemy who think of ſaving themſelves by flight.

There is no danger to be apprehended in theſe expeditions, during the critical inſtant while the armies are engaged, and all the troops a great way in the front of the camp: you meet none but ſutlers, ſervants, lame people, and ſome picquet guards ſcattered here and there, whom you may eaſily defeat as they advance. The commanding officer ought to have an eye over all; and as ſoon as he perceives ſome bodies of troops advancing upon him, he ought to retreat quickly, and at leaſt gain the entrance of the wood in the neighbourhood of the enemy's camp; for without ſome ſuch ſhelter enterpriſes like this can hardly be attempted.

Each detachment having rejoined the infantry, muſt there wait the fate of the battle; ſo that if it is decided in favour of their army, they may ſpeedily regain the propereſt places for haraſſing the enemy on his retreat. Theſe moments are the more favourable, as diſorder, dread, and noiſe, render all defence impracticable. But all theſe ſorts of ſurpriſes require places proper to cover approaches and retreats.

The great importance of ſkill in the language of the enemy is apparent from the following exploit of the prince (now reigning duke) of Brunſwick in the campaign of 1760. That excellent partiſan was ſituated at ſome diſtance from

Zerenberg, at that time in the poſſeſſion of the French; and being informed by two Hanoverian officers, who had been in the town diſguiſed like peaſants, that the garriſon were very remiſs in their duty, truſting to the vicinity of their army, and the diſtance of ours, the prince was reſolved to ſurpriſe them: and after appointing a corps to ſuſtain him, he advanced in the night with Major Maclean of the 88th regiment; and 200 Highlanders, with bayonets fixed and their arms not loaded, followed at a little diſtance. Upon the firſt ſentry's challenging, the prince anſwered in French, and the ſentry ſeeing but two perſons advancing (whom he believed to be French), he had no diſtruſt; ſo that the major getting up to him, ſtabbed him, and prevented his giving the alarm. The Highlanders immediately ruſhing in, attacked the guard with their bayonets, and carried the town, having killed or taken the whole garriſon of 800 men.

The French officer who commanded at that time in Zerenberg concerted a ſcheme for being amply revenged, which failed only by a moſt trivial accident. When almoſt every houſe in Bremen was filled with corn, being the grand magazine and grand hoſpital of our army, this officer held a ſecret correſpondence in the town, which informed him of the ſtate of the garriſon, and that there was a general order to let couriers going to the army paſs out at all hours. He diſpatched about 20 huſſars to ſcamper over the country, who were all that were heard of his party, while he marched 15,000 infantry from Duſſeldorp to Bremen (about 200 miles), concealing them in woods by day, and marching in the night. He arrived at the gate at the appointed hour; when a perſon on horſeback blowing a horn came along the ſtreet, and deſired to paſs out to the army. The officer of the guard had the keys, and happened to be out of the way; and while a meſſenger went for him, the people without growing impatient, began to break down the outer barrier, which made the ſentry fire at the place where he heard the noiſe; and the guard taking the alarm, got upon the rampart, and likewiſe fired at the ſame place: upon which the pretended courier galloped back; and the French, believing that they were diſcovered, relinquiſhed their ſcheme, and retired.

This example proves that no diſtance is a ſecurity from ſurpriſes, and that very conſiderable parties may paſs over a great extent of country without being diſcovered. The following inſtance of that preſence of mind ſo much the happineſs of all who poſſeſs it, and more particularly of a military man ſo expoſed to ſurpriſes, deſerves to be recorded.

In the month of February 1761, when Prince Ferdinand beat up the quarters of the French, they were obliged to retire a great way without being able to reſiſt: However, when they came to collect their force, and to recoil upon our army, Sir William Erſkine with the 15th regiment of light dragoons was in a village in our front. In a very foggy morning, ſoon after the patroles reported that all was well, Sir William was alarmed by his vedettes having ſeen a great body of cavalry coming to ſurpriſe him. He inſtantly mounted his horſe, and ſallied out at the head of the picquet of 50 men, leaving orders for the regiment to follow as faſt as they could mount, without beating a drum or making any noiſe. He attacked their advance-guard in the curſory manner of the light cavalry, and continued to do ſo, while his men were joining him by tens and twenties, and the French cavalry forming to reſiſt an attack, till he collected the whole, and then retired, the ſurgeon of the regiment (Mr Elliot) having in the mean time carried off the baggage.

Strokes of this kind diſplay a ſuperiority of genius, and to that alone was the preſervation of the regiment owing. Had a drum to beat to arms, the enemy muſt have known that they were unprepared, and probably would have ruſhed in and deſtroyed them; but the attack convinced them that they were diſcovered, and made them think only of their own preſervation.

Among many inſtances in the courſe of the war, the ſucceſs of this officer on another occaſion, where he diſplayed the moſt ſingular addreſs, likewiſe merits our attention. After a repulſe, and a march of 72 miles in one day, when the men were fatigued and ſcarcely a horſe able to trot, he ſaw a regiment of French infantry drawn up with a moraſs in their rear. He left his own corps, and advancing to the French, deſired to ſpeak with the commanding officer, whom he entreated to ſurrender to prevent their being cut to pieces by a large body of cavalry that were advancing. The French officer deſired leave to conſult with his officers, which having done, they refuſed to ſubmit; but upon Sir William telling them that their blood muſt be on their own heads, and turning to move off to his own corps, they called to him, and laying down their arms ſurrendered to his haraſſed troops.

Such ſtratagems overleap the bounds of inſtruction, and no author will preſume to propoſe them for imitation. Here was the reaching out the hand to fortune which Vigetius recommends: but there are few who have the requiſite talents from nature; and we may as properly ſay of the ſoldier as of the poet, *naſcitur non fit*.

SECT. VIII. *Of Ambuſcades from the Partiſan.*

AN ambuſcade may be formed in any place covered by art or nature in which a party may be concealed to ſurpriſe the enemy in paſſing; and the proper uſe of them is, of all the ſtratagems in war, the beſt calculated to diſplay the genius, ſkill, ſpirit, and addreſs of a partiſan. They are eaſily carried into execution in woods, buildings, and hollow places; but require a more fertile imagination, and greater trouble, in a level country. Both ought to be regulated by the knowledge of the enemy's march, and the extraordinary means that may be employed to ſurpriſe them.

When a partiſan has information that can be depended on of the march of ſome part of the enemy; whether a convoy of artillery, baggage, or proviſions; a body of recruits, or horſes to remount the cavalry; an eſcort of a general officer going to rejoin, or reconnoitre ſome country; he ought to apply directly to procure a ſufficient knowledge of the route that the enemy is to take, the ſituation of the places he is to paſs, and of the poſt he goes to. The better to cover his deſign, he muſt get information of the roads that lead to oppoſite places, which he muſt pretend to be attentive about, as has been mentioned in the ſection of Reconnoitring.

Having perfectly concerted his plan, he ſhould ſet out at the head of his detachment if poſſible, and leaving his poſt on the ſide oppoſite to his true route, the better to conceal his deſign. If the place where he intends to plant his ambuſcade is not diſtant, he ſhould come into his true route about half way, and there place half his infantry in ambuſh to favour his retreat. But when the country where he propoſes going is diſtant, and the march requires at leaſt two nights, he muſt conduct his party by meandring from wood to wood, if there are any. He muſt not forget to provide neceſſary refreſhments for the day, which muſt be paſſed in ſome concealed place where he may not be perceived, and muſt cauſe three rations of oats to be carried for each horſe.

The firſt night you muſt make to ſome wood or other place proper for paſſing the day near ſome rivulet, and, if poſſible, on the road of your retreat to leave a part of your infantry in ambuſh, in caſe there is no other water to paſs till you come to the place of your principal ambuſcade; for when there is ſtill a river or canal to paſs, you muſt conduct the infantry to the paſſage, and chooſe the moſt convenient place to fix them in ambuſcade.

If there is no bridge or ford, the cavalry muſt ſwim over, in which we ſuppoſe the horſes are practiſed. When there is a ford, half the infantry ſhould paſs behind the cavalry, to go along with them. In caſe there is a bridge to paſs near the village, the officer who is left in this poſt with ſome infantry, ſhould be enjoined to allow no one peaſant or ſoldier to leave the place; and for greater ſecurity, a ſmall detachment of cavalry ſhould remain with him, to ſtop any who may attempt to run away before the return of the whole corps, who ought not to delay long. If the enemy come in the interval to attack the bridge, it muſt be defended till the return of the party, that their retreat may not be cut off.

Every precaution being thus taken to guard the bridge, the commanding officer ſhould be diligent to arrive at the place of ambuſcade two hours before the enemy is to paſs, and place the ambuſcade on the ſide he would retire to; never on the other ſide, if poſſible, leſt the advanced guard happen to diſcover you, and oblige you to repaſs in ſight of the corps, who, ſeeing your ſtrength, may ruſh upon you and drive you back.

Plate DXXVI.

The infantry A (fig. 2.) ought to be ambuſhed at leaſt 600 paces behind the cavalry B, ſo that if they are purſued, they can fall back to A, and both afterwards to the guard at the bridge, or to the infantry that are in ambuſh at half way.

If the ambuſcade is placed in a wood, an intelligent non-commiſſioned officer ſhould be choſen to get upon a high tree C, from whence he can ſee the march of the enemy, and give notice of the moſt eſſential circumſtances. There are three: the firſt is, the ſeeing the advanced guard; the ſecond is, the approach of the corps; and the third is, the time when their front is advanced as far as the ambuſcade B: for which the commanding officer ſhould inſtruct the obſerver what ſignals he is to make from the top of the tree, to communicate the neceſſary information without ſpeaking, which may be done by the means of a ſmall cord D, of a brown or green colour, ſo as to be leaſt perceivable. Let this cord be placed as in the plan, ſo that no branch interrupt it, with one end in the hand of the obſerver, and the other in the commanding officer's in the ambuſcade B.

As ſoon as the advanced guard appears, the obſerver muſt pull the cord, and the commanding officer cauſe the party to mount and remain in deep ſilence. If by a ſtratagem, which is frequently practiſed for particular reaſons, the advanced guard is immediately followed by the corps, which may eaſily be known by their being more numerous than ordinary, and not followed by any other corps, that you may not be deceived by the enemy, the cord ſhould be drawn a ſecond time, and a third time when their front is advanced as high as the ambuſcade; upon which you muſt ruſh out, and pour furiouſly upon the flank of their centre in the following manner.

If the advanced guard E is formed only of an ordinary number, they ſhould be let paſs; and at the approach of the principal party or convoy F, the chief to be informed by the ſecond pulling of the cord. At the moment the head of the convoy ſhall be advanced as high as B, the cord muſt be pulled the third and laſt time; at which ſignal the whole party muſt ruſh out without being perceived, and ſuddenly attack the centre upon the flank, engaging only with their ſwords, and making ſuch a noiſe as to prevent the enemy from hearing the orders of their officers. They muſt diſarm all whom their bravery or chance throws in their way, taking care not to ſcatter or purſue too far, unleſs you are ſure that they are ſo far from their army or other parties that they cannot be aſſiſted; for in either of theſe caſes, they will not fail to run at the noiſe, and diſturb your retreat.

In all ſecret expeditions you ought to be extremely circumſpect that you may not be ſeen or betrayed. If the advanced guard diſcovers you before the blow is ſtruck, abandon the enterpriſe immediately, and retire. When your guide, or ſome one of your party deſerts, and you cannot catch him, think immediately of retreating, or placing your ambuſcade ſomewhere elſe; therefore, to prevent ſuch a misfortune, the officers ſhould be charged to examine frequently if they have all their people.

You ſhould never form an ambuſcade for cutting off the enemy's retreat, as this manœuvre will give him an idea of rallying, and attacking you in deſpair; but the caſe is different when you are well informed that you run no riſk in ſtopping his whole force, either from the nature of the defile where they cannot form, or from the ſmallneſs of the number which cannot reſiſt.

It is equally difficult and dangerous to form ſeveral ambuſcades at once; the greater number that are formed, the more they are expoſed to be diſcovered, and leſs in a ſtate to unite for a retreat. To this rule, however, there is one exception. When ambuſcades are formed to ſeize foragers, it is very proper to have ſeveral, and to diſpoſe them in ſuch a manner that the ſentries can ſee from one to another. Theſe diſpoſitions being made, they who chance to be next the foragers muſt ſtrike the blow, while the others march to ſecure the retreat of their companions, as ſoon as they perceive it.

In all ambuſcades, no ſentries ſhould be placed but officers, or non-commiſſioned officers. On downs, behind mountains, or in gullies, the ſentries ſhould lie with their bellies on the ground, and their feet towards the ambuſcade, the body covered with a grey or green cloak, according to the colour of the ground, with their heads a little raiſed, and wrapped in a handkerchief of a ſtraw-green colour, or white in time of ſnow, ſo as not to be perceived. The number of ſentries cannot be determined; but ſhould be diſpoſed ſo as to watch on all ſides of the ambuſcade, and ſtop every one who from ignorance approaches too near. The ſentries ſhould give notice of what they diſcover by geſtures, to which all the officers ſhould be very attentive.

In countries where there are no woods, vineyards, or hedges, you may place an ambuſcade in a field of hemp or corn, or ſome ſort of grain, provided it be high enough to cover you, at leaſt with the help of art. When the ſtalk of the corn, &c. is not high enough, you muſt get ſome of the infantry to work with ſpades and pick-axes, which they muſt have brought along with them.

Plate DXXVII.

The commanding officer muſt mark out the ground A (fig. 1.) which they are to prepare for an ambuſcade, entering at the ſide B, and raiſing in the front and at the two flanks a kind of parapet C, made with an inſenſible ſlope outwards, covered with corn raiſed from the ſurface of the ambuſcade in form of ſquare turfs of a foot thick D. They ſhould be ranged and placed one againſt the other till they have gained ſix feet and a half. If the grain is not more than three feet high, it is plain, that forming the ſlope imperceptibly to a foot and a half high, with the earth dug of the ſame depth, the grain which borders the ambuſcade will be ſix feet and a half from the bottom, reckoning the thickneſs of the turf, which ſerves to ſhow that ſuch a work ought not to be declined in arable ground ſo eaſily worked. When the ſoldiers have finiſhed the work, a ſubaltern officer muſt lead them back to the place deſtined for the infantry.

The ambuſcade being thus made at 100 paces from the road where the enemy are to paſs, they ſhould lead the horſes into it one after another by the bridle, ſo as not to enlarge the entry: the horſemen to range themſelves ſtanding, and holding the bridles in their hands, with the reins ſlackened on the horſes necks. The officers ſhould be continually employed in viſiting the party, and waking thoſe who ſleep; and be equally careful to deface all traces of the entry, that none may appear near the ambuſcade.

Plate DXXVI.

Ambuſcades may be placed advantageouſly in hollow roads when they open obliquely behind that of the enemy, as the road K (fig. 2.) which enters by an acute angle upon the route F of the enemy; nor is there greater difficulty in concealing themſelves in the gullies of ſome rivulet G, when the borders are of a ſufficient height, or have ſhrubs that run parallel with the road of the enemy. It is extremely dangerous to fix there when the road of the enemy approaches towards, or croſſes too near, the ambuſcade, as they cannot fail to diſcover it.

As theſe gullies are not very large, it is neceſſary to have a number of ways to ruſh out quickly on the enemy: We ſuppoſe four, H, H, H, H, by which the cavalry can dart out ſuddenly upon the enemy at F.

It will be proper, before the placing the party, to cauſe the rivulet to be cut ſomewhat higher, to give it a new courſe I, ſo that the horſes feet may be dry in the gullies, and make leſs noiſe; and the ſhorter way they have to go, they will more certainly ſucceed. The commanding officer will not fail to diſpoſe them in ſuch manner, that the whole can ruſh out at once by the four paſſages, and pour in great numbers upon the flank of the enemy.

In ſuch ſort of ambuſcades, the commanding officer ſhould himſelf be the ſentry, leaning upon the edge, and covering himſelf, ſo that he may ſee every thing without being perceived.

Plate DXXVII.

In deſerted villages they may fix an ambuſcade in the gardens G (fig. 1.), or in the barns H. The doors fronting the enemy muſt be ſhut up, and the paſſages which are marked by ſmall dots made uſe of; for it is a general rule in all ambuſcades, to ſally forth in ſuch manner as to take the enemy obliquely behind their front.

You ought never to employ infantry in the ambuſcades we have been deſcribing, where the cavalry act, unleſs to favour their retreat: but when you go at hazard, ſeeking to draw the enemy into an ambuſcade, then the infantry ſhould have their turn. Neither woods, villages, nor any places which are much covered, are proper for them; however unſkilled an enemy may be, he will not follow a party on the ſkirts of a foreſt, or in the neighbourhood of ſome covered place: for which reaſon, there are no places fitter for ſucceeding with ambuſcades of infantry, than heaths, hilly countries, hollow roads, corn-fields, ditches at the ſide of great cauſeways; provided always that you do not plant them on roads that lead to your army, for then the enemy will take care how he purſues you too far.

When you would place an ambuſcade on a heath, or in a country full of little hills, your infantry muſt lie down with their bellies on the ground. If there is ſome water near them, it may ſuggeſt to them to wet their clothes and cover them with duſt, to give them the colour of the ground: but that this party ſo laid on the ground may not be cruſhed or trod upon by the enemy's horſe when hurried along with violence, they muſt preſerve the flank of the ambuſcade I, next the enemy, with a bar K, which may be made in a hurry with ſome ſtakes drove in the ground, at ten feet from one another, and above five or ſix feet high, held together by croſs pieces tied above five feet from the ground, which can be eaſily done in the neighbourhood of a wood. The time for the infantry to fire is, when the enemy's cavalry L, paſſing before the front, ſtretch their flank the whole length of the ambuſcade; then your cavalry M muſt quickly face about and attack the enemy. Their defeat will be ſo much the more certain, as the fire of your infantry happens to have driven their ſquadrons into confuſion.

To ambuſh in the ditch of a great cauſeway, you muſt chooſe the deepeſt place, and at the edge of a corn-field which is pretty high, and there place your people ſitting or kneeling. You ſhould collect as many ſmall round buſhes as poſſible, which are to be found in plenty in the country, which ſhould be planted, as if naturally, along the ſide of the road in front of your party, and beyond the ambuſcade on the ſide you expect the enemy, and here and there ſo open, that the enemy being accuſtomed to them may paſs without diſtruſt. You ſhould then make the corn lean over to cover the ambuſcade; but if there is none near enough the ditch, you muſt have as many ſquares cut in the manner directed above as will cover the edge of the ditch. Some of the corn ſo tranſplanted ſhould be beat down, but to appear as if done by hail or wind.

Mr Jeney ambuſhed in this manner with 50 men, when under the command of Captain Palaſti, who advanced with his cavalry upon the cauſeway leading to Straſbourg; and as ſoon as he was perceived, 400 Bavarian dragoons advanced to attack him: he wheeled about, and the dragoons believing themſelves maſters of the booty, did not fail to purſue, and arrived before the ambuſcade without ſuſpecting. Mr Jeney let their front paſs, and fired ſuch a deadly fire upon their centre, that he brought to the ground 17 killed or wounded: at the ſame time, the cavalry who pretended to fly, faced about and attacked the enemy, and would have completed their defeat, if it had not been for the great ſupport of cavalry and infantry hurrying out of Straſbourg to ſuſtain the dragoons; nevertheleſs, he carried off more than 50 horſes.

An officer having placed his infantry in ambuſcade, ought to ſend on the cavalry at day-break, a non-commiſſioned officer with ſix of the beſt mounted horſemen making the advanced guard: they ſhould advance as far before the party as the commanding officer can ſee. At ſight of the enemy, they ſhould begin to retire ſlowly without flying, at leaſt till the enemy comes to purſue with keenneſs: in that caſe, the advanced guard makes the rear-guard, and may drop a few ſhot at the enemy, to haraſs them and draw them on, or make pretended delays to excite them to purſue, till they fall by degrees into the ambuſcade.

When you cannot place your infantry in ambuſh without having a village between them and the enemy, the cavalry ſhould not be ſent beyond the village, becauſe the enemy will never expoſe themſelves to croſs it in following your party, for fear of falling into ſome ſnare: but inſtead of going beyond it, your cavalry ſhould enter the village, and demand refreſhment for 50 men, if the party are 100; then make three or four peaſants carry orders to the magiſtrates of the villages that are towards the enemy, to come to you, and regulate the delivery of waggons and forage, or ſome other pretence. As the peaſants will not fail to acquaint the enemy, and to deſcribe your ſtrength and ſituation according to what they have heard, the enemy will certainly come with ſuperior force; and that they may come more ſpeedily, they will bring no infantry.

As ſoon as the peaſants are gone, you muſt be careful to let none of the inhabitants leave the place, and ſend continually ſome ſtrong patroles to the rear on the road of your retreat, and eſpecially to the paſſages by which they can cut off your communication with the ambuſcade. Every horſeman holding his horſe by the bridle muſt be ready to mount, ſo that upon the enemy's appearing you may retire quickly from the village, and fall back one after another upon your ambuſcade.

When a partiſan has no infantry, he may form an ambuſcade with cavalry, which ſhould be as near as poſſible to the enemy. In the night, he ſhould ſend out two or three waggons covered with white linen, that they may be ſeen at a diſtance: care muſt be taken that the harneſs be in good order, ſo that no troubleſome accident happen by the want of attention to it. Each carriage to have four horſes mounted by two dragoons diſguiſed like waggoners, with their arms in the hands of two or four comrades concealed in each waggon, ſo that they may repulſe any patrole they chance to fall in with.

The waggons ſhould go ſlowly on ſome road parallel to the front of the enemy, and paſſing at ſome diſtance from their poſt (for it is not neceſſary that they paſs through them), and regulate their march ſo, that they may be within half a league of the ambuſcade at day-break, and readily perceived by the enemy; then let them ſtop while one mounts a tree or ſome height to ſee round them. When they perceive the patrole of the enemy, they muſt move off, for the others will not fail to follow; but if the enemy appears not to be inclined to follow, which the non-commiſſioned officer muſt attend to, and make one of the drivers ſtop, as if ſomething were the matter with his waggon, which will draw them on till they fall into the ambuſcade.

Among the thouſand opportunities that the different marches of the enemy offer for ambuſcades, there is none more proper than the retreat of an army which decamps to fall back. When a partiſan happens to get information of it on the eve by good ſpies, he ought to ſet out immediately with his whole party, making ſuch a round as has been drawn in fig. 1. leaving his infantry in ambuſcade at half-way.

Plate DXXVII.

The cavalry muſt be diligent to arrive at the place of ambuſcade by day-break, which ought to be placed on the route that the enemy is to take, and two or three leagues in the rear of his camp.

To be more ſecure of his retreat, he ſhould leave two or three detachments of cavalry between him and his infantry, at a good diſtance from one another; the remainder to line the road in ſeveral ranks parallel to it, and 300 or 400 paces behind one another, concealed from the view of paſſengers by the favour of hollows, woods, or hills.

The firſt line being near the road, muſt take care of ſutlers, equipages, &c. which are the forerunners of an army, and the firſt to decamp when they are retiring. When they ſecure ſome waggons or mules, the firſt detachment ſhould paſs them to the ſecond, and ſo on till they come to the infantry.

You muſt haſten to carry off what you can for a full quarter of an hour; after which you muſt preſs your retreat, expecting that the alarm will ſoon paſs to the army, and the light troops be inſtantly at your heels.

Sect. X. *Of the Retreat.*

Every march in withdrawing from the enemy is called a *retreat*. That which is done in ſight of the enemy, who purſues with a ſuperior force, makes the preſent ſubject; and is, with reaſon, looked upon as the glory of the profeſſion. It is a manœuvre the moſt delicate, and the propereſt to diſplay the prudence, genius, courage, and addreſs of an officer who commands.

The ſucceſs of the retreat depends upon the knowledge of the country that is to be paſſed over, and the goodneſs of the diſpoſition that is made for the troops to defend themſelves. The firſt offers advantages, and contributes greatly to the ſeizing them; the ſecond reſtrains the ardour of the enemy, and keeps up the force of a party to its higheſt pitch. Both deſerve to be ſtudied.

1ſt, Every officer who commands a detachment ought to apply himſelf carefully to reconnoitre every ſtep he takes, and examine perfectly every route that can conduct him from one place to another; he ſhould obſerve attentively all the ſtratagems that can be employed for ambuſhing infantry, or poſting cavalry; the courſe of rivers, their bridges and fords; the roads moſt covered with woods, hills, gullies, and villages; and, in a word, he ſhould know all the advantages, as well as the dangers, that lie in his way. It will be eaſy for him to acquire a knowledge of all this, if he will uſe the method recommended in a former ſection. With the aſſiſtance of ſuch a plan as is there deſcribed, he may regulate his retreat with eaſe, and put it in practice to advantage, profiting by every means proper for his defence, or ſurpriſing the enemy.

2dly, The diſpoſitions that ought to be made for a party, to ſuſtain their retreat in the face of the enemy, depend upon the number and kind of troops in both corps; for they muſt be varied according as they happen to be of cavalry or infantry united, or of either ſingly.

Every forced retreat in conſequence of an unfortunate action, would be almoſt impracticable, if it were not premeditated before you come in preſence of the enemy, or when you are obliged to fly by unknown routes. That which can be made in a fog, or in the night, is eaſieſt, when your rear is ſecured, as you can ſlip out of ſight of the enemy without any difficulty, and they will be afraid of following you for fear of being ſurpriſed in the dark: we ſhall only therefore ſpeak of that which is to be made in open day, and under the fire of the enemy.

To conduct it properly, you muſt abſolutely know the ſtrength of the enemy; for it is ſhameful to be the dupe of a falſe alarm, and to retreat precipitately from an ill founded fear at the approach of an inferior enemy. You muſt therefore be convinced of his great ſuperiority, and know what his party conſiſts of.

If they come with a ſtrong cavalry, united to a more numerous infantry than yours, you muſt immediately render their acting uſeleſs, by hurrying your infantry as quick as poſſible to retreat to the firſt place where they can lie in ambuſh, and ſerve the cavalry advantageouſly, if they can draw on thoſe of the enemy, as has been ſaid in ſpeaking of ambuſcades.

To conceal from the enemy, and favour the departure of your infantry, you ſhould cauſe your cavalry to advance, and pretend as if they were going to attack the enemy A (fig. 2.), your party forming into two diviſions B and C, each drawn up in two lines, the ſecond double the firſt, and diſpoſed as in the plan.

The diviſion C is to retire firſt 100 or 200 paces, and then fronting the enemy divide into two wings, leaving an interval for the paſſage of the diviſion, B, who, in retiring, muſt leave a rear-guard at 50 paces, which muſt be divided into ſeveral parties D, to ſcamper about the enemy's front; and in caſe they appear deſirous to attack you, your ſmall parties muſt keep a conſtant fire, particularly on the ſides that advance the moſt; and continue this manœuvre till they have joined the diviſion C, which ſhould immediately detach ſome ſmall parties of the beſt mounted to ſerve for a rear-guard,

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guard, and to haraſs the enemy, till the diviſion B is drawn up 100 paces in the rear, and divided into wings, leaving an interval for the diviſion C to paſs through in its turn; and continue to manœuvre it in this manner, till you draw the enemy's cavalry under the fire of your infantry.

When the force of the enemy conſiſts of cavalry alone, your infantry (marked in the plan by dotted right angles) ſhould retire jointly with the cavalry, at leaſt if the country does not expoſe you to be ſurrounded by ſome covered place; becauſe in that caſe your infantry ſhould go and occupy that place, and form an ambuſcade.

The reſt of the infantry ſhould place themſelves in the ſecond line of each diviſion. If the enemy approaches the firſt line too near, they ſhould fall lightly back upon the two wings of the ſecond, opening the centre quickly for the infantry to fire upon the enemy in platoons, at the ſame time that your cavalry detach ſeveral ſmall parties to advance briſkly to prevent the enemy's forming, who were thrown into confuſion by the fire of the infantry. The diviſion which retires will force its march, and go to a greater or leſs diſtance according to the purſuit of the enemy. The ſuſtaining diviſion muſt fall back afterwards till it has paſſed between the wings of the ſecond diviſion, who muſt then make the manœuvre of the firſt, continuing it alternately till the enemy deſiſts from the purſuit.

To facilitate the retreat of the infantry, and gain ſome way on the enemy, many have been of opinion that they ought to tranſport them in waggons. But when the enemy is at our heels, the time is very ill employed in collecting carriages and harnaſſing them: thoſe moments are too precious; and ſhould be employed in cauſing the infantry to move off quickly, by which they will not be expoſed to a train of waggons taken in haſte, which may ſoon break, or be put out of order, and may ſtop the whole line; which not only retards the infantry, but likewiſe the cavalry, when they find the route they were to have taken blocked up with broken carriages.

When there happens to be a wood in your rear, you need not enter it if the enemy follows you cloſe, and is prevented by your ſtrength: it is better to coaſt along it by the route marked G, for fear of his coming round you; but if you cannot avoid croſſing it, the diviſion C ſhould paſs quickly, and at getting out face to the two flanks of the wood. The diviſion B is to remain at the entrance of it, till they judge that the diviſion C is ſufficiently advanced, and then fall back, leaving the infantry for a rear-guard during the whole paſſage through the wood: at which time the whole ſhould reſume their firſt diſpoſition.

In all defiles, and paſſages of bridges, the ſame manœuvre ſhould be uſed as for woods: but the firſt diviſion having paſſed, they ſhould form facing the enemy; and the infantry likewiſe draw up on the other ſide, upon the edge of the river.

When the country through which you are to retire happens to be mountainous, the diviſion which falls back ſhould guard the heights by ſmall detached parties, or, if poſſible, guard them themſelves.

A body of cavalry retreating without infantry, ought to form in three lines at 200 paces behind one another; the two laſt extending their front, that they may appear more numerous, and draw up on the two ſides out of the road. The firſt line being attacked, the ſecond is to ſuſtain it, the third to wait the retreat of the firſt, and to ſuſtain the ſecond, and continue to do ſo alternately.

If the enemy ſeem to quit the purſuit, the whole corps muſt reſume the order of an ordinary march; with this precaution, that the rear-guard be reinforced, and the advanced guard weakened.

As to the retreat of a ſmall detachment of cavalry, ſuch as go to reconnoitre the enemy, to diſcover their march, to carry off ſome officer, or for ſome other commiſſion, as they are not numerous enough to ſkirmiſh and retreat by rule, they have but two ways to chooſe; either to fly, or break through the enemy. They ought to determine for the laſt, when their retreat is cut off on all ſides, ſo that they have no other way to eſcape but by cutting their way through the enemy ſword in hand: but flight is always leſs hazardous when it is practicable.

If the officer is certain of the fidelity of his men, and their attachment to him; and ſees that they cannot get out of ſight of the enemy, but are ready to fall into their hands; he ought to try one means ſtill, which has been known frequently to ſucceed. He ſhould diſperſe his party by two and two, by the favour of the firſt covered place, where they may be at liberty to take ſo many different routes. It is evident that two men may wind from right to left, and eſcape more eaſily than a party of 12 or 20, who cannot move ſo freely.

Mr Jeney made uſe of ſuch an expedient ſucceſsfully in Italy, when the Spaniards having advice of his detachment having ſlipped to the rear of their army, they cut off his retreat on all ſides. The whole party being diſperſed, he took two huſſars with him, and was followed ſo cloſe, that every inſtant he thought he muſt be taken; however, he ſaved himſelf by croſſing a marſhy pond. The enemy ran to turn him but he got ſo far before them, that they could not take him. He got ſafe to his poſt, and in three days the whole detachment met without the loſs of a man; which will prove that in ſuch a ſituation we need not deſpair, and that in extreme neceſſity the paſſage of a river or moraſs ought not to be declined.

PART IV. Of SIEGES.

SECT. I. *Of Attack.*

§ 1. *Maxims or Principles to be obſerved in the Attack of Places.*

1. THE approaches ought to be made, without being ſeen from the town, either directly, obliquely, or in flank.

2. No more works ſhould be made than are neceſſary for approaching the place without being ſeen; that is, the beſiegers ought to carry on their approaches the ſhorteſt way poſſible, conſiſtent with being covered againſt the enemy's fire.

3. All the parts of the trenches ſhould mutually ſupport each other, and thoſe which are fartheſt advanced ought not to be diſtant from thoſe which are to defend them above 120 or 130 fathoms, that is, above muſket-ſhot.

4. The parallels or places of arms the moſt diſtant from the town, ought to have a greater extent than thoſe which are neareſt, that the beſiegers may be able to take the enemy in flank, ſhould they reſolve to attack the neareſt parallels.

5. The trench ſhould be opened or begun as near as poſſible to the place, without expoſing the troops too much, in order to accelerate and diminiſh the operations of the ſiege.

There is no ſuch thing as giving any exact rule in regard to the diſtance which ought to be obſerved upon opening the trenches. On level ground this diſtance may be 800 or 900 fathoms; but if there ſhould be a hollow way in the neighbourhood of the place, the beſiegers are to take advantage of it, and open the trenches nearer. In general, they are to regulate themſelves upon this head according to the nature of the ground, more or leſs favourable to the opening of the trenches.—We ſhall ſuppoſe, in the preſent work, that the opening ought to be made within 800 fathoms of the covert way; the firſt parallel within 300 fathoms, the ſecond within 150, and the third at the foot of the glacis.

6. Care ſhould be taken to join the attacks; that is, they ought to have communications, to the end that they may be able to ſupport each other.

7. Never to advance a work, unleſs it be well ſupported; and for this reaſon, in the interval between the ſecond and third place of arms, the beſiegers ſhould make, on both ſides of the trenches, ſmaller places of arms, extending 40 or 50 fathoms in length, parallel to the others, and conſtructed in the ſame manner, which will ſerve to lodge the ſoldiers in who are to protect the works deſigned to reach the third place of arms.

8. Obſerve to place the batteries of cannon in the continuations of the faces of the pieces attacked, in order to ſilence their fire; and to the end that the approaches being protected, may advance with greater ſafety and expedition.

9. For this reaſon the beſiegers ſhould always embrace the whole front attacked, in order to have as much ſpace as is requiſite to plant the batteries on the produced faces of the works attacked.

10. Do not begin the attack with works that lie cloſe to one another, or with rentrant angles, which would expoſe the attack to the croſs-fire of the enemy.

§ 2. *Of Inveſting.*

The firſt operation of a ſiege is inveſting. The body of troops inveſting a town ought at leaſt to be as ſtrong again as the garriſon; they are to divide themſelves into ſeveral parties, in order to take poſſeſſion of all the avenues leading to the place. By day they ſhould keep themſelves out of the reach of cannon-ſhot; but as ſoon as it is duſk they muſt approach much nearer, the better to be able to ſupport each other.

The inveſting is generally made by cavalry; but when the country is cut with ravins or hollow ways, or when there are woods in the neighbourhood of the place, then there muſt be likewiſe a body of infantry to guard all the avenues, and even to ſtop up, by a kind of retrenchments, ſuch as might be the eaſieſt to penetrate.

A few days after the inveſting, the army arrives, and is diſpoſed round the town, according to the ground taken up by the line of circumvallation, and aſſigned by the engineer who has the direction of the ſiege. As ſoon as the place is inveſted, they begin to trace the line of circumvallation, and afterwards they ſet about its conſtruction.

§ 3. *To trace out the line of Circumvallation.*

Before a general begins the attack of a place, he muſt endeavour to have as exact a plan of it as poſſible, by which he forms a deſign of the circumvallation and the attacks. The plan is rectified after the inveſting as much as the vicinity of the enemy will permit; and thereby he may correct the deſign traced at firſt, as far as there may be occaſion for correction. It is upon ſuch a plan, ſo rectified, that we ſuppoſe a general to proceed. We ſhall therefore begin with explaining or tracing the operations of the ſiege. We ſhall exhibit the progreſs of theſe operations from the inveſting to the taking of the place, in the order they are really executed. The line of circumvallation being a fortification intended againſt the enemy from without, who ſhould attempt to ſuccour the town, its defences ought to be directed againſt that enemy; that is, they ought to be oppoſite to the town; and the beſieging army ſhould, as we have already obſerved, be encamped behind that line, that is, between it and the town. The camp ſhould be, as much as poſſible, without the reach of cannon-ſhot: therefore, as the line of circumvallation ſhould be at a greater diſtance from the place than the camp, the reaſon is ſtill ſtronger for its being alſo out of the reach of the cannon-ſhot; which, whether fired horizontally, or at an angle of 10 or 12 degrees, may be reckoned about 1200 fathoms. As the rear of the camp ſhould not be incommoded by the cannon, this part ought to be above 1200 fathoms diſtant from the place; and we ſhall ſuppoſe that the diſtance ought to be fixed at 1400 fathoms from the covert way. The depth of the camp may be eſtimated at about 30 fathoms. From the front of the line of circumvallation there ſhould be a ſpace of 120 fathoms, to draw up the army in battalia behind the circumvallation; which ſpace added to 30 fathoms, ſuppoſed for the depth of the camp, gives 150 fathoms; and this added to the diſtance from the covert-way to the rear of the camp, gives 1550 fathoms for the diſtance from the circumvallation to the covert-way.

This being laid down, if the place be a regular octagon, fortified according to M. Vauban's firſt method*, the radius thereof will be 234 fathoms. This diſtance being added to the 1550 fathoms, then we ſhall have 1784. Or we may make it a round number by adding 16 fathoms, which are here of no manner of conſequence, and we ſhall have 1800 fathoms for the diſtance from the centre of the place to the line of circumvallation.

The radius of the circumvallation being thus ſettled, from the centre of the place, with the diſtance of 1800 fathoms, you are to deſcribe the circumference of a circle round the place. The diameter being 3600 fathoms, the circumference will then take 11,314; then take the diſtance of 120 fathoms, which you are to carry to the circumference above deſcribed. This diſtance will be in this example 93 times, and ſomething over, which differs very little from 120 fathoms; ſo that you may look upon the polygon of this circumvallation as a polygon of 94 ſides, of 120 fathoms each.

Plate DXXVIII. fig. 1.

The polygon of the circumvallation being traced, take on each of the extremities of its ſides the lines BD and BE, each of 15 fathoms; and from the points D and E, taken for the centre and diſtance of 25 fathoms, deſcribe two arcs which cut one another at the point F; from whence draw the lines FD, FE, for the faces of the redans of the line of circumvallation: thus it is we form the ſaliant parts EFD of this line, which ſerve to flank it. Perform the ſame operation on every ſide of the circumvallation, and then you will have its principal line traced.

The parapet within muſt be ſix or eight feet deep; and without make a ditch parallel to all its parts, three or four fathoms in breadth. The parapet of the circumvallation will be ſeven feet and a half high, and the depth of the ditch equal to the height of the parapet.

To make the profile of the circumvallation, let AB fig. 2. be the line level with the country, and CD the ſcale of the profile. Let A be the ſide of the town, and B that of the country; take AE, of ſix feet; from the point E, raiſe the perpendicular EF, of three feet, and draw the line AF, which will be the talus of the banquette.

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* See Fortification.

Draw FG parallel to A B, three feet from F to G, and the line FG will be the breadth of the banquette. On the point G raiſe the perpendicular GH, upon the line FG, four feet and a half. Draw from the point H, HK, parallel to AB. Make HK ſeven feet and a half, HI a foot and a half, draw GI, which will be the inſide of the parapet of circumvallation.

From the point K, let fall on the line AB the perpendicular KM; take KL a foot and a half, and draw IL, which will be the upper part of the parapet of the line of circumvallation. Take MN five feet, and from the point N draw the perpendicular NO, and ſet off ſeven feet and a half from N to O. Draw OR parallel to AB, making the diſtance three fathoms or 18 feet from O to R; draw the line LN and produce it to P, and LP will be the ſcarp, or the outſide of the parapet of the line of circumvallation. From the point R raiſe RS, perpendicular to OR, or parallel to ON. Make QR equal to OP, and draw QS, which produce beyond S three feet to V; then take SX ſix feet, and draw VX, and the profile of the circumvallation will be completed.

This kind of glacis, VX, will ſerve to raiſe the enemy, and to expoſe them more to the fire of the line, ſhould they attempt to make themſelves maſters of it, and to cover the parapet of the circumvallation, in the ſame manner almoſt as the glacis of a place covers the top of the rampart.

The dimenſions above given may vary a little without inconvenience; but it would be to no manner of uſe to make the lines ſtronger; only you may reduce the ditch to ten or twelve feet in breadth at the top, and five or ſix feet in depth. A ditch of leſs breadth and depth, beſides its not allowing ground enough to form a good parapet, would have the inconvenience of being too eaſy to paſs over by the enemy. The lines may be fraiſed (ſee Fraise); which is done when they are to laſt for ſome time, and the neighbouring country furniſhes wood enough for the purpoſe.

Sometimes a fore-ditch is dug before the lines, 12 or 15 feet in breadth at the top, and ſix or ſeven feet deep; it is made about 12 or 15 fathoms from the ditch of the line.

The deſign of it is to ſtop the enemy when they attempt to attack the lines, and to make them loſe both time and men in paſſing over it. As it is expoſed to the fire of the lines, the time the enemy muſt neceſſarily ſpend in croſſing will of courſe occaſion their loſing a great many men; and beſides, the paſſage itſelf may throw them into ſuch diſorder, as ſhall prevent their attacking ſo advantageouſly as they would otherwiſe do, were it not for this obſtruction. Between this fore ditch and the ditch of circumvallation, at the ſiege of Philipſburg, in order to ſtrengthen the defence of the circumvallation, there were likewiſe dug wells, which were ranged chequerwiſe, of about nine feet diameter at the mouth, and ſix or ſeven feet deep. They were ſituated near to each other, to prevent the enemy from paſſing eaſily through the intervening ſpaces. The Spaniards practiſed ſomething of this kind at the ſiege of Arras in 1654. Before the circumvallation, they dug a number of holes two feet diameter, and a foot and a half deep; in which they faſtened ſtakes that were capable of greatly obſtructing the paſſage of the cavalry. See Plate DXXIX.

A line of circumvallation requires a ſtrong army to defend it. We have found the circumference of the line which we have been now tracing, namely, of 94 ſides, each of 120 fathoms, to be 11,280 fathoms; out of this number the gorges of the redans are to be deducted, but then their faces are to be added. The gorges have 30 fathoms; and the two faces which have 50, give an overplus of 20 fathoms on each redan; that is, to the number above mentioned of 11,280 fathoms, add as many times 20 as there are redans, in order to have the entire circumference of the circumvallation. This circumference has 95 redans; therefore we muſt add 94 times 20, or 1880, which will make 13,160 fathoms for the whole circumference. This number being divided by 2282 (which is the number of fathoms contained in a French league) gives about five leagues and a half. Now it is clear, that ſo great an extent of ground requires a very numerous army to guard it. We may make a calculation pretty near, by ſuppoſing that every ſoldier drawn up in a line occupies a ſpace of three feet, that is, half a fathom; that the ſoldiers are four deep; and that the army is drawn up in two lines, which will give eight ranks of ſoldiers. Each rank containing 26,320 ſoldiers, the circumference of the circumvallation being 13,160 fathoms, the eight ranks will therefore make 210,560 men.

To theſe we ſhould likewiſe add about 12,000 or 15,000 men for the works of the attack, which would form an army of about 225,000 men. And as it is not cuſtomary, at leaſt in Europe, to ſend ſuch ſtrong armies into the field, from thence it follows, that the circumvallations, and the lines in general, when they are of a very great extent, are extremely difficult to guard. And indeed the moſt celebrated generals have been divided in their opinions upon this ſubject. They all agree that there are certain caſes in which they may be of ſome advantage, eſpecially when they are of a narrower compaſs, and the deſign of them is to ſtop up the entrance of a country of a ſmall extent; but if they are very large, it is extremely difficult to defend them when attacked by a ſkilful enemy.

It was heretofore the cuſtom to add great outworks to the lines, ſuch as horn and crown works, tenailles, &c. All the circumvallations of the towns that were beſieged during the wars between Spain and Holland, under the princes of Orange, were remarkable for this ſort of works. Theſe have been ſince laid aſide, becauſe we find that even a line, with its ſimple redans, is very difficult to guard; and ſuch a number of outworks does but increaſe its circumference. The modern lines have only a few ſmall half-moons A, before the gates of the circumvallation, placed, like thoſe of the towns, againſt the middle of the curtains; the entrance is ſhut up by wooden barriers, and ſometimes by chevaux-de-frize, and other contrivances, which will hinder the paſſage from being eaſily forced.

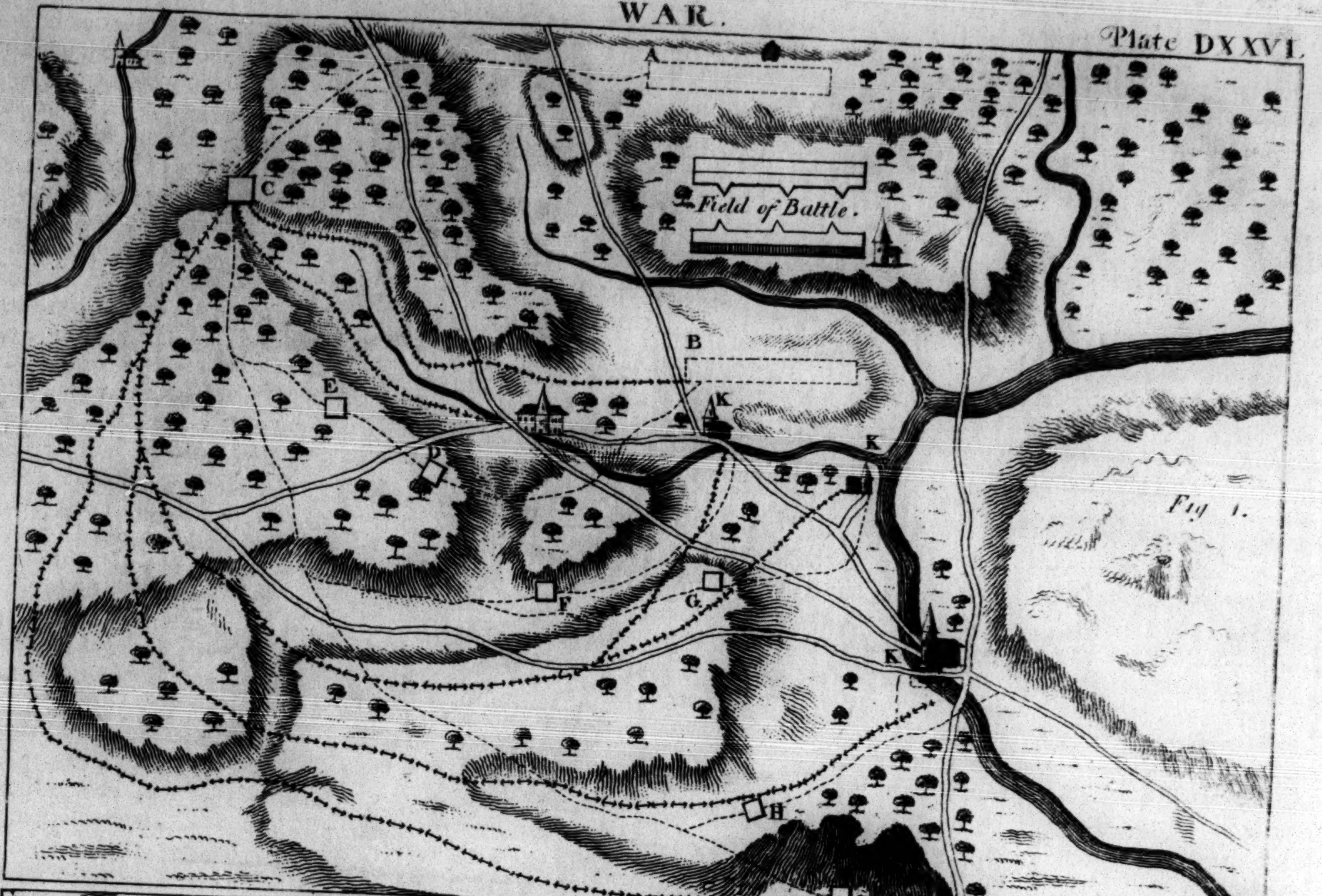
Plate DXXVIII. fig. 1.

The lines having very little elevation, ſtand in no need of baſtions to be flanked in all their parts, like thoſe in the circuit of a town. Redans, which are of more ſimple and expeditious conſtruction, are ſufficient. The angle they make with the curtain is always very obtuſe, to the end that the ſoldier being placed on the face of the redan, may be the better able to defend its approach. It is cuſtomary indeed to make baſtions in thoſe parts where the lines form ſuch angles as could not be ſufficiently defended by redans. Yet, whenever it may be judged neceſſary, the line of circumvallation may be fortified with baſtions. The greateſt part of the lines at the ſiege of Philipſburg was flanked in this manner, as may be ſeen in Plate DXXIX. The baſtions increaſe the circumference of the circumvallation; and probably the reaſon why they were uſed at the ſiege of Philipſburg, was becauſe the circumvallation was of a very ſmall extent.

At the point of the redans, batteries are erected to fire the cannon a barbette over the parapet; and the ſame is practiſed wherever the cannon are placed on the line of circumvallation.

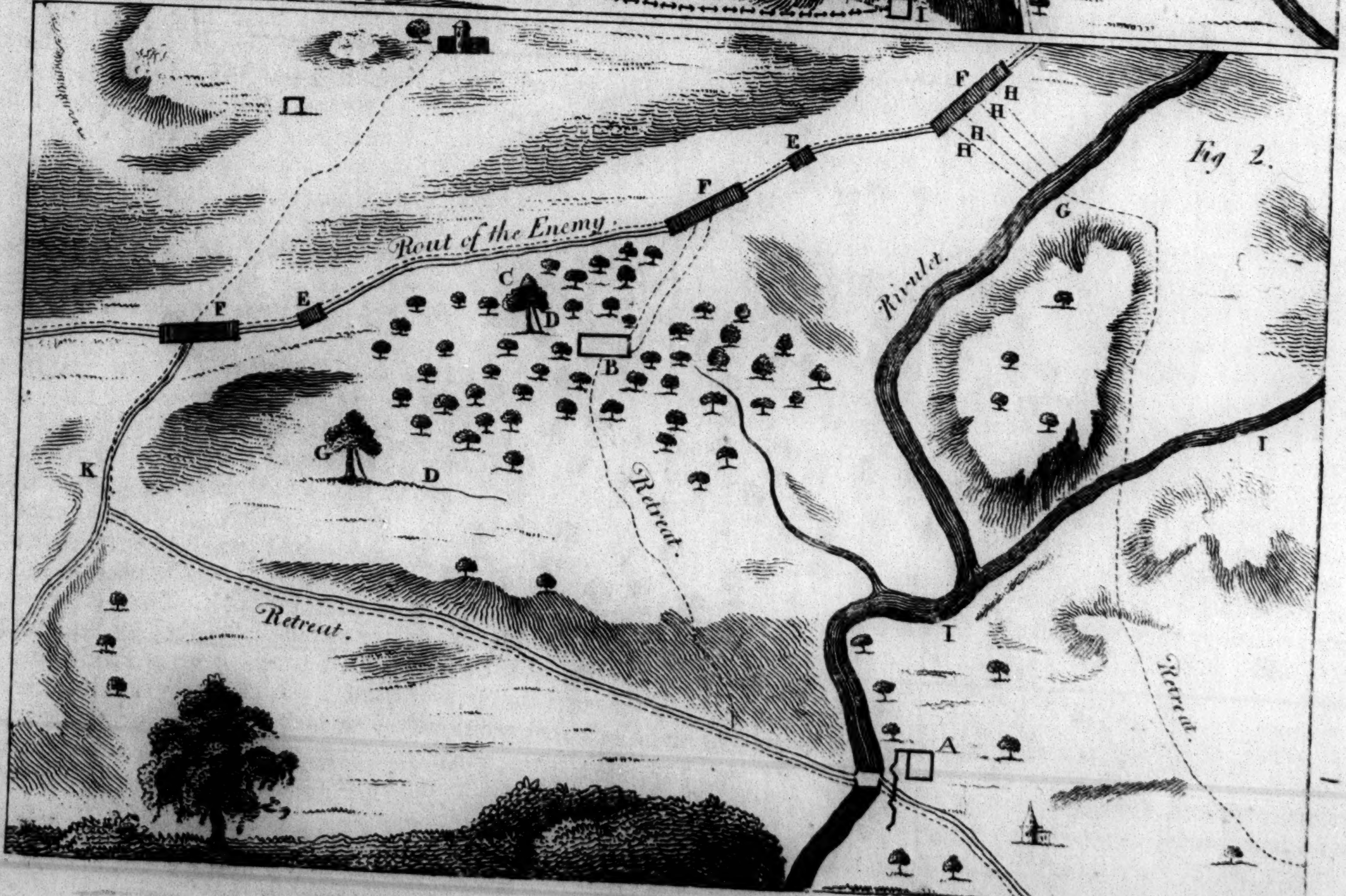
Hitherto we have ſuppoſed that the circumvallation was regular: but even were it irregular, the conſtruction of it would differ very little from that which we have juſt now given.

A general ought to poſſeſs himſelf of all places from which



A
Field of Battle.
B
C
E
D
K
K
K
F
G
H
I

Fig 1.



F
H
H
H
H
E
F
G
Rout of the Enemy.
C
D
B
E
F
Rivulet.
K
G
D
Retreat.
Retreat.
Retreat.
I
I
A

Fig 2.

H.W.Weston Sc.

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WAR

Plate DXXVI

Fig 1

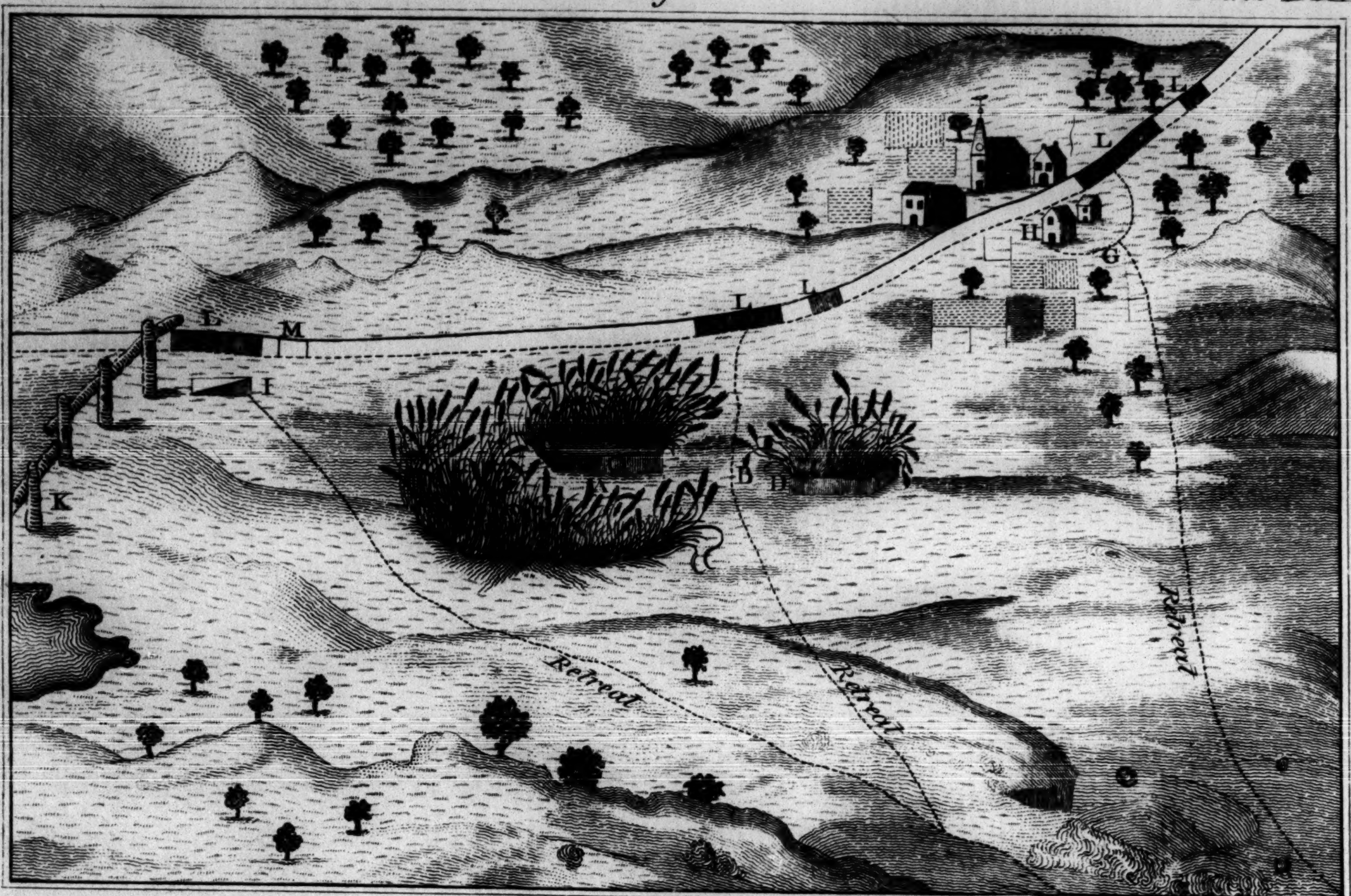
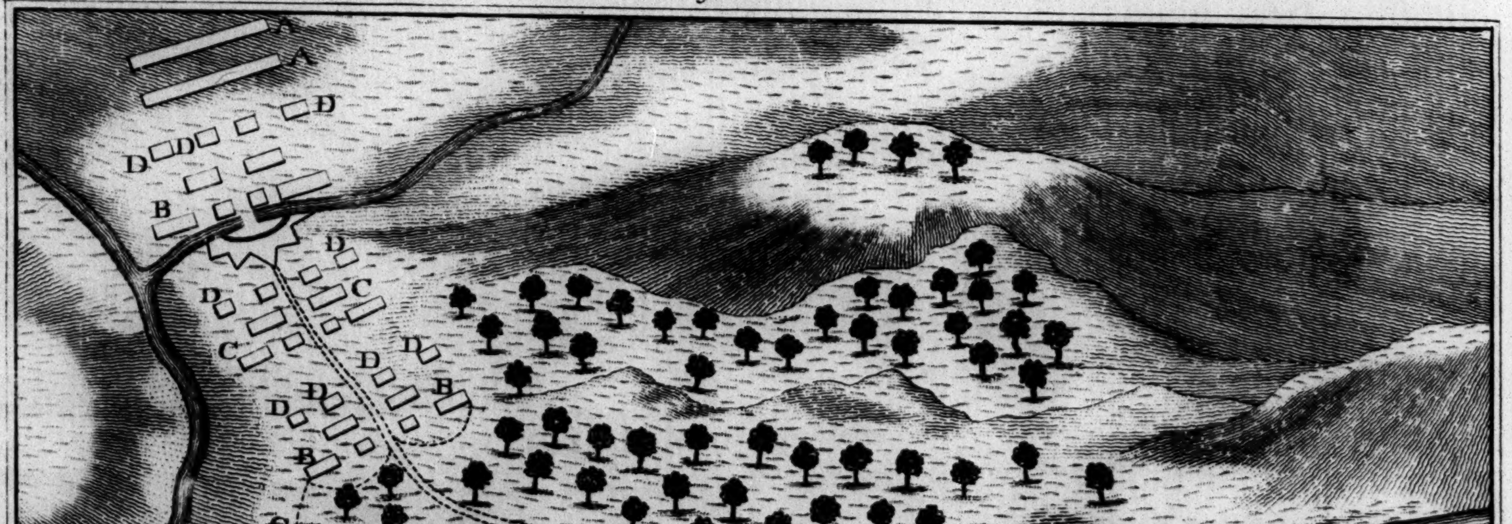

L
M
I
K
L
L
L
L
H
G
D
D
Retreat
Retreat
Retreat

Fig 2


A
A
D
D
D
B
D
D
C
C
D
B
D
D
B
C
C
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D
B
D
D
D
C
C
D

Etchd by Lawson

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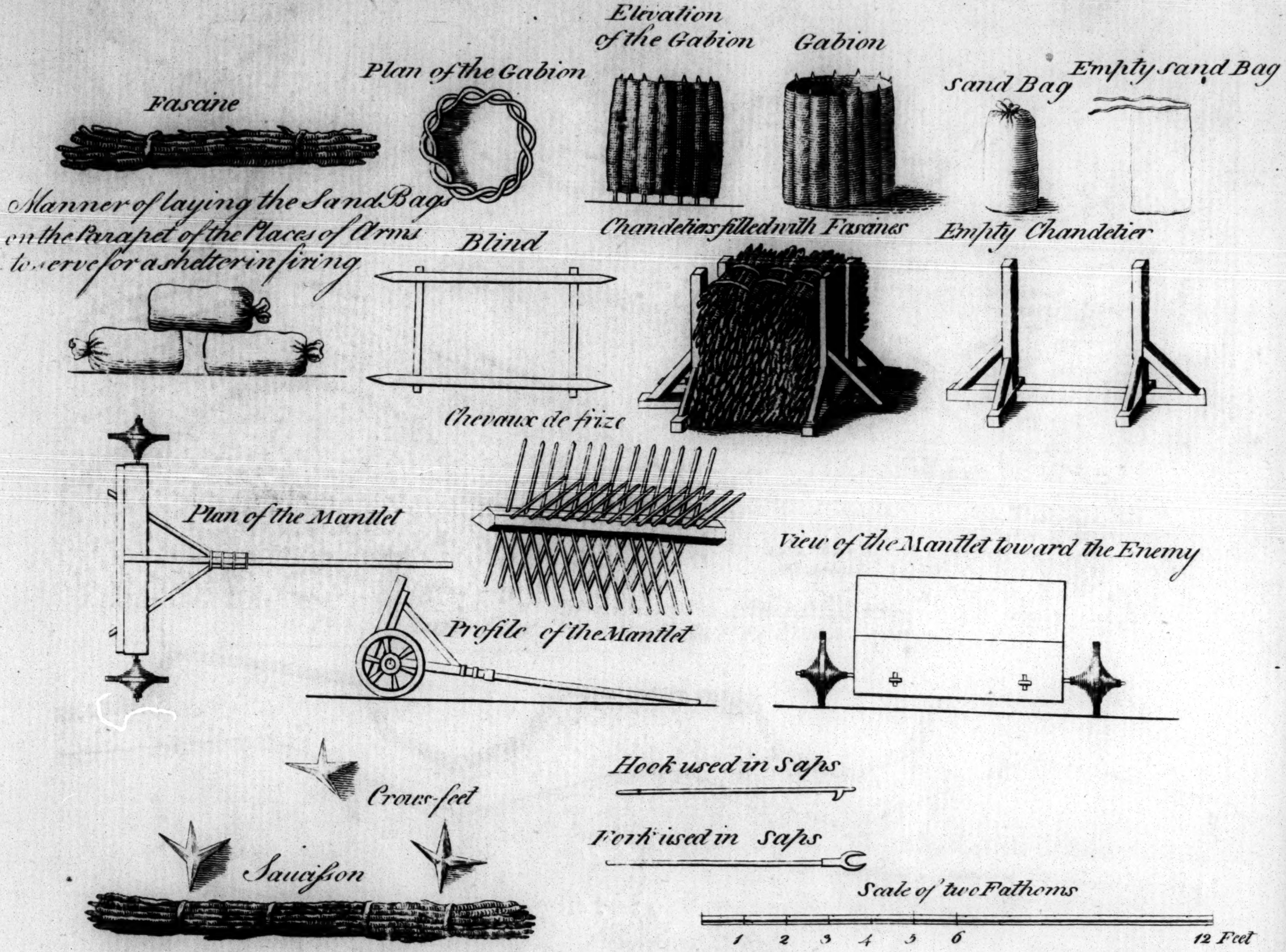
Attack of Fortified Places


Fascine
Plan of the Gabion
Elevation of the Gabion
Gabion
Sand Bag
Empty sand Bag
Manner of laying the Sand Bags on the Parapet of the Places of Arms to serve for a shelter in firing
Blind
Chandeliers filled with Fasines
Empty Chandelier
Chevaux de frize
Plan of the Mantlet
Profile of the Mantlet
View of the Mantlet toward the Enemy
Hook used in Saps
Crows-feet
Fork used in Saps
Saucisson
Scale of two Fathoms
1 2 3 4 5 6
12 Feet

Part of a Line of Circumvallation

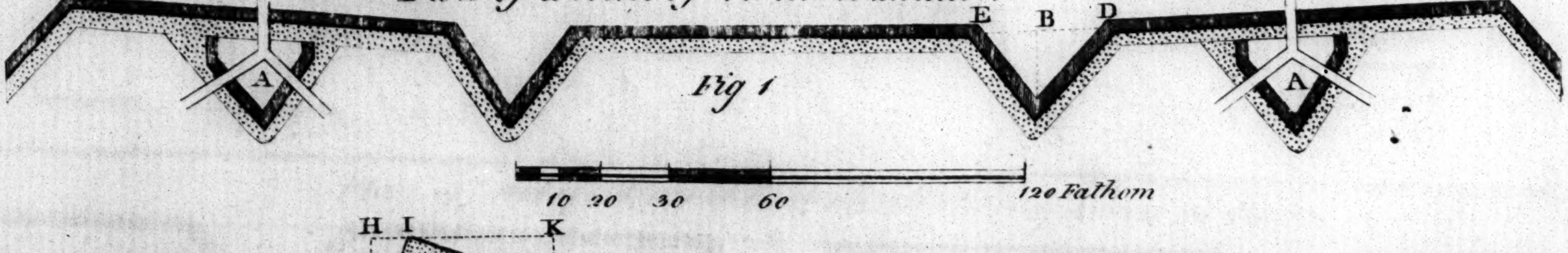

A
E B D
A
10 20 30 60
120 Fathom

Fig 1

Section or Profile of a Line of Circumvallation

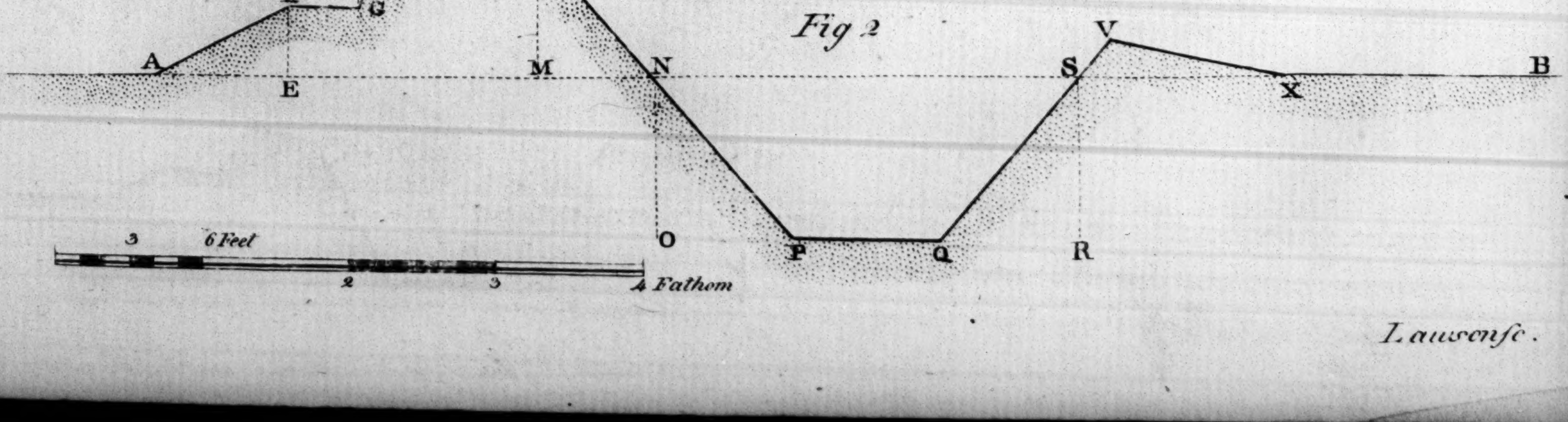

H I K
L
F
G
A
E
M
N
V
S
X
B
O
P
Q
R
3 6 Feet
2 3
4 Fathom

Fig 2

Lausen sc.

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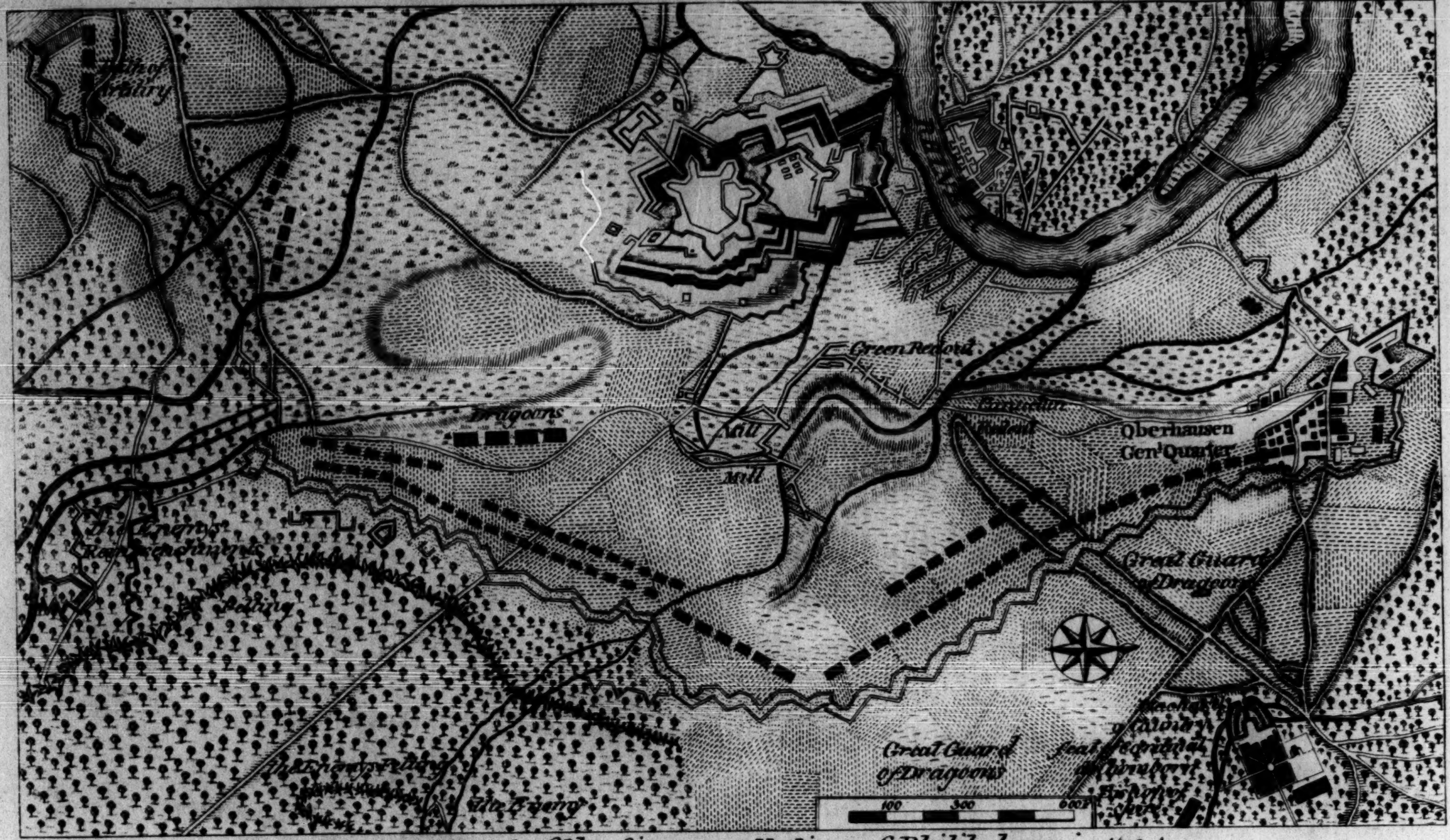
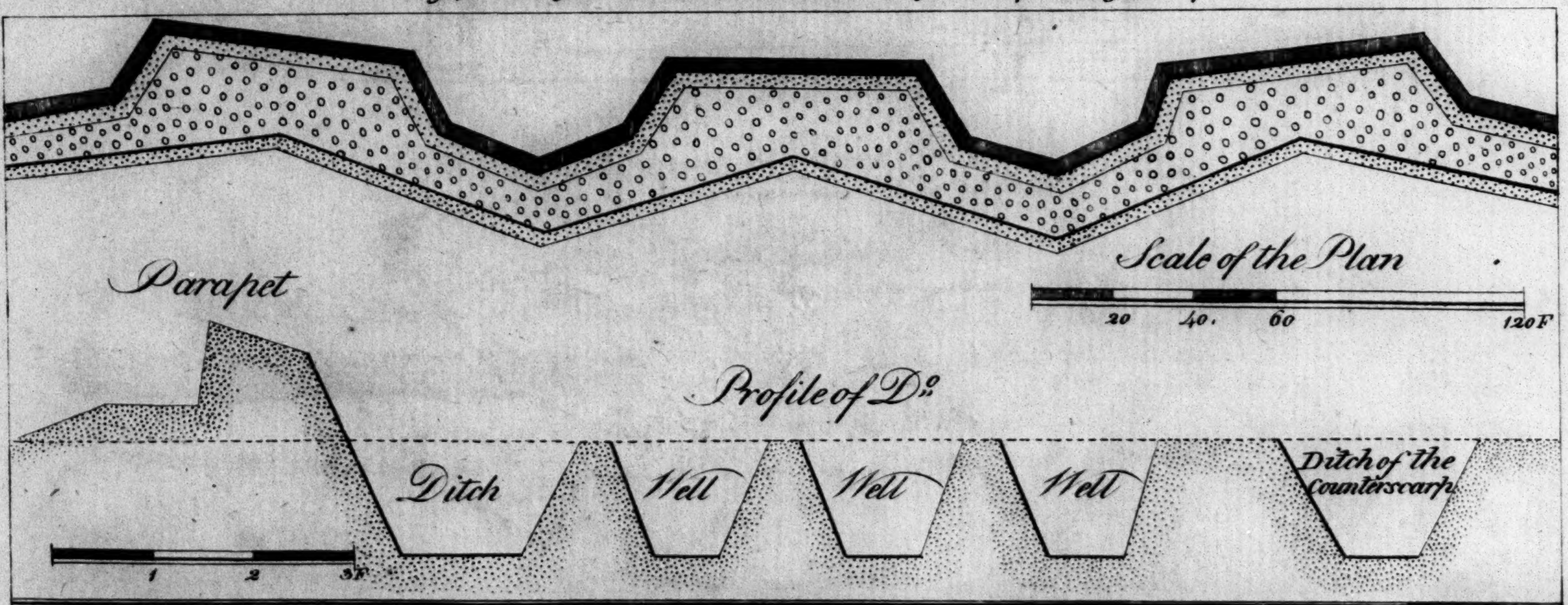
WAR

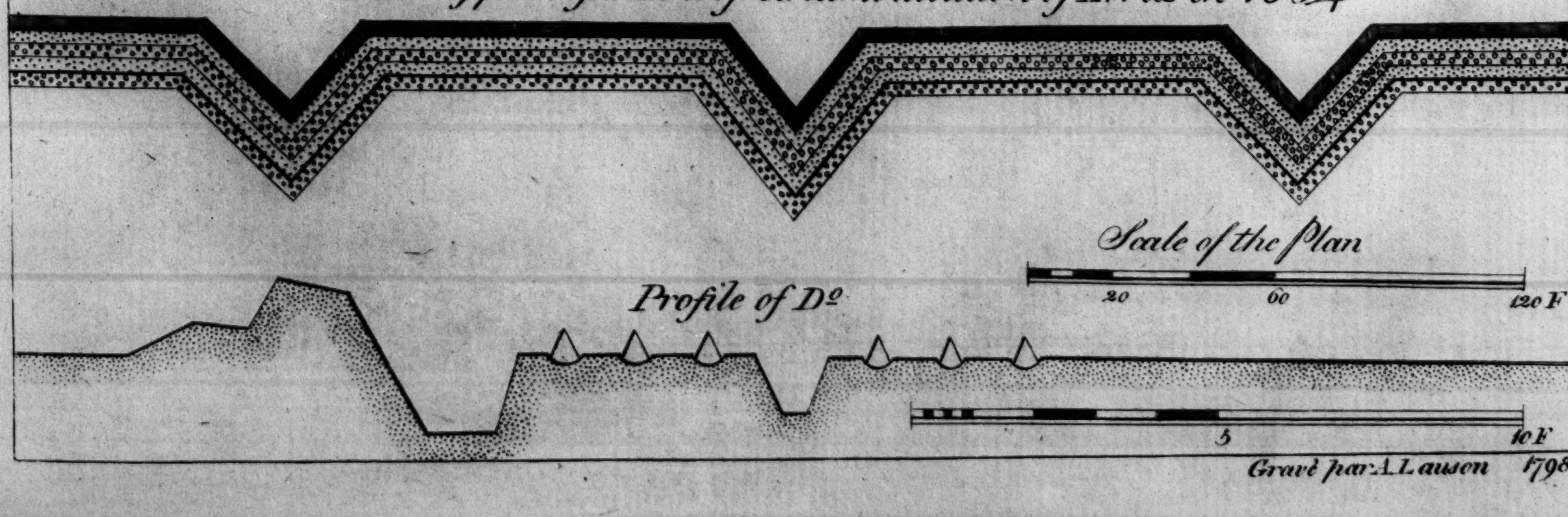
Plan of the Circumvallation and Attacks of PHILIPSBURG in 1734 Plate DXXIX


Path of Artillery
The Enemy's Retrenchments
Felling
The Enemy's Felling
The Enemy
Dragoons
Mill
Mill
Green Redout
Oberhausen
Gen.l Quarter
Great Guard of Dragoons
Great Guard of Dragoons
100
300
600

Plan of part of the Circumvallation of Philipsburg in 1734


Scale of the Plan
20
40
60
120 F
Parapet
Profile of D.o
Ditch
Well
Well
Well
Ditch of the Counterscarp
1
2
3 F

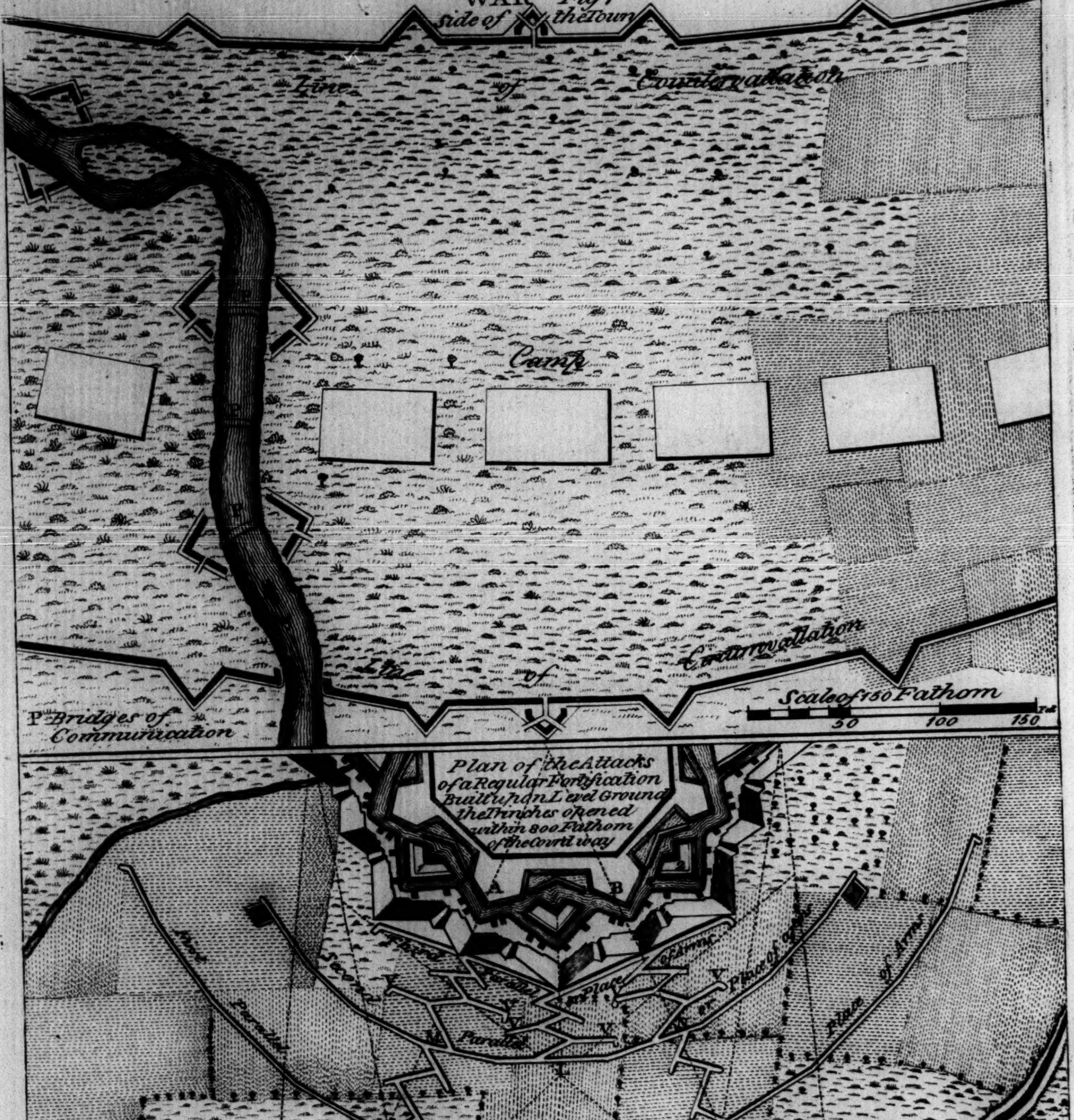
Plan of part of a Line of Circumvallation of Arras in 1654


Scale of the Plan
20
60
120 F
Profile of D.o
5
10 F

Grav.é par A. Lauson 1798

BRITISH MUSEUM

WAR Fig 1 Plate DXXX


Side of the town
Line of Countervallation
Camp
P Bridges of Communication
Line of Circumvallation
Scale of 150 Fathom
50
100
150
Plan of the Attacks of a Regular Fortification Built upon Level Ground the Trinches opened within 800 Fathom of the Covert way
A
B
Third Parallel
Second Parallel
Place of Arms
Place of Arms
Place of Arms
V
M
L
H
N
T
X
S
F
G
Line of Communication of the Attack
Scale of Fathoms
200
100
50

Lauron sculp

BRITISH MUSEUM

which the lines may be commanded, when it is poſſible to do it without carrying the circumvallation to too great a diſtance. He ſhould likewiſe take all advantages ariſing from the nature of the ground, as precipices, eminences, rivers, brooks, moraſſes, and, generally ſpeaking, whatever is capable of rendering the camp of difficult acceſs. If there are any woods or buſhes within its incloſure, it will be right to cover it in thoſe parts by ſelling the trees, and therewith making a proper fence.

The tracing of the lines is a matter of no difficulty, if you have a good map of the adjacent country; ſince you have only to bring the ſeveral parts of the line nearly within 1800 fathoms of the centre of the place, and to take care that there ſhall be about 120 fathoms from the point of one redan to another.

Nor is there any difficulty in transferring this line to the ground; the operation is too eaſy to thoſe who know a little of practical geometry, to loſe any time in explaining it here.

When the garriſon is numerous enough to diſturb the beſieging army, another line is traced in the rear of the camp, called the *line of countervallation*. As it is intended to oppoſe a far leſs conſiderable body of troops, it is never made ſo ſtrong as the line of circumvallation; but it is conſtructed on the very ſame principles, as the figure will ſufficiently ſhow.

Plate DXXX. fig. 1.

§ 4. *Of the Park of Artillery.*

The park of artillery is the place which contains the cannon, bombs, powder, and in general all military implements and machines that have any relation to the artillery. This park ſhould be placed where there is leaſt danger of being inſulted by the enemy. It ought to be without the reach of cannon-ſhot, and incloſed within a particular ſpot, which ſhould be fortified alſo by a line, conſiſting of a ditch and a parapet, flanked with redans in the ſame manner as the circumvallation. Nothing ſhould be neglected that is capable of ſecuring it either from the attacks of the enemy, or from any other poſſible damage.

§ 5. *Of the Trenches and Parallels.*

While the line of circumvallation is finiſhing, all the materials neceſſary for the conſtruction of the trenches are got ready, and the engineer who has the direction of the ſiege, examines on the ſpot the moſt proper place for the attacks, and the figure they ought to have; and of theſe he makes a particular plan.

We have ſuppoſed that the place is regularly fortified, and on level ground; ſo that here it is indifferent on which ſide the attack is begun. It is ſufficient to explain the rules that are to be there obſerved; and afterwards to apply them to irregular towns, and to uneven grounds. Let C (fig. 2.) be the place beſieged, and A and B the baſtions attacked. Begin with indefinitely producing towards the field the capitals of theſe two baſtions; in like manner produce the capital of the half-moon oppoſite the curtain between theſe two baſtions; ſet off 800 fathoms from the ſaliant angles D and E of the covert-way to F and G. This done, take DH, and EI of 300 fathoms; and from the centre C, with the radius CH or CI, deſcribe an arc, which produce beyond the points H and I; and on this arc H I conſtruct the firſt parallel. Then on the ſame lines, DF, EG, take the points M and N 140 fathoms diſtant from the points H and I; and through theſe points deſcribe from the centre C another arc, on which the ſecond parallel is conſtructed. This ſecond arc will cut the produced capital of the half-moon in the point L, which is to be obſerved, in order to begin from hence a trench, which ſhall extend to the ſaliant angle of the covert-way before this half-moon. Laſtly, through the points O and P, the diſtance of 20 or 25 fathoms from the angles D and E, deſcribe from the centre C a third arc, on which the third parallel is conſtructed.

Plate DXXX.

Terminate the firſt parallel by producing the faces *a b*, *a b* of the half-moons 1 and 2, collateral to the baſtions A and B; but extend the parallel 15 or 20 fathoms beyond the interſection of this prolongation. The ſecond parallel will be leſs extended than the firſt, by about 30 fathoms on each ſide; and the third alſo leſs extended than the ſecond, by about 30 fathoms on each ſide.

This being done, you have a ſketch of the trenches and the places of arms. The buſineſs now is to trace the trenches, or approaches, without being ſeen or enfiladed.

Take a long ruler, and lay it on the point G, ſo that it ſhall make, with the produced capital EG of the baſtion B, an angle EGS, whoſe ſide GS being produced, ſhall meet no part of the covert-way, and ſhall be diſtant about 10 or 12 fathoms from the angles to which it approaches neareſt. Take GS of an arbitrary extent, as of 200 or 220 fathoms, and put the ruler on the point S, ſo that it ſhall make with GS ſuch an angle GST, as that the ſide ST produced ſhall not fall on any part of the covert-way, but be 10 or 12 fathoms diſtant from the moſt ſaliant parts. Terminate this ſide in T, and there make alſo a new angle STI, whoſe ſide TI ſhould terminate at the point I, where it meets the firſt parallel. Perform the like operation on FH, and it will give you the outline of the trenches as far as the firſt parallel.

At this part of the trenches you may make a greater number of turnings; you may likewiſe carry it in a direct line to the firſt parallel. The moſt important article is, to take care not to let it be enfiladed from any part of the covert-way; and the fewer angles and turnings it makes, the quicker it is conſtructed, which in transferring it to the ground is worthy of great attention. Take care alſo, that its extremity I, do not fall far from the point where the produced capital of the baſtion meets the firſt parallel.

By the ſame method trace the trenches between the firſt and ſecond parallel, as may be ſeen in the figure; but as this part is nearer the place than the former, in order to avoid being raked, it muſt have a greater number of angles. All its ſides ought to cut the prolongment of the capital of the baſtion B, as appears by the figure. In like manner trace the trenches betwixt the ſecond and third place of arms, by making as frequent turnings on the produced capital of the baſtion B, as ſhall be neceſſary, in order to its defiling from the covert-way. By the ſame method trace the trenches on the capital of the baſtion A; trace alſo a trench on the produced capital of the half-moon, between the ſecond and third parallel, to reach the flanked angle of its covert-way.

When the garriſon happens to be ſtrong and enterpriſing, it will be proper, between the ſecond and third parallel, to make parts of trenches V, V, &c. parallel to the places of arms; they are to be 30 or 40 fathoms long, and to communicate with the trench, as may be ſeen in the figure. Theſe parts of the parallels are what we have diſtinguiſhed by the name of *half parallels* or *places of arms*. At every angle of the trenches obſerve to produce the part of the trenches in thoſe places, ſo that this prolongation ſhall cover that part of the trenches which it terminates.

This will be illuſtrated by an example.

Let ABCDFGMQ be a part of the trenches, and let AB be one of the ſides oppoſite to the enemy; produce AB, ſo that BE ſhall be five or ſix fathoms; and in FG take alſo five or ſix fathoms from I to L, which will give

Plate DXXXI. fig 1.

the end of the trench BELI, the uſe of which is to cover the *boyau* or branch IOMG, whereby the enemy will not know the place where it falls into the trench AB, and to make room for withdrawing thoſe who are in this part of the trenches, and that the paſſage may be free at all the angles. In like manner produce the ſide GM from M to N, and the ſide IC from O to P, and you will have the end of the trench MNOP, which will cover the branch DCOQ. Do the ſame at all the angles of the trench.

The parapet of the trench being made to cover it, ought to change ſides alternately. If, for inſtance, AE, in the preceding figure, is towards the place, it is evident that the ſide GN will be towards it alſo, and likewiſe the ſide CD; and therefore the parapet of the trench is ſucceſſively conſtructed from the right ſide to the left, and from the left to the right. In the plans of attacks, the ſide of the parapet of the trench, as alſo that of the parallels, are diſtinguiſhed by a ſtronger line than any of the reſt; but the latter admits of no difficulty, becauſe we may eaſily conceive that, being parallel to the place, its parapet muſt neceſſarily be on the ſide that faces it. Care has been likewiſe taken to expreſs, as we have already mentioned in the figure, the parapet of the branches, by a ſtronger line than the other lines of the attacks. The ſide of the trench oppoſite to the parapet is called the *reverſe of the trench*.

The trenches are generally no more than three feet deep; and their parapet, beginning from the bottom of the trench, is ſix feet and a half high, or thereabouts. The parallels have a parapet like the trench, and of the ſame height; but as they are intended for firing over, they are made with a kind of banquette, as may be ſeen Plate DXXXI. fig. 3. to raiſe the ſoldier, to the end that he may fire over the parapet. On the parapet of the places of arms are put baſkets, faſcines, or ſand-bags, ranged in ſuch a manner that the troops may be able to fire without being too much ſeen by the enemy. The third parallel, or place of arms, is generally wider than the reſt. Sometimes the inſide of its parapet is likewiſe made with ſteps or banquettes, to the end that the ſoldiers may conveniently paſs over it in caſe of an attack. See fig. 4.

There will never be any great difficulty in tracing the attacks, from an exact plan, by obſerving the method we have made uſe of to make its parts defile properly. But the difficulty is to transfer the works from the plan to the field; for doing which the following plan has been recommended.

In the firſt place, the engineer muſt from all the angles of the branches of the trench, upon the plan, draw perpendiculars to the produced capitals; obſerving the diſtance of each of theſe perpendiculars and their length. He is then to walk about the place in the day-time, at a ſufficient diſtance to be without the reach of muſket-ſhot. It is not uſual to fire cannon againſt a ſingle man, becauſe the ſhot is very uncertain, eſpecially againſt a perſon who does not ſtand ſtill for any time; therefore, without any great danger, he may only keep himſelf out of muſket-ſhot. It is eaſy to diſcover the flanked angle of the baſtions againſt which he wants to direct the attacks, and the ſaliant angle of the covert-way oppoſite to them; which gives two points, and theſe the direction or the prolongation of the capitals of thoſe baſtions. Conſequently he has only to plant ſome picquets on the direction of theſe points, in order to have the prolongation of the capitals of the baſtions. Theſe picquets can only be put out of the reach of muſket-ſhot; but by day-light he may obſerve ſomething of the ground lying in the direction of theſe picquets, and he may afterwards reconnoitre it in the evening, in order to place picquets there alſo. In this manner he may have the prolongation of the capitals pretty exact.

In order to conduct the trench by theſe capitals, the following method has been pointed out by marſhal Vauban.

Examine upon the plan of the attacks what diſtance there is from the beginning of the trench to the firſt perpendicular; meaſure this perpendicular and the ſide or part of the branch correſponding to it; take cords of equal length with theſe lines, and faſten the extremities of the two cords, one repreſenting the length of the line of direction, and the other that of the branch which makes an angle with it, to a picquet at the point of the produced capital where the trench begins, and make two men walk, each of them holding one end of theſe cords, viz. one in a direct line towards the place, the other alſo advancing towards the place and walking alongſide of the former. When the firſt comes to the fartheſt diſtance betwixt the opening of the trench and the firſt perpendicular, he muſt plant a picquet on this point, to which he is to faſten the cord which expreſſes the perpendicular. He muſt take the other end of this perpendicular, and afterwards turn off to the right or to the left, according to the ſide where the perpendicular ought to be, till the part of the cord expreſſing the perpendicular is well ſtretched, and joined to that end of the cord of the trench carried by the other man: at their meeting they are to plant a picquet, by means of which the triangle, thus tranſferred to the ground, will be like that which was taken upon the plan; and this part will be traced on the ground in the ſame manner as on the plan. In like manner may every part be traced in the beginning, when the trench is yet at a diſtance from the place.

Plate DXXX.

Let the trenches be traced upon the plan (fig. 2.), and let C be the place againſt which you are to direct the attacks, transferring the plan to the ground: let BG be likewiſe equal to the line of direction of the plan; you are to plant along this line a ſufficient number of picquets, with burning matches tied to them, in order to diſcover them the more eaſily.

To begin the tracing of the trenches, tie to the picquet G a cord of the length GS, and to the ſame picquet another cord of the length GX: let there be two men, and each take an end of theſe two cords, and let them walk, the one at a venture towards S, and the other directly to X towards the place along the line of direction BG; and having reached the end of his cord, let him faſten it with a picquet, after having drawn it very ſtraight; and to this picquet let him tie one of the ends of the cord, which is to mark the perpendicular XS. Let him take the other end, and walk towards S till his cord XS is ſtretched very tight, and then let him join the man who holds the end of the cord GS, and let them faſten a picquet in S, where both the cords join. Let them afterwards take away the cord XS, the perpendicular which is of no uſe, and the cord GS which remains will mark the real tracing of the trenches. In order to have the line ST, you come to the picquet X; to which you tie a cord of the length of XY, and another to the picquet S of the length of ST. Let two men, as before, take each an end of theſe two cords, and let them walk, the firſt who holds the end of the cord XY directly towards B, and the other who holds the end of the cord ST obliquely towards T: he who holds the cord XY, having reached Y at the end of his cord, ſhall place a picquet there; to which let him tie the end of the cord of the perpendicular YT, and let him walk towards T, holding the end of this cord, till he meets or joins the man who holds the end of the cord ST; and at the point T of their meeting let them place a picquet, to which let them tie the end T of the cord ST.

After this take away the cord of the perpendicular, and thus continue the ſame operation as long as you pleaſe, or are able, in order to trace all the other turnings or windings of the trenches.

Plate DXXXI.

This whole operation ſuppoſeth that you know exactly the diſtance of the point G, the extremity of the line of direction to the top E of the ſaliant angle of the covert-way. This diſtance may be found by the common rules of trigonometry, or by the following ſimple method pointed out by marſhal Vauban: Let A (fig. 5.) be the vertex of the ſaliant angle of the covert-way, and AB the line of direction of the trench whoſe length you want to take. At the point B, draw BC perpendicular to AB, to which give what meaſure you pleaſe, as 80 or 100 fathoms, and at the point C draw CD perpendicular to BC: In CD take any point E, and in the line of direction between it and the angle A, place a picquet G, in the line BC. Meaſure GC and CE, and ſay, as GC : BG : : CE : AB.

When once you have found out by this, or ſuch other methods as you may make uſe of, the length of the line of direction EG (Plate DXXX. fig. 2.), you will be always able to know the diſtance that remains to the ſaliant angle of the covert-way, and to the points I, N, P, through which the parallels or places of arms are to paſs. Theſe points being determined, it would be an eaſy matter from geometry to find out a method of deſcribing the parallels that are to paſs through them, if their ſituation admitted the engineers to perform the operation quietly by day-light; but they are to be traced in the dark, and under the fire of the place: ſo that there is no other way to trace them than by approximation, that is, to move as nearly parallel to the circuit of the place as you can by your judgment; and to plant picquets, with cords tied to them at proper intervals, the whole length of the line. But you can trace with cords only the firſt parallel; for the others are too near the place to permit you to perform this operation: you are therefore to proceed in tracing them almoſt in the ſame manner, as we ſhall obſerve when ſpeaking of the ſap, to which they belong, and which is carried on by that method.

§ 6. *Obſervations on the propereſt Part for making the Attacks.*

While the lines are perfecting, the neceſſary materials are to be got ready for the conſtruction and operations of the attacks. The materials conſiſt of faſcines, picquets three feet long, and about an inch or two in diameter, gabions, and picquets for gabions. There muſt likewiſe be a proviſion of the ſeveral inſtruments or tools neceſſary for theſe operations.

The engineer, who has the direction of the ſiege, will likewiſe make uſe of this time to examine into the parts moſt convenient for carrying on the attacks, and where they will be moſt ſimple and expeditious. There are few fortreſſes in Europe, of which plans are not to be had; but as it is preſumed that the enemy hath increaſed the fortifications of a town which is threatened with a ſiege, care ſhould be taken to get intelligence thereof from ſome ſkilful perſon that has been in the place, and made all the obſervations poſſible in regard to the works lately raiſed, without giving any ſuſpicion of his intentions. The danger of ſuch an undertaking is very well known, ſo that the perſon employed cannot be too cautious in keeping himſelf concealed.

While the circumvallation is making, the engineers may at a diſtance, or, as we have already obſerved, out of muſket-ſhot, examine ſome part of the out-works; and afterwards, from the report of the perſon ſent into the place, and from what they know themſelves, they may ſettle with the general the propereſt and fitteſt place for carrying on the attacks. On this occaſion there are many things to be obſerved, as well with regard to the ground as to the fortifications; but in a work of this nature, it is ſufficient to conſider the points of moſt importance.

Firſt of all, the nature of the ground about the place muſt be well obſerved, Whether there are any ditches or hollow ways, that may ſerve as a cover to guards of horſe and foot againſt the cannon of the place; whether there are any parts that command the town, and may ſerve for the erecting of batteries; and whether the ground is fit for the works. The moſt favourable circumſtance is to find a ſoil eaſy to dig; then the works advance with eaſe and leſs loſs, becauſe the ſoldier is ſoon under cover, and the cannon does not do half the miſchief as in ſtony places. If the ground about the place is a pure rock, or a moraſs, the operations are extremely difficult; and there will be occaſion for a vaſt quantity of faſcines, ſand-bags, wool-packs, &c. becauſe the workmen are in much greater danger.

The rivers which run through the town, or in the neighbourhood, likewiſe deſerve conſideration; for they ſeparate the attacks, and it may happen by ſome ſtoppage of the water, or other accident, that the bridges of communication being broke down, the ſeparation of the attacks will expoſe the army of the beſiegers to be defeated, by which means the place may be relieved. It is proper alſo to inquire, whether thoſe rivers are not ſubject to inundations, which, if they were to happen during the ſiege, and to break in upon the attacks, would oblige the beſiegers to abandon the trenches, and to raiſe the ſiege. In a word, whether the town can command any quantity of water ſo as to make an inundation round the place, and to lay the ground appointed for the attacks under water. All theſe points, and a great many others which we do not mention, deſerve the moſt ſerious attention.

After chooſing the propereſt ground for the attacks, a general is to conſider the front which is leaſt fortified and leaſt covered with outworks. All other things being the ſame, it is evident, that the fewer outworks there are, the eaſier will be the attack. But if the place be ſituated in a moraſs, or upon an eminence, then he muſt neceſſarily make his attack on the acceſſible ſide, be its outworks what they will. In a word, the whole choice of the attacks conſiſts in finding out the propereſt ground, and the weakeſt ſide; but as it is to be preſumed that the enemy are acquainted with the nature of the ground about the place, and therefore have taken care to fortify more exactly thoſe parts which are moſt favourable to an attack, the beſiegers ſhould not heſitate to make their approaches on that ſide; where, by the ſituation of the ground, they may gain, what the increaſe of the fortifications might otherwiſe make them loſe.

§ 7. *Of opening the Trenches.*

Every thing being ready for opening the trenches, the ground pitched upon, the attacks ſettled and drawn upon a plan, and ſtores or magazines of all the materials neceſſary on the occaſion being within reach of the place where the pioneers propoſe to work; the general having alſo ſettled the round of duty for the guard of the trenches, both of horſe and foot, as likewiſe the number of horſe for bringing the faſcines, with the number of pioneers and troops to ſupport them: and the chief director of the engineers having acquainted the reſt of the corps with his plan of attack, and the manner they are to act; in a word, every thing being ready for execution, the troops deſigned for the ſervice of the firſt night being prepared and drawn up in battalia at the place of rendezvous, and the pioneers provided with faſcines, picquets, ſhovels, and pick-axes;—in the duſk of the evening they all begin to advance, every ſoldier being obliged to carry a faſcine, together with his arms, in order to reach the place deſigned for opening the trenches. The guard of horſe march at the ſame time to their aſſigned poſts, to the right and left of the attacks, ready to ſupport the troops for the guard of the trenches in caſe of any ſally from the enemy. All this is to be done with the greateſt ſilence poſſible, and nothing ſhould be neglected to conceal the deſign from the enemy.

The pioneers are, according to marſhal Vauban, divided into brigades of 50 men each, commanded by a captain, a lieutenant, and two ſergeants. They advance four or ſix abreaſt, near the place where the trenches are to be opened; after which the reſt of the troops that are to ſupport them, being come up, the engineers charged with the tracing of the trenches, and who are to place the pioneers, make them come forward where the opening is to commence, while the battalions that ſupport them are drawn up to the right and left in the places aſſigned them, where they unload the faſcines, and ſilently wait for further orders. In the meanwhile the engineers trace the branches of the trenches, and the firſt parallel in the manner already deſcribed, and the work is advanced as faſt as poſſible.

As much work is undertaken as the pioneers can be expected to perform this firſt night: and in proportion as the tracing goes on, the engineers place the pioneers, making them file off one by one, each carrying his faſcine under the right arm if the place is on the right, or under the left if it is on the left, to the end that by the poſition of their faſcines, which they lay on the ground along the tracing, and on the ſame ſide as they carry them, they may be enabled to diſtinguiſh the ſide of the place, that is, the ſide towards which they ought to throw up the ground in order to cover the trench from the fire of the town. As faſt as they are placed, they are ordered ſilence, and made to lie down with their faces on the faſcines, and not to begin to work till commanded. The whole operation begins at the ſame time, that they may advance equally. When every thing is ready, and the pioneers are all placed along the tracing which is purpoſed to be made this firſt night, orders are again given for them to work; and then they all ſet about it with all the diligence poſſible till day-light, that they may be covered againſt the fire of the place, which is ſtill very dangerous in the morning, conſidering that the trench has not had time as yet to be rendered ſo perfect as it ought. The troops that are to ſupport the pioneers are put under cover on the back of that part of the trench which is finiſhed; that is, on the border of the trench oppoſite to that on which its parapet is raiſed; they are made to lie on their faces; after which the pioneers, who have been upon duty in the night, begin to file off, and others fill up their places. It is very difficult this firſt day to render the trench as complete as it ſhould be; but no pains are ſpared to make it as complete as poſſible.

As the deſign cannot be now concealed from the enemy, the guard mounts the next day with drums beating about noon; and care is taken to continue the work of the trenches the ſecond night, in the ſame manner as the firſt, that is, by placing the pioneers uncovered, becauſe they are at ſuch a diſtance from the town, that the fire is not yet dangerous enough to require their being placed otherwiſe: the work goes on quicker in this manner; but it muſt neceſſarily be altered as ſoon as the workmen come within muſket-ſhot of the place.

The firſt night is the beſt adapted for advancing the works of the trenches, becauſe of the diſtance from the place, which is too great to apprehend any danger from the enemy's fire. Sometimes it happens ſo, that the enemy is not appriſed of theſe works; eſpecially when all the neceſſary precautions have been taken to conceal them, and in that caſe the buſineſs is done in a manner without loſs or danger. It is of importance to advance them with ſuch expedition, that they may be fit to receive the troops who are to ſupport the pioneers, in order to cover them againſt the fire of the place; and as the firſt parallel is deſigned for this purpoſe, therefore it cannot be perfected too ſoon.

According to marſhal Vauban, the firſt place of arms, though begun the firſt night, has need of a ſecond and a third, before it can be completely finiſhed and in condition to hold the troops that are to guard the trenches; but the work for perfecting this line will not hinder the beſiegers from advancing to the ſecond parallel, which ought not to be begun till the fourth night. It is to be obſerved, that the guard who mount the trenches are changed every day; they mount about noon, and they are to be as ſtrong as ſhall be requiſite for oppoſing the ſallies which the garriſon of the place may make againſt the workmen. They are generally equal to two-thirds of the garriſon, becauſe the enemy may fall upon the trenches with that number, reſerving the other third to guard the town. But as it is poſſible that the beſieged may think proper to ſally forth with their whole force and fall upon the workmen, together with the troops that ſupport them; therefore, in order to guard againſt every accident of that ſort, the troops in the trenches ought to be nearly equal to thoſe of the place, eſpecially in ſmall towns, where a few are ſufficient to guard the poſts, or where the burghers are ſo well attached to the prince, that the commandant may depend upon their fidelity in guarding the town; becauſe in that caſe he may make a general effort with his whole garriſon againſt the troops in the trenches.

We have obſerved, that the ſecond night the pioneers may ſtill be placed uncovered; but the third it would be very dangerous to do it, becauſe of the enemy's fire being too near. When the engineers are of this opinion, they take care not to expoſe the men any longer uncovered, and then the works are carried on by ſap.

§ 8. *Of the Sap.*

LET ABC be the part of the trenches advanced to A, ſo near the town as to render it impoſſible, without evident danger, to work any longer at the approaches, unleſs the men have ſome cover againſt the fire of the place: and let the branch AD be traced by the engineer, not with a cord, as at the opening of the trenches, but with ſome picquets, which he has taken care to place in the direction this branch ought to have, to ſerve as a guide to the workmen. A cut is made in the parapet BA of the trenches; and then the men deſigned to work by ſap, who are therefore called ſappers, will move forward through the opening A, ſucceſſively eight in number. The firſt is to roll before him a mantlet to cover him againſt muſket-ſhot. He advances as far as is neceſſary to place a gabion on the line AD; and this gabion being ſet on its baſe, in the proper ſituation, with the picquets uppermoſt, the ſapper makes a little trench behind, about ſix inches diſtant from the gabion, of a foot and a half in depth, and as many in breadth, and he empties the earth of this ditch into the gabion. This done, he places a ſecond gabion near the firſt, in the ſame manner, and always under the cover of his mantlet; in like manner he makes a ditch behind, the earth of which ſerves to fill his gabion. Thus he places a certain number, till he grows tired of the operation.

The ſecond ſapper, who immediately follows him, widens the ditch made by the former by ſix inches; on the oppoſite ſide to where the gabions are placed, and makes it half a foot deeper. The earth he digs up ſerves to fill the gabions of the firſt ſapper. The third ſapper widens the ditch of the two firſt likewiſe half a foot, and he deepens it in the ſame proportion.

At length the fourth enlarges it alſo in the ſame proportion, in breadth and depth; and then the trench is three feet wide, and the ſame in depth, which is as much as it ought to be. The earth dug up on this occaſion is ſufficient, not only to fill the gabions placed by the ſappers, but likewiſe to make a parapet of the reſt, which is thrown up, and is ſtrong enough to reſiſt muſket-ſhot. The third and fourth ſapper lay the faſcines over the gabions, with their hooks, or otherwiſe; then they preſs them down, ſo that the ſtakes of the gabions ſhall keep them firm. As the ſappers are ranged by brigades of eight each, while the firſt four are working at the ſap, in the manner above deſcribed, the other four furniſh them with gabions, faſcines, and whatever other things they want. But when the firſt four are tired, the four laſt take their places, and work in the ſame manner; after which they are relieved by the firſt, and ſo alternately, till each has performed his part at the head of the ſap.

When the firſt gabions are placed, and the ſap is not as yet perfected, the part in which the gabions touch one another being leſs ſolid than the reſt, their joints are filled up by ſand-bags, which are taken away when the work is completed, or thoſe interſtices are filled up with ſmall faſcines called *ſap-faggots*.

This is the nature of the ſap; a work ſo much the more conſiderable, as it is performed by day as well as night. Several ſaps are carried on at the ſame time; and there is one to both ſides of each of the attacks for the ſecond and third parallel. There are likewiſe ſaps to each of the advanced parts, and to the half places of arms or parallels.

We have ſuppoſed that the firſt ſapper covered himſelf with a mantlet; this was the cuſtom formerly, and an excellent cuſtom; but now it is more uſual to have a ſtuffed gabion. He rolls this gabion before him, and uſes it in the ſame manner as he would the mantlet. Though care be taken to give a ſtuffed gabion to the directors of the ſaps, yet it happens ſometimes that the ſappers will not make uſe of them: for as the weight of this gabion renders it ſometimes troubleſome to roll, they chooſe to do without it; and are ſatisfied with rolling ſeveral gabions before them, near one another, and with working behind them. Theſe gabions are indeed of little defence, but are ſufficient to conceal them from the enemy, who cannot tell the gabion behind which the firſt ſapper is. But as the preſervation of theſe men is of great importance, they ought to be obliged to work behind the ſtuffed gabion: for the ſame reaſon, the firſt ſappers ſhould have a cuiraſs, and even a head-piece, muſket-proof.

There are three ſorts of ſap; the ſimple, viz. that which we have been deſcribing, the double, and the flying ſap.

1. The ſimple ſap, or the ſap without any other appellation, is made on one ſide, or, which is the ſame thing, has only one parapet. 2. The double ſap has a parapet on each ſide, and is carried on wherever its two ſides are ſeen from the place. 3. The flying ſap is that in which they do not give themſelves the trouble of filling the gabions with earth; it is made where the workmen are not much expoſed, and in order to accelerate the approaches.

As ſoon as the men have brought the ſap to its proper perfection, the pioneers are ordered forward, and theſe make it of the ſame width as the other parts of the trenches; upon which it changes its name of ſap to that of trench. It is called a *trench*, if it ſerves as a way to the town; and a place of arms, if it be parallel to it, and deſigned to lodge troops. See Plate DXXXI. fig. 7, 8. DXXXII. fig. 1. 2. See alſo the upper compartment of Plate DXXVIII. for figures of the different inſtruments uſed in this and other operations of a ſiege.

§ 9. *Of Batteries.*

Cannon is made uſe of at a ſiege for two different purpoſes; the firſt to drive away the enemy from their defences, and the ſecond to diſmount their guns.

To produce theſe two effects, the batteries ſhould not be above the mean reach of cannon ſhot from the place; that is, above 300 fathoms. Therefore there is no poſſibility of conſtructing them till the firſt parallel is formed; and as the diſtance of this firſt parallel from the place is generally 300 fathoms, the batteries muſt be on this line, or beyond it, nearer the town. They muſt always be placed, when the ground will permit, on the produced faces of the works attacked, as we have mentioned in the maxims of attack.

Plate DXXXII. fig. 3.

Let Z be the centre of the place attacked, and the trenches, as well as the parallels, completed. To find a proper poſition for erecting batteries, produce the faces AD, AC, BE, BF of the two baſtions attacked, till their prolongation cuts the firſt parallel. Produce alſo the two faces OM and OL of the half-moon MOL of the front attacked, and the faces HG and IK of the two collateral half-moons 1 and 2, to the firſt parallel, and erect batteries on theſe produced faces, as you ſee in P, Q, R, S, T, U, X, and Y.

They are advanced beyond the firſt parallel 40 or 50 fathoms; and are parted from the trenches, to the end that they may be uſed with greater eaſe and convenience, and leſs trouble to the workmen.

§ 10. *Of Sallies.*

That we might not interrupt the making of the trenches, we conducted them to the foot of the glacis, without taking notice of ſallies; that is, attacks which the garriſon may make againſt the trenches, with a view of ruining or retarding the works. As it is not to be preſumed that the enemy will ſuffer themſelves to be ſtraitened in the town without uſing ſome endeavours to prolong the ſiege, and as ſallies ſeem to be one of the principal means they can employ, it is proper to point out the conduct to be obſerved, not only for preventing their effects, but likewiſe for rendering them diſadvantageous to the enemy.

Sallies can be attended with no ſucceſs, unleſs they are made at a time when unexpected. When the workmen are ſuddenly fallen upon, they are ſcattered, and obliged to fly; which muſt occaſion confuſion and diſorder among the troops that are to ſupport them; and it requires ſome time before they can be brought again to order, and made to charge the enemy. In the mean while the latter avail themſelves of the opportunity to fill up the trenches, and to do all the miſchief poſſible, but when the troops are upon their guard againſt every deſign of the enemy, if the latter ſtir out of the place, they are ſuffered to advance; and care is taken to cut off their retreat, by means of the cavalry and the picquet, in caſe they ſhould advance too far into the field: otherwiſe they are fired at from the places of arms, and other works within reach; and then they are briſkly attacked by the grenadiers and the troops upon duty in the trenches. Care, however, muſt be taken not to purſue them too far, for fear of the fire of the place, which never fails to be extremely ſharp when the enemy have got back to the covert-way.

In proportion as the works advance towards the town, ſallies become more dangerous to the beſiegers, becauſe the enemy may fall upon the trenches more readily; for which reaſon, double care ſhould be taken to ſtraiten them more cloſely, and to prevent their ſallying out with impunity. As the works carried on beyond the ſecond parallel are more expoſed than the reſt, becauſe of their proximity to the covert-way, no part ſhould be advanced without being well ſupported. Hence, as we have already taken notice, half-places of arms are formed, in order to ſupport the head of the trenches, till they reach the third place of arms; which muſt be ſet about with the greateſt care and expedition poſſible. When this is done in the manner it ought, there will hardly be any farther danger from the ſallies.

Sallies are ſeldom made in the day-time but by a preſumptuous enemy, who imagine they may ſafely attack and deſy the troops on duty in the trenches: but they are eaſily repulſed, unleſs the beſiegers are ſo weak as not to be able to furniſh a ſufficient guard for the trenches; in which caſe they ought not to continue the ſiege, leſt they run a riſk of being at length entirely defeated.

At the opening of the trenches, and when the beſiegers are at a good diſtance from the place, there is little occaſion to be afraid of any ſallies in the day; for there would be full time enough to prepare to receive them before they reached the works. If the enemy are diſpoſed then to iſſue forth, they will do it by night; but it will be an eaſy matter to get intelligence of any attempt they may make, by ordering parties of 10 or 12 men, headed by a ſerjeant, to range in the night between the trenches and the town.

Theſe men may lie on their faces as near the place as poſſible; remaining in profound ſilence till they hear or perceive ſome motion in the covert-way; then they ſhould ſend one of their own body immediately to acquaint the lieutenant-general who that day commands the trenches, and the reſt ſhould continue there as long as they can be concealed, to ſee which way the enemy direct their courſe. This caution is not only ſimple and eaſy, but ſufficient to guard the beſiegers againſt ſurpriſe, and to enable them to give a warm reception to the enemy.

When the works are advanced pretty near to the place, for inſtance, to the third parallel, if the enemy ſhould then ſally out and fall upon the workmen, the latter muſt be ordered to retire quickly to the back of the third place of arms, and let the guard fire briſkly upon them, without minding the overturning of a dozen or two of gabions; for the galling fire of the ſmall arms, to which the enemy are expoſed during this expedition, will make them pay dearly for what little diſorder they occaſion.

§ 11. *Of the Lodgments on the Glacis, and the taking of the Covert-way.*

We left the works at the foot of the glacis, and at the third parallel; our buſineſs is now to make a lodgment there, and to go on with them till we have driven the enemy from the covert-way.

Our being then ſo near the covert-way, renders it impoſſible to defile from it; but in order to prevent the effect of enfilading, it is neceſſary to make the trenches much deeper in the glacis; the fire of the covert-way being very near, cannot plunge into thoſe deep trenches, which renders it leſs dangerous to abide there than it would otherwiſe be were it not for this precaution: or they are made with traverſe, much in the ſame manner as in the covert-way, by which means the enfilading will be prevented in part, though not entirely.

In regard to the figure of the lodgment on the glacis, it varies according to the different circumſtances or poſition of the works by which it is defended. The common way is to make ſeveral ſhort turnings or zig-zags upon the ridge of the glacis, in the direction of the ſaliant angle of the covert-way, and continued to this angle; or you begin with making two or three ſhort turnings towards the foot of the glacis, from whence you aſcend afterwards by a direct trench, or ſap, in the following manner.

Two ſappers roll each a mantlet, or ſtuffed gabion, before them on the ridge of the glacis; each making a ſap, one on one ſide of the ridge, and the other on the other. The ditch is dug deeper than uſual, in order to cover them the better againſt the fire of the place. This work, which advances on both ſides at the ſame time, and both ſides covered, each with a parapet, is what we called a *double ſap.* In the middle they make traverſes three fathoms thick, and of the ſame breadth as the trench. On each ſide ſmall paſſages are made like thoſe over againſt the traverſe of the covert-way, to the end that the communication thereof be not interrupted.

Theſe traverſes are conſtructed ſo near to each other, as to be a ſufficient cover, by their elevation and diſtance, againſt the fire of the place. In order to guard againſt the effect of the grenades, upon coming within their reach, that is, within 14 or 15 fathoms of the covert-way, care is then taken to cover this trench with blinds, or, which is the ſame thing, to cover the upper part of it. The firſt and ſecond figures of Plate DXXXIII. will ſhow this direct trench. The firſt exhibits the plan, and the ſecond the profile, which paſſes over one of the traverſes.

All this being done, and the third parallel finiſhed in the manner we ſuppoſed, they advance from this parallel upon the glacis to each of the ſaliant angles of the covert-way of the front attacked, and they begin with making two or three ſhort turnings, as marked on Plate DXXXIII. fig. 6. along the ridge of the glacis, ſo as to occupy about one-third thereof. Theſe are to be made as deep as neceſſary, to be a ſhelter againſt the fire of the covert-way; afterwards they may proceed directly along the ridge of the glacis, by a deep ditch, to the ſaliant angle of the covert-way. M. Vauban obſerves, that if we follow directly the ridge of the glacis, this trench is made without much danger: for the paliſade which is placed at the ſaliant angle of the covert-way, and the other two next it, do not preſent directly to the ridge, but only oppoſite to the faces; where at the moſt there is only room for one or two fuſileers to ſee the head of the trenches, and who are eaſily ſilenced by the fire of the third parallel, which ought to be well ſerved, and likewiſe by that of the ricochet.

Upon coming to the middle, or two-thirds of the glacis, two new ſaps are made, *b b, ibid.* which embrace both ſides of the covert-way, to which they are almoſt parallel. Their length is 18 or 20 fathoms, and about five in breadth. They are covered at the end with crochets and winding traverſes, which prevent the fire of the covert-way from enfilading them eaſily.

The parapet of theſe ſaps is raiſed about eight or nine feet above the glacis; and by means of gabions, three banquettes are made, as may be ſeen Plate DXXXIV. fig. 5. The ſoldier placed on the upper banquette is thereby raiſed high enough to plunge into the covert-way, as appears from the ſame figure. When this work, which Marſhal Vauban calls the *cavalier of the trench,* is once finiſhed, it is very difficult for the enemy to remain anywhere in the covert-way; for they would be too much expoſed to the fire of the ſoldiers placed on theſe cavaliers. But theſe places of arms or cavaliers cannot be made without being protected by the ricochet batteries, which enfilade the covert-way.

Theſe cavaliers being once finiſhed, it is eaſy to carry on the direct trench, as far as the ſaliant angle of the covert-way, and to eſtabliſh at the point of this angle and on the head of the glacis a ſmall lodgment bounded by a circular arc; whence the enemy may be entirely driven from the ſaliant place of arms of the covert-way. Afterwards this lodgment may be widened on branches of the covert-way, by digging into the upper part of the glacis, at the diſtance of three fathoms from the inner ſide of the covert-way; to the end that this thickneſs may ſerve as a parapet to the lodgment, and ſcreen it from the cannon.

The operation we have been deſcribing, to reach from the third parallel to the ſaliant angle of the covert-way, is formed at the ſame time againſt all the ſaliant angles of the front attacked: hence the enemy is obliged to abandon them almoſt at the ſame time; and the lodgment on the glacis is afterwards advanced on both ſides of theſe angles, towards the re-entering places of arms of the covert-way.

As it is impoſſible to make this lodgment defile from the works of the place, there is no other way to guard againſt the enemy's fire than by many traverſes. The 5th figure of Plate DXXXIII. ſhows the plan of part of this lodgment with its traverſes; which are made with chandeliers and gabions. If the enemy, notwithſtanding the cannon and bomb-batteries *à ricochet*, and the fire of the cavaliers of the trenches, ſhould obſtinately continue in the re-entering places of arms of the covert-way; in order to compel them to remove, batteries for throwing of ſtones are raiſed overagainſt thoſe places of arms: and with this view, as ſoon as the lodgment of the glacis is brought within one-half or two-thirds of the branches of the covert-way, on both ſides of the re-entering angle, a ſap is carried on oppoſite to the place of arms; and on this ſap batteries for throwing ſtones are erected, as may be ſeen in *c c*, Plate DXXXIII. fig. 6. Theſe batteries being finiſhed and ready to play, they diſcharge a ſhower of ſtones into the place of arms (fig. 6.), which will not ſuffer the enemy to maintain themſelves there any longer. The lodgment continues to advance; and as ſoon as the enemy is driven from the place of arms, it is continued all round the faces thereof. This lodgment being properly finiſhed, will hinder the enemy from venturing to return to the covert-way; and of courſe will ſecure the poſſeſſion of it to the beſiegers. Theſe lodgments are made with gabions and faſcines; the gabions are filled with earth, faſcines are put over them, and the whole is covered with earth; they ſink into the glacis as deep as is requiſite to be covered againſt the fire of the place.

In the whole of this account we have not made uſe of mines; becauſe we were willing that the deſcription of the works, which are carried on from the third parallel, in order to become maſters of the covert-way, ſhould be as plain as poſſible. This omiſſion we ſhall now ſupply, by making mention of the principal difficulties occaſioned by mines, in endeavouring to drive the enemy from the covert-way.

Without mines the enemy would find it very difficult to retard the works we have been deſcribing; becauſe the ricochet batteries muſt gall them exceſſively, and break up their defences, ſo as to deprive them of all ſhelter: but they may have ſome reſource left in works under ground, where their miners can proceed with more ſafety; while thoſe of the beſiegers, not having the ſame knowledge of the ground, can only grope in the dark; ſo that it is altogether a mere chance if they find out the enemy's galleries, and ſucceed ſo as to deſtroy them. If information is received that the glacis is countermined, there can be no manner of doubt but the enemy will avail themſelves of their countermines, to carry branches forward into the field; and then to avoid, as much as poſſible, the miſchief that may be done by thoſe ſubterraneous fires, in the third parallel ſhafts or pits are ſunk 18 or 20 feet deep, if the ground will permit, in order to get below the galleries of the beſieged: and from thence galleries are carried on towards the covert-way, to meet with thoſe of the enemy, by boring the earth with a long iron needle or augre, to find them out. If they are found underneath, an opening is made down into them, and ſhells are thrown in, to drive away the enemy and to ruin their gallery. If, on the contrary, they are found above them, a ſmall mine muſt be ſprung to break them: but if none of the enemy's galleries can be found, in that caſe branches muſt be carried to the right and left; at the end of which are made ſmall chambers, to ſhake the neighbouring ground, which can hardly miſs deſtroying the galleries and chambers of the beſieged.

Notwithſtanding all the care that can be taken in this caſe, it is not to be preſumed that the mines of the beſieged under the glacis ſhould be rendered abſolutely ineffectual; but as ſoon as any of them are ſprung, workmen are immediately ſent to make a lodgment in the pits. In ſome grounds, the mines of the beſieged may be ſpoiled, by letting in a brook or rivulet into the galleries; for which purpoſe you have only to dig pits in the neighbourhood, and let the water run in. The expedient was made uſe of at the ſiege of Turin in 1706, whereby a great many mines of the beſieged were rendered uſeleſs.

The enemy ſhould have mines placed to hinder the lodgment on the head of the glacis, within four or five fathoms of the paliſades of the covert-way; to the end that in ſpringing them the paliſades may not be hurt, but that they may be under the lodgment which the beſiegers make there. When they have ſprung the mines, they make lodgments in them; and the beſiegers likewiſe on their part ſpring mines, with a view to deſtroy the paliſades; but nothing that is not very general can be ſaid on this ſort of conteſts. They depend on the ſituation of the ground, and upon the capacity and underſtanding of thoſe who attack, and thoſe who defend the place.

Before we made mention of mines, we ſuppoſed, when treating of the lodgment on the top of the glacis, that the fire of the cavaliers of the trenches, together with the cannon and ricochet bomb-batteries, had obliged the enemy to quit the covert-way; but if, notwithſtanding theſe fires, they ſhould obſtinately continue in the places of arms and behind the traverſes, the way to drive them entirely from thence, and to make the lodgment we have been ſpeaking of upon the glacis, is as follows.

Whether the enemy has ſprung a mine near the ſaliant angle of the covert-way, or the beſieged have blown up ſome of the paliſades near it, as ſoon as the mine is ſprung, workmen muſt be ſent to the excavation; where they are to cover themſelves with all poſſible expedition, and afterwards to extend their lodgment in the covert-way on both ſides of its ſaliant angle.

The double trench, or the double ſap on the ridge of the glacis, muſt be made to communicate with this lodgment, in order to be able to ſuſtain it if there ſhould be occaſion, and to communicate with it more ſafely. Particular care muſt be taken to cover the extremities of it, that is, to make traverſes everywhere, in order to be ſheltered from the fire of the other parts of the covert-way, where the enemy ſtill maintain themſelves.

When this lodgment is extended to the firſt traverſes of the covert-way, if the enemy keep their ground behind it, as there can be but few under cover there, conſidering the ſpace they have to occupy, a company of grenadiers muſt make a briſk attack to drive them away: this done, ſome of thoſe grenadiers ſhould endeavour to find out in the part abandoned by the enemy the entrance into the mine, and the Saucisson; and upon finding it, as there is great probability that they will, they are to cut it off, and thereby render the mine uſeleſs. Workmen may be likewiſe ſent into the paſſage round the traverſe, and there make a ſmall lodgment, which will be the ſafeſt that can be contrived when the enemy is ſo very near. After this an entrance is to be dug in the covert-way oppoſite thoſe traverſes, and continued towards the bank of the ditch, under cover of the traverſe; then a ſap is to be made from each of the extremities of this paſſage, that is, near the border of the counterſcarp; which are to be carried along the rounding of the counterſcarp towards the middle, where they are to meet. This lodgment muſt be made very deep, that it may be no hindrance to that on the head of the glacis; and it is to be managed ſo as to leave between it and the border of the ditch a breadth of earth ſufficient to reſiſt the cannon of the flanks and the curtain. This lodgment muſt be alſo covered with blinds, to prevent the effect of the grenades; and it is of great uſe towards an opening into the ditch.

During the whole time that the beſiegers are working upon this lodgment in the interior part of the covert-way, they are to continue the lodgment on the top of the glacis, as far as the re-entering places of arms; from whence the enemy may be driven by ordering a few companies of grenadiers to attack them, ſuppoſing they ſhould be ſo obſtinate as to continue there, notwithſtanding the fire of the ricochet batteries, and of the ſhells and ſtones. As ſoon as the enemy have entirely withdrawn themſelves, a lodgment muſt be made there, as we have already mentioned.

§ 12. *Attack of the Covert-way ſword in hand.*

There is another method of driving the enemy out of the covert-way, more expeditious indeed, but at the ſame time more bloody, more precarious, and infinitely leſs ſkilful. This conſiſts in making a ſudden attack on the whole front of the covert-way, in driving the enemy from thence by main force, and afterwards making good a lodgment.

There may be circumſtances that ſhall abſolutely require this method of attacking the covert-way; as when there is no poſſibility of erecting ricochet batteries to fire at its branches, nor at the faces of the works in the front of the attack; or when it is preſumed that the enemy are not in a condition to withſtand an attack of this ſort; or, in fine, when it is thought expedient to run any hazard in order to be maſters of the covert-way a few days ſooner: on ſuch occaſions it is uſual to take this method of attacking it, which is conducted thus:

When the reſolution is taken to attack the covert-way ſword in hand, the third parallel ſhould be made to advance as near as poſſible to the glacis; and the more forward it is brought, the ſafer the attack. All along this parallel banquettes are to be made, ſtep-faſhion, to the top of its parapet, that the troops deſigned for the attack may paſs over it with eaſe. At the back of this line, and in the very line itſelf, a great quantity of materials, as tools, gabions, faſcines, ſand-bags, &c. muſt be got ready, that nothing may be wanting to make the lodgment with all expedition, after driving the enemy out of the covert-way. A ſtrong party of grenadiers is ordered, and placed along the third parallel, four or ſix deep, and the workmen behind them on the back of this parallel with their tools, gabions, faſcines, &c. Care, moreover, is taken, that all the other parts of the trenches be well furniſhed with troops to ſupport the grenadiers, if there ſhould be occaſion; and to fire at the enemy's defences wherever they appear: the grenadiers muſt alſo be provided with hatchets, to cut down the paliſades of the covert-way.

Plate DXXXI. fig. 4.

The guns and mortars muſt be ordered to be ready to ſupport the attack with their whole fire.

A ſignal is to be agreed on for all the troops that are to commence the attack, to move at the ſame time, and to fall upon the enemy. This ſignal is to conſiſt in firing a certain number of cannon, or a certain number of bombs, and at the laſt cannon-ſhot, or at the laſt bomb, the troops are to move.

The ſignal being given, all the troops of the third parallel are to move at the ſame time, and to paſs quickly over the parapet of the parallel, and to march directly to the covert-way; which they enter either through the ſally-ports or paſſages made by the guns, or elſe the grenadiers cut down the paliſades with their hatchets. As ſoon as they have entered, they charge the enemy vigorouſly; and when they have obliged them to abandon ſome of the angles, the engineers ſet the workmen about making a lodgment on the ridge of the glacis, oppoſite to that part of the covert-way which the enemy have abandoned, and within three fathoms of the inſide of it. This lodgment, as we have obſerved, is made with gabions, which workmen lay on the glacis on the ſide of one another. The joints are covered with ſand-bags, or with ſap-faggots. Theſe gabions are filled with earth and covered with faſcines; and a-top of all you are to throw earth taken out of the glacis, by digging and widening the lodgment; and of this a parapet is raiſed to ſcreen the troops as quick as poſſible from the direct fire of the place, and traverſes are to be made everywhere to prevent the enfilades, as may be ſeen in Plate DXXXIII. fig. 5. While this is doing, the batteries of the trenches are to fire inceſſantly upon the defences of the place, in order to diſturb the enemy, and to abate as much as poſſible the briſkneſs of their fire upon the workmen and the lodgment.

When the troops employed in the attack have driven the enemy from the covert-way, or from their places of arms, they retire behind the lodgment, where they kneel down till it is in a condition to cover them. Sometimes it ſhall happen that the enemy, who was ſuppoſed to have been driven from the covert-way, will return to the charge, and oblige the beſiegers to renew the attack, by overthrowing the lodgment and falling upon the troops unawares. This attack may be renewed ſeveral times, and vigorouſly diſputed, when there happens to be a ſtrong garriſon. In this caſe the beſiegers muſt exert their bravery, and reſolutely encounter every obſtacle raiſed by the enemy.

It muſt be allowed that this manner of attacking is very bloody: for the beſiegers muſt move almoſt the whole breadth of the glacis, uncovered and expoſed to the whole fire of the place. It is indeed in every reſpect ſo inferior to the former, that, according to M. Vauban, it never ſhould be attempted but for the moſt eſſential reaſons. Night is the beſt time for it, becauſe the beſiegers are leſs ſeen from the place, and of courſe the fire of the beſieged is leſs dangerous: yet there are generals who undertake it by day. There is nothing ſettled in regard to this article; they are at liberty to act as they judge moſt proper, according to the circumſtances of time and place.

§ 13. *Of the Batteries on the Covert-way.*

When the enemy are entirely driven out of the covert-way, the next thing to be done is the erecting of batteries, in order to ruin the defences of the place, and to make a breach.

As it is neceſſary for the beſiegers to make themſelves maſters of the half-moon C (Plate DXXXIII. fig. 6.) before they can come to the body of the place, which is flanked or defended by part of the faces of the baſtions A and B oppoſite to its ditch; they muſt begin with erecting batteries on

WAR.

Attack of Fortified Places.

Plate DXXXI.

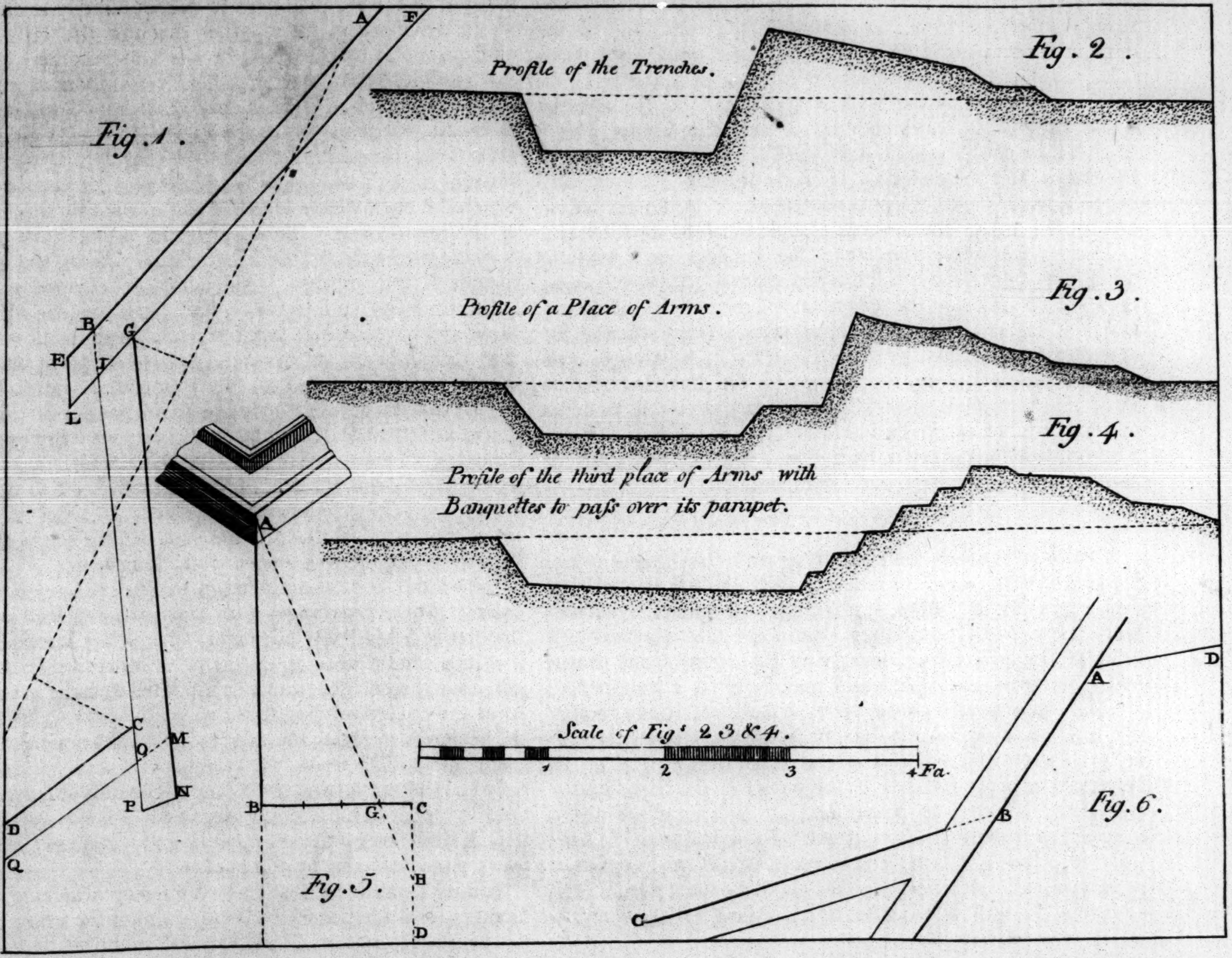


Fig. 1.
A
F
B
G
E
I
L
C
M
O
D
P
N
Q
Fig. 2.
Profile of the Trenches.
Fig. 3.
Profile of a Place of Arms.
Fig. 4.
Profile of the third place of Arms with
Banquettes to paſs over its parapet.
Scale of Figs 2 3 & 4.
1
2
3
4 Fa.
A
B
G
C
H
D
Fig. 5.
A
D
B
C
Fig. 6.

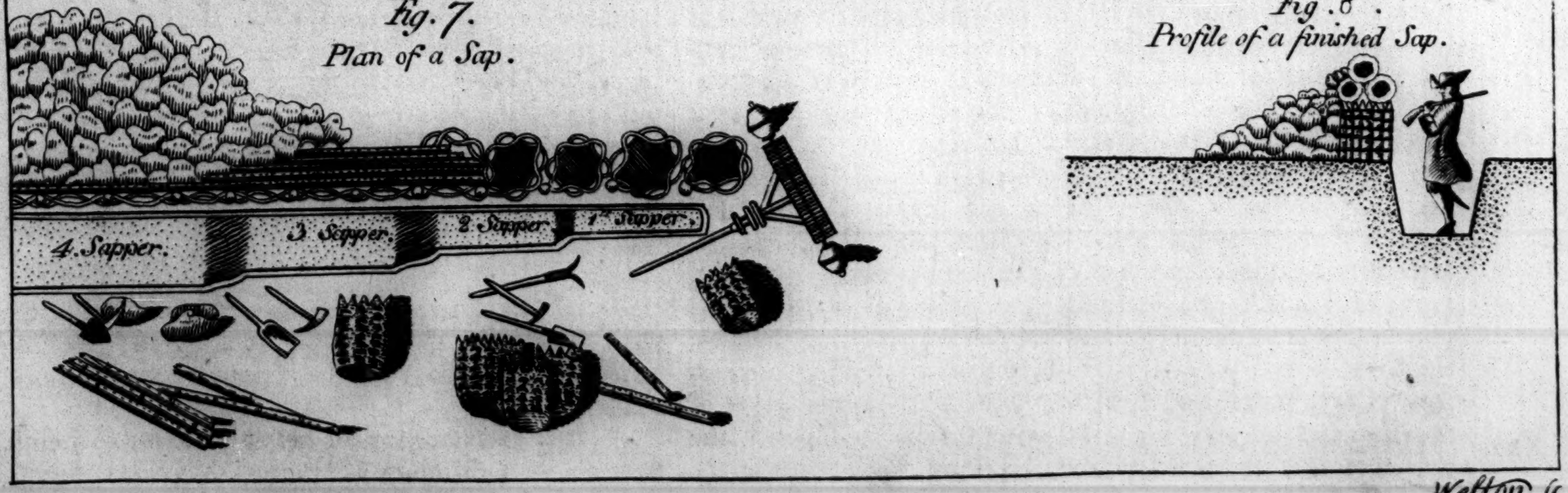


Fig. 7.
Plan of a Sap.
4. Sapper.
3 Sapper.
2 Sapper.
1st Sapper.
Fig. 8.
Profile of a finiſhed Sap.

Weſton sc.

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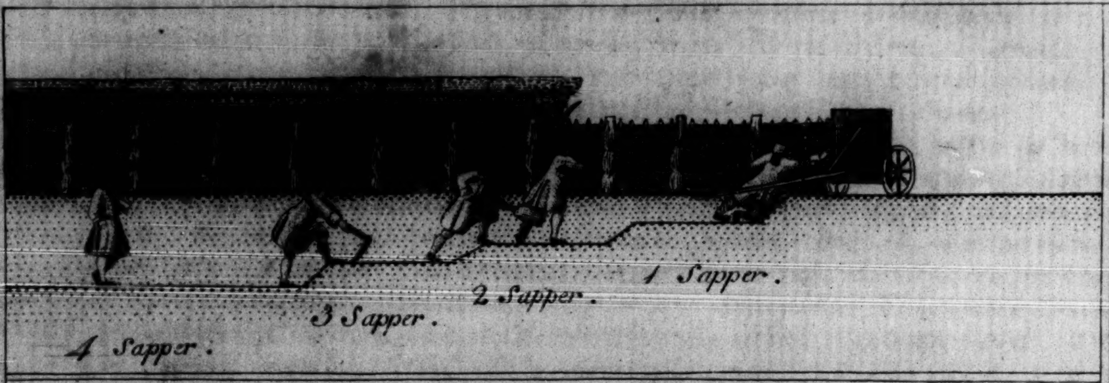
WAR.

Plate DXXXII.

Fig. 1.

Back of a Sap.


1 Sapper.
2 Sapper.
3 Sapper.
4 Sapper.

Front of a Sap.

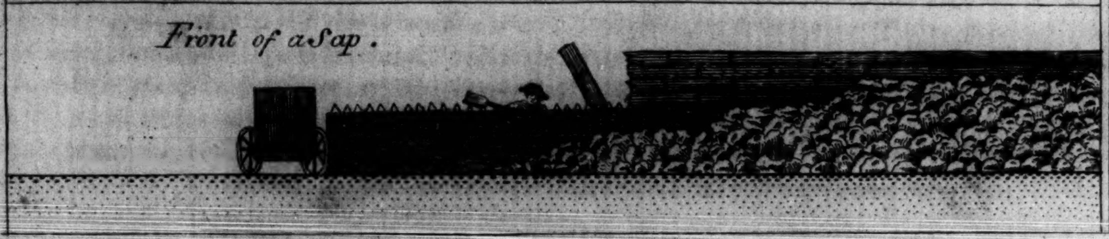


Fig. 2.

Profile representing the excavation of 4 Sappers.

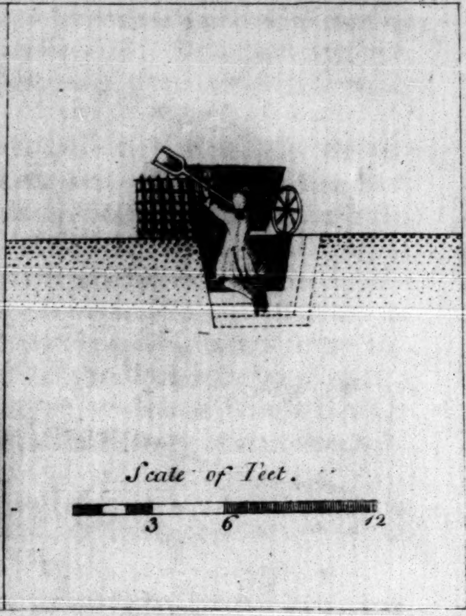
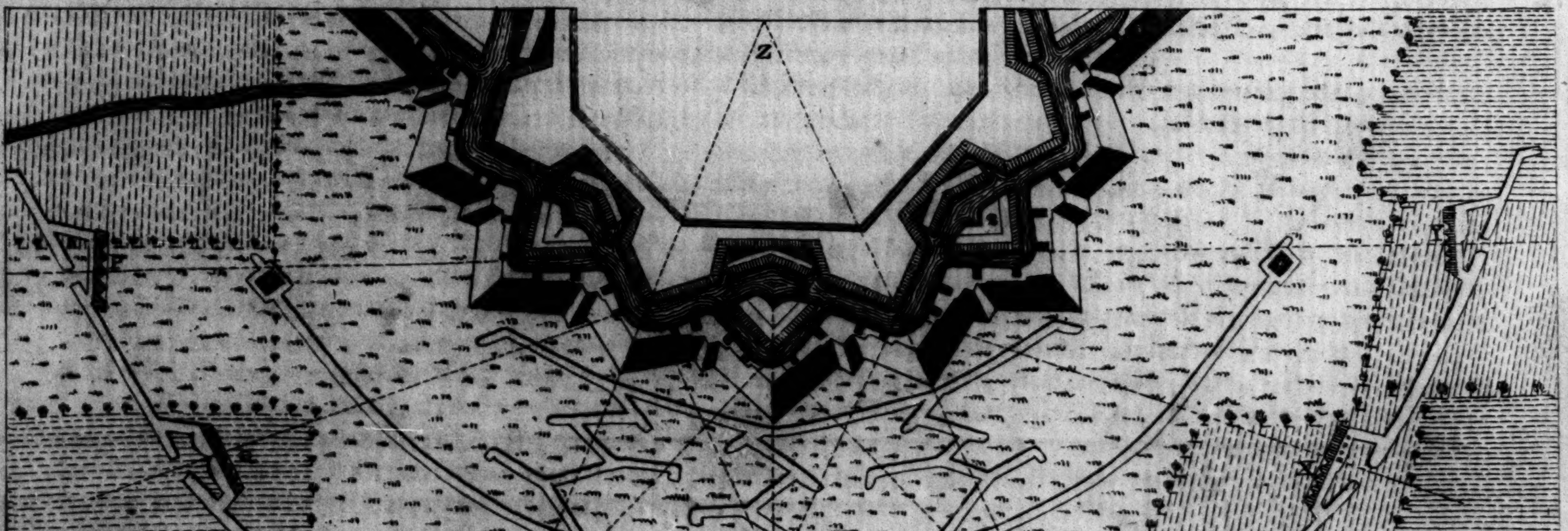

Scale of Feet.
3
6
12

Fig. 3.

Plan shewing the disposition of the Batteries.


Z
I
Scale of Fathoms
30
60
100

Weston Sc.

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on the covert-way oppoſite thoſe parts. They are marked on the plan *e*, *e*. Batteries muſt be alſo erected to make a breach in the half-moon. But before they are erected, it will be proper to conſider what part of the face of the half-moon is to be attacked; or, which is the ſame thing, at what part the half-moon is to be entered. It muſt not be at its flanked angle, becauſe an opening towards the point would not afford a ſufficient ſpace to make a lodgment able to withſtand the enemy, and moreover the troops would be ſeen in their paſſage by the two faces of the baſtions by which its flanked angle is defended. The moſt favourable paſſage is towards the third part of its face, reckoning from its flanked angle; becauſe by battering at the ſame time the two faces near this part, the whole point of the half-moon may be deſtroyed, and a large opening made there eaſier than anywhere elſe. Thus the batteries for making a breach in the half-moon C will be placed in *d* and *d*, and will occupy almoſt the third part of each of the faces of the half-moon from its flanked angle. Theſe batteries are each to conſiſt of four or five pieces of cannon.

When the faces of the baſtions A and B are well enfiladed by the ricochet batteries, there will be no occaſion for the batteries *e* and *e*; for thoſe which are to batter the half-moon in breach will be ſufficient; and after it is taken, if there is any neceſſity for ruining the faces of the baſtions A and B, you may make uſe of the batteries *d* and *d*, by placing them in *e*, *e*. Batteries muſt alſo be erected to ruin the flanks of the demi-baſtions in the front of the attack. It is evident that they cannot be placed but in *i*, *i*, on the covert-way oppoſite to them. They ought alſo to contain as great a number of guns as the ſpace of ground will permit.

For the ſame reaſon that batteries have been erected to make a breach in the half-moon, oppoſite the third part of the face joining to its flanked angle, thoſe alſo are to be erected which are to make a breach in the baſtions; they are marked *h*, *h*, and are each of ſeven or eight pieces of cannon. Batteries are likewiſe erected to ruin the flanks of the demi-baſtions bordering upon thoſe of the front attacked, in order to favour the paſſage over the ditch which is made on the ſide, upon a ſuppoſition that the baſtion is entered at both faces, as we ſuppoſe in this example. The attacking both faces of the baſtion renders the taking of it more certain and eaſy; but, generally ſpeaking, it is looked upon as ſufficient to make only a breach in the face of the earth of the demi-baſtions towards the front attacked.

Beſides all theſe batteries, others are erected in the re-entering places of arms of the covert-way, as in *k*, and in *k*; they ſerve to batter the tenaille when there is one, the curtain, and the faces of the baſtions, &c. Sometimes they are of mortars for throwing of ſtones.

All theſe batteries ſhould have 24 pounders; ſometimes larger pieces are uſed, eſpecially when there is any work of extraordinary ſtrength and ſolidity to be demoliſhed.

They are all to be placed on the parapet of the covert-way; and the outſide of their epaulement is to graze the inſide of the covert-way. It is in order to have room enough for this epaulement, that the lodgment is made on the ridge of the glacis at the diſtance of three fathoms from the inſide of the covert-way.

The only eſſential thing to be obſerved in theſe batteries, is to open their embraſures, ſo that they ſhall perfectly diſcover every part of the place they are to batter, and have a ſufficient ſloping from the back to the fore-part, to fire as low as the bottom of the revetements (c), which they are intended to deſtroy. It is alſo proper to prevent the enemy's blowing them up with mines: for this end it will be requiſite to dig wells deep enough round the batteries, ſo as to be ſure of being lower than the enemy, and to make ſmall galleries round the batteries, in order to diſcover the branches the enemy have underneath to blow them up.

As the conſtruction of this ſort of batteries is very dangerous, being abſolutely to be made under the fire of the rampart of the place, they are ſometimes maſked; that is, before the part where they are erected, ſand-bags or ſome other materials are placed, with a view to ſhelter the workmen from the enemy.

In order to batter in breach, all the guns ſhould fire together, and towards the ſame part. They ſhould fire as low as they can, and continue to batter the ſame part, till the earth of the rampart behind the revetement begins to fall, which is a ſign that the revetement is entirely deſtroyed. This united firing, repeated in this manner againſt the ſame place, is productive of a much better effect than if the guns were to be fired one after the other; for not only a greater quantity of the wall is ſhaken at the ſame time, but, moreover, the ſhaking is far more conſiderable.

§ 14. *Of the deſcent, and paſſage over the Ditch of the Half-moon.*

While the batteries on the covert-way are erecting, preparations are made for the deſcent and paſſage over the ditch of the half-moon.

The ditches are either dry, or filled with water, which may be either ſtagnated, or running; and even into dry ditches the enemy may let in water, only opening the ſluices by which it is withheld. Each of theſe ſorts of ditches requires a different manner of paſſing.

Firſt of all, if the ditch be dry, and very deep, as from 25 to 30 feet, the deſcent may be made by one or ſeveral ſubterraneous galleries, paſſing under the covert-way, and terminating at the bottom of the ditch: the entrance is to begin about the middle of the glacis. Theſe galleries are made like thoſe of miners, and the earth is ſupported by boards and timber frames. They are directed in ſuch a manner, that the opening in the ditch ſhall be oppoſite to that part of the breach where the paſſage is intended.

As this gallery is made ſloping, the buſineſs is to have ſome rule for directing the ſlope, ſo as to prevent its being too ſmall or too great: too ſmall, if it terminated above the bottom of the ditch; and too great, if it terminated below it.

The following is a moſt ſimple way to find it out: Firſt of all, it is requiſite to take the depth of the ditch; which is done by letting fall a plummet, with a ſtring tied to it, from the border of the covert-way to the bottom of the ditch. It is requiſite alſo to know the diſtance from the entrance of the gallery to the border of the covert-way, which may be eaſily meaſured thus: Suppoſe the depth of the ditch is 30 feet, and that the diſtance from the entrance of the gallery to the border of the ditch is 90 feet, then by advancing ſix feet towards the counterſcarp, the ſlope muſt ſink two; that is, there muſt be always the ſame proportion between the length of the paſſage made to approach the counterſcarp and the depth of the ſlope, as between the diſtance from the entrance of the gallery to the border of the

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(c) The revetement is a ſtrong wall built on the outſide of the rampart and parapet, to ſupport the earth, and prevent it from rolling into the ditch.

the counterſcarp and the depth of the ditch: ſo that if the diſtance from the entrance of the gallery to the border of the counterſcarp is four times as much as the depth of the ditch; then for every four feet advanced horizontally towards the ditch, there muſt be one ſunk perpendicularly, &c. When the ditch is not deep, as of 12 or 15 feet deep, inſtead of a gallery under ground, the deſcent is made by a ſap only, which cuts the parapet of the covert-way, and ſinks therein as deep as is neceſſary for the deſcent to terminate at the bottom of the ditch. This ſap muſt begin at the lodgment on the ridge of the glacis; it is ſecured on both ſides with blinds, to ſupport the earth, and it muſt have a good epaulement on the ſide expoſed to the place. Above it is covered with faſcines and with earth, to avoid the ſhell-ſtones and grenades that may be thrown in by the enemy. Upon advancing to the foot of the counterſcarp, an entrance is made into the ditch. There are generally two or three deſcents made for the ſame paſſage of the ditch, near enough to ſupport each other for greater ſafety.

It is in the paſſage of the dry ditch that the enemy has the advantage in making uſe of various artifices to retard it. In theſe they are chiefly aſſiſted by their miners, who blow up the ſaps by means of ſmall mines, and ſally out at the ſame time, neglecting nothing that can delay the progreſs of the work. They may likewiſe order 12 ſoldiers to fall at once upon the head of the ſap: this number is ſufficient to drive away the ſappers, and to do ſome damage to that work. A few companies of grenadiers ſhould be placed near at hand, to attack theſe men as ſoon as they appear; and the cannon muſt be kept continually firing againſt every part, from whence the enemy may poſſibly ſally out. As the batteries of the covert-way command all their communications, they may deſtroy them, or at leaſt render them very dangerous.

In order to protect the ſap at the bottom of the ditch, the beſiegers may likewiſe make uſe of a kind of ſmall galleries behind the counterſcarp, near the place where the entrance is effected; and they may pierce ſome loop-holes, from whence the enemy may be fired at, and a check put to their ſallies, at leaſt by day: and in regard to night, the beſieged ought to be more circumſpect than by day, ſince they can neither ſee the diſpoſitions nor the troops that are ordered into the ditch to ſupport the ſappers; ſo that they can only raiſe a falſe alarm, without doing any great miſchief. Yet we muſt obſerve, that this paſſage can be made only ſo far as it is protected by the battery placed on the ridge of the parapet of the covert-way oppoſite the ditch: for as the cannon of this battery keeps continually playing againſt the defences of this ditch, they muſt ruin them of courſe, and deſtroy their parapet, ſo that the enemy ſhall no longer be able to keep any cannon there; the conſequence of which will be, that the beſiegers have only to ſcreen themſelves from muſket-ſhot, which is an eaſy matter.

The paſſage of the ditch is made on each ſide of the faces of the half-moon, as may be ſeen in *m, m*, fig. 6. Plate DXXXIII.

If the ditch is full of ſtanding water, and the ſurface of it be raiſed to three, four, or five feet, below the upper border of the counterſcarp, the deſcent will be eaſier; becauſe as the ſteps are to have but a very ſmall ſlope, they may begin nearer the border of the ditch, as in the lodgment on the ridge of the glacis, and be directed in ſuch a manner as to terminate at the ſurface of the water. They are to be covered on the ſide expoſed to the place, and ſtrongly ſecured with blinds, placed within five or ſix feet of each other. Blinds are likewiſe to be laid over the deſcent, which is to be covered with faſcines, and theſe with earth, to prevent the enemy from ſetting them on fire.

In order to paſs this ditch, a bridge muſt be made with faſcines; for which end, after breaking the counterſcarp, a number of men, ſufficient to occupy the whole length of the deſcent, are ranged at the diſtance of two feet from each other: theſe men muſt be covered by the parapet, and to forward the faſcines from hand to hand, from the head of the paſſage to the opening into the ditch. The ſapper in this part (for all theſe works relate to the ſappers) will throw them into the ditch, in order to make an epaulement or covering on that ſide of the town which looks towards the paſſage.

As ſoon as he has flung in a ſufficient number of faſcines to ſhelter himſelf, and to advance a few paces into the ditch, he muſt throw a great number of them into the paſſage, in order to fill the ditch up entirely in that part.—They are laid different ways, and ranged in different beds; which are covered with earth, in order to make them ſink to the bottom. All theſe different beds of faſcines muſt be fixed with long ſtakes, that they may keep cloſer together: and as the work advances, the parapet muſt be puſhed forward, otherwiſe it would be impoſſible to effect the paſſage without the utmoſt danger.

When the paſſage is commanded, or fired into from the oppoſite parapet of the place, or from any other part, the foremoſt men muſt be covered with a great heap of faſcines, or by ſome other contrivance: but whatever cover it be, in that caſe the paſſage of the ditch is extremely difficult and dangerous.

After what has been ſaid concerning the paſſage of dry ditches, and thoſe which are full of ſtanding water, it remains to take notice of thoſe which are full of running water, and thoſe that are dry but may be filled at any time with water. Theſe ſorts of ditches are extremely difficult to paſs, unleſs the current can be turned and made to take a different courſe from that which carries it to the town ditches, or unleſs the beſiegers can contrive to break down the ſluices which keep up the water reſerved by the enemy for filling the ditch.

A great deal might be ſaid, were we to enter into the whole detail of the works neceſſary for paſſing theſe ſorts of ditches; we ſhall only touch upon the ſubject.

Suppoſing the ditches to be filled with running water, or with a river, the channel of which can be diverted no other way, which is called *draining the ditch*, it will be requiſite then, generally ſpeaking, to throw into the ditch a large quantity of faſcines, loaded with earth and ſtones, faſtened together with long ſtakes: thus the paſſage is to be puſhed on, till the ditch is contracted to the breadth of 20 or 30 feet; and then ſmall beams may be laid acroſs, to join the bridge of faſcines to the rubbiſh of the breach. The filling up, and conſequently the paſſage of the ditch, may be alſo forwarded, by ordering the miners to advance to the rubbiſh, and to ſpring a mine, in order to blow up part of the revetement of the work into the ditch.

Should the enemy happen to have reſervoirs of water which they may open, and thereby deſtroy the lodgments in the ditch when they are no longer to make a ſtand there, the beſiegers muſt endeavour during the ſiege to deſtroy the ſluices, that is, the ſtone-work or timber that ſerves to keep up the water. This may be done by throwing a great number of bombs towards that part where the ſluices are known to be ſituated; if they ſhould be broke down by that means, then the water will have a free current; and after it has run off, the paſſage of the ditch muſt be attempted in the ſame manner as if it was ſtanding water; if there remains only a very ſmall current, a paſſage muſt be left to drain it, as was mentioned before.

This whole operation is very tedious, difficult, and dangerous;

gerous; nay, it is impoſſible to be done at all without being protected by a very briſk firing, not only from all the cannon of the covert-way and the ricochet batteries, but moreover from the lodgments on the glacis and thoſe on the covert-way.

Plates DXXXIV. and DXXXV. will illuſtrate all that we have been ſaying upon this head, concerning the deſcent and paſſage over the ditch.

Plate DXXXIV. fig. 1. exhibits the plan of the deſcent under ground, and that of its opening into the dry ditch. Fig. 2. repreſents the profile of that deſcent; the opening of which is made at the lower part of the ditch. Fig. 3. is a perſpective view of the opening of this deſcent, ſeen from the bottom of the glacis: and fig. 4. ſhows in perſpective the opening of the ſame deſcent, ſeen from the top of the breach.

Plate DXXXV. fig. 1. is the plan of the paſſage over a wet ditch in the open air; that is to ſay, the gallery of which is an open ſap. A is the opening of it. You ſee in B, towards its opening, the blinds that are laid on its upper part, to ſupport the faſcines with which it is covered. On theſe blinds, at firſt, is laid a bed of faſcines, ranged according to the length of the gallery: over this firſt bed is laid a ſecond, wherein the faſcines are ranged according to the breadth of the gallery, as you ſee in B and C. D is the epaulement of faſcines, which covers the paſſage againſt the fire of the place, by which it is flanked. E is part of the bridge of faſcines; and F is an elevation alſo of faſcines, intended to cover the head of the work, and to ſecure it from the immediate fire of the place. Fig. 2. repreſents the profile of this deſcent into the ditch. Fig. 3. gives its opening ſeen in perſpective from the country; and fig. 4. its opening into the ditch, alſo in perſpective, as it appears from the top of the breach.

§ 15. *Of the attack of the Ravelin, or Half-moon.*

The paſſage over the ditch before the half-moon being effected on both ſides, and a breach made 14 or 15 fathoms wide, preparations are made for the aſſault. For this purpoſe a large quantity of materials is collected from all the neighbouring lodgments. Endeavours are uſed to render the breach practicable by making the ſlope eaſy. The cannon continue playing, in order to throw down the parts of the revetement that may yet be ſtanding. Very good uſe may alſo be made of ſhells fired point blank; for they are eaſily buried in the breach, the earth of which has been already broken up and ſhaken by the cannon; and as they burſt upon that earth, they produce the effect, as it were of ſmall mines. Howitzers may likewiſe be uſed with ſucceſs on theſe occaſions.

In order to render the breach more practicable, ſome miners, or a ſergeant with a few grenadiers, are ſent to level it with hooks. The fire from the lodgments and batteries will hinder the enemy from appearing on their defences; or if they ſhould, they muſt do it with great circumſpection, which renders their fire leſs dangerous.

If the enemy have made any galleries along the face of the half-moon, and oppoſite the breaches, the miners may go and diſcover them, in order to ſtop them up, or to cut off the match, or to drive away the enemy: if they cannot find them, they ſpring ſeveral mines; which being often repeated, muſt needs occaſion ſome diſorders in the galleries and mines belonging to the beſieged. Every thing being ready for making a lodgment in the half-moon, that is, for taking poſſeſſion of the breach: the materials being at hand, in order to be removed hither with eaſe and expedition: the batteries and lodgments of the covert-way being in a condition to fire away briſkly;—a ſignal is agreed upon with the officers that command thoſe batteries and lodgments, to give them notice to fire, and to leave off whenever it is thought proper. This ſignal is generally a flag raiſed in the former caſe, and lowered in the latter. All this being ſettled, and the breach as we obſerved, made practicable, two or three ſappers are ſent to the extremity of the breach next to the place, there being generally a kind of ſmall cover or cavity in this part; there they begin a lodgment for themſelves, and for ſome more, who are ſent after them; when there is room to receive them, they make them mount, and inſenſibly extend the lodgment upon the top of the breach; and thus they proceed till they make a lodgment towards the point, which is generally called a *magpy's neſt*. While theſe ſappers are at work, the fire of the batteries and the lodgments ceaſes; but when the enemy attempts to attack the workmen in order to deſtroy their lodgments, they muſt retire as quick as poſſible; and then the colours being raiſed, the batteries fire upon them with the utmoſt vivacity, to oblige them to quit the upper part of the breach.—Upon this the colours are lowered, the fire ceaſes, the ſappers return to repair the miſchief that was done to their lodgment, and try to enlarge and ſtrengthen it.

This way of proceeding muſt be continued till the lodgment is in a ſtate of defence; that is, till it can hold a number of troops ſufficient to awe the enemy, and to withſtand any attack that may happen to be made againſt it. The beſieged, before they entirely quit the half-moon, will ſpring what mines they have ready there. As ſoon as this is done, the beſiegers ſhould directly lodge themſelves in the excavations made by thoſe mines, or at leaſt ſome defence ſhould be made there, to hold a few ſappers, and to forward the lodgments of the inſide of the work.

The lodgment of the point is made in the form of a ſmall arc, the concavity of which is turned towards the place. From each of its extremities a lodgment is carried along the faces of the half-moon, on the platform of its rampart, at the foot of its parapet. This lodgment is ſunk deep in the earth of the rampart, to the end that the ſoldiers may be the better covered againſt the fire of the place; there muſt be alſo traverſes to ſecure it from the enfilades, as was done in regard to the lodgment on the glacis. Withinſide the half-moon, lodgments are alſo made, which traverſe the whole breadth thereof, as may be ſeen in the half-moon *C*, Plate DXXXIII. fig. 6. They ſerve to command the communication between the tenaille and the place; of courſe to render that communication more difficult, and to hold a ſufficient number of troops to reſiſt the enemy, ſhould they have any deſign to return and repoſſeſs themſelves of the half-moon.

What we have been obſerving, in regard to the attack of the half-moon, is only when the beſiegers intend to take it by the ſap, or with pick-axe and ſpade: but ſometimes they go about it in a more expeditious manner: for when the breach is made ſo as the troops may mount to enter the half-moon, they advance boldly to the aſſault, juſt as in the attack of the covert-way, ſword in hand, and endeavour to come up with the enemy, and to drive them entirely out of the work. This attack is very dangerous, and may coſt a great many men, when there happens to be a brave garriſon, who will not eaſily yield their ground. But there are frequent caſes in which it may be thought prudent to adopt this meaſure, in order to accelerate a few days the taking the half-moon. As ſoon as the beſiegers are maſters of the upper part of the breach, they make a lodgment there in a hurry with gabions and faſcines; and while it is making, as alſo while they charge the enemy, and oblige them to abandon the upper part of the breach, ſome ſoldiers are ſent to diſcover the mines, which the beſieged are ſuppoſed to have made within the rampart of the half-moon, and to cut off the ſauciſſon. If they cannot find them, they muſt advance with great circumſpection, and take care not to keep all together, that the mine may have leſs effect. Oftentimes the enemy will ſuffer the beſiegers to carry on their lodgment without making any great oppoſition, becauſe it cannot be effected without a conſiderable loſs of men; but when the lodgement is advanced, the enemy ſpring their mines, and return afterwards to the half-moon, in order to take it amidſt the confuſion which thoſe ſubterraneous fires muſt unavoidably occaſion among the troops in the lodgment; in that caſe, it will be requiſite to renew the charge moſt vigorouſly with freſh troops, which ſhould be at hand to ſupport thoſe of the half-moon, to place themſelves in the excavations made by the mines, to render the lodgment ſufficiently ſtrong, and to ſecure it with a proper number of ſoldiers, ſo as to be able to withſtand any further attempt of the enemy.

This work can hardly be diſputed in this manner, except when the half-moon has a reduit (D), as it affords a ſhelter or retreat to the garriſon, and enables them more eaſily to fall upon the half-moon. For if there ſhould be no reduit, and the enemy are driven out of the half-moon, they can ſcarce attempt to return, eſpecially if the communication between the place and the half-moon is diſcovered by the batteries and lodgments of the covert-way: becauſe, if the ditch is filled with water, this communication can hardly be made but with boats, which may be eaſily ſeen from the lodgments of the covert-way, and may be overſet by the cannon of the batteries; and if the ditch be dry, and there happens to be a caponnier, the communication, though more ſafe, is not without danger, by reaſon of the fire that may plunge into it from the lodgments of the covert-way; ſo that it will be extremely difficult for the enemy to advance quick enough to repoſſeſs themſelves of the half-moon; beſides, they want room to aſſemble in a large body, and fall all at once upon the lodgments of that work.

There is only one caſe in which they may do it; that is, when in the angle of the gorge of the half-moon they have made a ſpace, nearly as large as the places of arms in the covert-way. This ſpace cannot be ſeen from the covert-way, nor from its lodgments; and as there are generally ſteps to aſcend from the bottom of the ditch to the half-moon, the enemy might take advantage thereof to try to enter it; but if the beſiegers are upon their guard, they will find it eaſy to repulſe them, even with loſs.

The beſt time for attacking the half-moon ſword in hand, is by night, for the enemy's fire is not ſo ſure then as by day.

§ 16. *The Attack of the Baſtions.*

WHILST the beſiegers endeavour to poſſeſs themſelves of the half-moon, they work the ſame time at the deſcents into the ditch, which are made nearly towards the third part of the faces, reckoning from the flanked angle of the baſtion. A deſcent may be effected at each face of the two baſtions in the front of the attack, as in *n*, *n*, Plate DXXXIII. fig. 6. or, according to the more general cuſtom, only oppoſite the faces in the front attacked. The manner of proceeding is much the ſame as in the deſcent and paſſage over the ditch of the half-moon, whether it be dry or wet; that is, if it be dry, a ſap is carried into the ditch, from the opening of the deſcent to the foot of the breach, and ſtrongly covered towards the oppoſite flank. If the ditch be full of water, it is paſſed over on a bridge of faſcines, conſtructed in the ſame manner as in the paſſage over the ditch of the half-moon.

The batteries erected on the ridge of the glacis for making a breach in the face of the baſtions, muſt fire againſt that part of the faces where the breach is to be effected, and fire all together, as was mentioned in the article of the attack of the half-moon; and when they have made a breach ſufficient to attempt the attack in front, ſome of the guns muſt be kept to batter the upper part of the breach, and ſome muſt be removed to the back of the platform, and diſpoſed in ſuch a manner, as to be able to annoy the enemy, whenever they preſent themſelves towards the upper part of the breach. All this is done during the deſcent and paſſage over the ditch. Mines are alſo made uſe of to widen, and ſometimes even to make the breach.

To fix the miner to the wall when the ditch is dry, a lodgment is made near the opening of the deſcent, to protect him from thence againſt the ſallies of the beſieged. Then the wall is broke with cannon, as near as poſſible to the bottom of the ditch, in order to get under the galleries which the beſieged may have built withinſide the baſtion. An opening of five or ſix feet may be made with the cannon, to lodge the miner that moves the rubbiſh, and makes room for one or two of his comrades, who are to aſſiſt him to get rid of the earth in the gallery. When the ditch is dry, and the ground will admit of it, the miner ſometimes gets under it by a ſubterraneous gallery, which leads him to the foot of the wall; but if the ditch be filled with water, it is not always the cuſtom to wait for the completing of the paſſage over the ditch, before the miner is fixed to the face of the baſtion. The wall is pierced with cannon, in the manner before mentioned, but a little above the ſurface of the water, to the end that the miner may not be incommoded in this gallery; and he is ſent over in a little boat to place himſelf in the hole. The miners relieve one another every two hours to carry on their work with more ſpeed; that is, to complete and finiſh their mine. At the ſame time, the enemy will uſe various artifices to obſtruct them.

When the miner has pierced the wall, he makes behind it, on both ſides of him, two ſmall galleries, from 12 to 14 feet, at the end of which he places, on both ſides the galleries, two mines, namely, one within the breadth of the wall, and the other ſunk 15 feet under the rampart. A common train is given to theſe four chambers, which taking fire at one and the ſame time, will produce a very large and ſpacious breach.

When there are countermines under the rampart, and along its revetement, care muſt be taken to ſeize them, and to drive the miners from thence. For this purpoſe M. Goulon propoſes to ſpring four fougaſſes* near them, in order to burſt them; when this is done, he is for entering it with 10 or 12 grenadiers, and as many ſoldiers, commanded by two ſerjeants; part of theſe grenadiers ſhould have each four grenades, and the reſt ſhould carry four or five bombs, of which three only ſhould be charged, the other two with fuſees only. The two ſerjeants ſhould begin with attacking the countermine ſword and piſtol in hand, and the grenadiers ſhould follow them. If the beſieged do not appear to defend their countermine, a lodgment is quickly made with ſand-bags. This lodgment conſiſts of no more than a good traverſe,

* See Fougade.

(D) The reduit is a ſmall half-moon conſtructed within the other. It uſually conſiſts of a ſingle wall with loop holes; but in Landau, Neufbriſac, and ſome other places, the reduit is conſtructed with a rampart and parapet like the external half-moon.

traverſe, which entirely ſtops up the gallery of the countermine, towards the ſide from whence the enemy may come. If they attempt to oppoſe this operation, the grenadiers ſhould throw their three loaded ſhells, and retire quickly with their comrades, to prevent being hurt by the effect of thoſe ſhells: for the ſmoke they make in burſting, together with the ſplinters, muſt unavoidably oblige the enemy to quit the gallery for ſome time: but as ſoon as they have produced their effect, the ſerjeants and the grenadiers, with their comrades, muſt immediately return, and work as hard as poſſible upon the traverſe, in order to ſtop up the gallery. If the beſieged ſtill perſiſt in interrupting this work, the grenadiers muſt throw the two ſhells with fuſees only, which will oblige the enemy to retire quickly; and as no harm is to be apprehended from them, which is more than the beſieged can tell, the beſiegers continue to finiſh the traverſe. Even openings or loop-holes are made, in order to fire upon the enemy, in caſe they ſhould appear again in the part of the gallery oppoſite the traverſe.

When there is no gallery or countermine behind the walls, or when there is one which cannot eaſily be come at, the miner ſhould leave no means untried to diſcover it; and at the ſame time he ought to uſe the utmoſt precaution to prevent being ſurpriſed himſelf by the enemy's miners, who will attempt to ſmother him in the gallery, and to deſtroy his works: therefore the buſineſs of a miner requires great art and cunning to avoid the ſnares of the enemy. "A miner (ſays M. de Vauban in his Memoirs) ought to liſten frequently to diſcover whether there are any at work under him. He ought to ſound with his augre towards the place he hears the noiſe come from; but the enemy often make a noiſe on one ſide, while they are at work on the other." If their miner draws too near, a ſmall mine muſt be made to ſtifle him in the gallery; which may be effected thus: A hole of five or ſix inches diameter, and ſix or ſeven deep, is made on that ſide of the gallery where the enemy is heard; a cartridge of the ſame ſize, and containing about 10 or 12 pounds of powder, is put into it: the hole or opening towards the gallery is ſtopped cloſe with a ſtrong tampion, which is immediately applied to the cartridge, and ſupported by ſtrong planks well buttreſſed: this powder is ſet on fire by a fuſee, which paſſes through a hole made in the tampion, and communicates with the powder in the cartridge. If the gallery of the enemy's miner is within four or five feet of this powder, it will undoubtedly burſt, and the miner will be either killed, or obliged by the ſmoke to retire.

Another way of burſting the gallery of the beſieged, when it is at no great diſtance, is to put ſeveral ſhells on the ſide where the enemy's miner is at work, and to range them in ſuch a manner that they ſhall have their effect.—When the miners are at work in ſearch of one another, they have great iron borers, with which they pierce the interval betwixt them, to find, as near as they can, their diſtance from one another. The miner muſt be very vigilant, and as ſoon as the borer is withdrawn, he ſhould clap a piſtol into the hole, which, when well directed, and fired by a man of reſolution, ſeldom fails, as M. Vauban affirms, to kill the miner. The firſt ſhot ought to be followed by three or four more; then the hole ſhould be cleaned with the borer, to prevent the enemy from ſtopping it up on their ſide: and this is a matter of importance, for it will hinder the miner from continuing his work in that ſpot, and oblige him entirely to abandon it. Theſe and many other ſtratagems, which may be ſeen in the Memoirs of M. Vauban, plainly ſhow that the buſineſs of a miner requires not only addreſs and cunning, but likewiſe great courage and reſolution, to guard againſt and remove the ſeveral obſtacles that may be thrown in his way, with a view to prevent the progreſs of the works committed to his direction: he may eaſily guard againſt them when he is undermoſt; but if it be otherwiſe, his ſituation is extremely bad. In order to know for certain whether they are at work under the gallery, the miner generally makes uſe of a drum with ſomething upon it, and then the ſhaking of the earth muſt occaſion a kind of trembling, which will diſcover that they are at work underneath. Sometimes he liſtens with his ear to the ground; but the fluttering of the drum is the ſureſt way.

While the miner is working upon the conſtruction of his gallery, the beſiegers muſt be employed in demoliſhing all the works of the enemy, and diſabling them from defending or repairing the breach. With this view a continual fire is made againſt the breaches, which will hinder the beſieged from ſhowing themſelves in that part, and from advancing to ſee the works which may be made in the ditch or at the foot of the breaches. If there is a tenaille before the curtain, batteries are placed in the re-entering places of arms of the covert way of the half-moon, which plunge into the tenaille, and hinder the enemy from making uſe of it to diſturb the paſſage over the ditch. And in order to ſilence them farther, another battery of mortars may be erected, in the moſt advanced lodgment of the gorge of the half-moon; which battery being well ſerved, will render it too dangerous and inconvenient for the beſieged to abide there, ſo as to have the attention requiſite for obſtructing the paſſage over the ditch.

But ſometimes the enemy will make oblique embraſures in the curtain; and from thence they fire on the lodgments of the covert-way, ſo as greatly to incommode both thoſe lodgments and the opening of the deſcent into the ditch. The way to prevent the effect of thoſe batteries, is to endeavour to deſtroy them with ſhells: and, when the ground will permit, to enfilade the curtain with ricochet firing. Four or five pieces may be alſo placed on the upper part of the flanked angle of the half-moon; in which poſition they can fire directly upon the curtain, and plunge into the tenaille and the poſtern, by which the enemy keep a communication with the ditch when it is dry.

Let us ſuppoſe that the paſſages over the ditch are finiſhed, ſo as to be fit to walk over; that the cannon or the mines have made the breaches ſufficiently wide for the aſſault; that the aſcent is made ſmooth, and that the beſiegers can eaſily mount to the top of the breach; then they may lodge themſelves there, by following either of the two methods mentioned in the article of the half-moon.

If the enemy have made no retrenchments in the inſide of the baſtion, they will hardly venture to ſtand an aſſault, as this would only expoſe the place to be carried ſword in hand, themſelves to be taken priſoners of war, and the town to be plundered. Therefore every thing being ready for the aſſault, they will beat the chamade, that is, they will deſire to ſurrender on certain terms.

When a reſolution is taken to attack the baſtions while the mines are making and charging, a conſiderable heap of materials is laid up in the lodgments neareſt the breaches, that they may be handed readily for the conſtruction of the lodgment, as ſoon as the enemy is driven away. Every thing being prepared to ſet fire to the mines, all the grenadiers of the army are ordered to march to the aſſault; and they are to be ſupported by a ſufficient number of detachments, that the enemy may not be able to make a ſtand. Theſe troops being ready, the mines are ſprung; and as ſoon as the duſt is a little laid, the grenadiers, commanded to march and to mount foremoſt, move on to the foot of the breach; and when they get there, they mount immediately with their bayonets fixed, and are followed by the reſt of the troops that are to ſupport them. The enemy will not fail to make uſe of their mines, if they have any left; and will likewiſe throw all kinds of combuſtibles, to make the beſiegers pay as dear as poſſible for the ground which the beſieged will be obliged to yield in the upper part of the breach; for yield at length they muſt, and the ſuperior numbers of the beſiegers muſt ſurmount every obſtacle.

As ſoon as they are beaten away, and have abandoned the upper part of the breach, the beſiegers muſt ſet about making a lodgment; which will conſiſt at firſt of a kind of arc of a circle, the convexity whereof is turned towards the enemy, if there is a breach in the faces of the two baſtions, otherwiſe it will only be made on the upper part of the breach. The breaches are to be all ſtormed at the ſame time, by which means the reſiſtance of the enemy will be divided. This whole time the batteries and lodgments are to fire with all the vivacity poſſible againſt the ſeveral defences of the enemy, and againſt every place they are in and that can be fired againſt, without annoying the troops that are ſtorming the breaches.

The lodgment on the breach being made, the ſaps are carried on to the right and left towards the centre of the baſtion, and diſpoſed in the manner as in Plate DXXXV. fig. 5. baſtion A. Cannon are brought upon the breach to batter the inner retrenchment, the ditch is paſſed over here alſo, and a lodgment is made upon the breach in the manner mentioned in regard to the baſtions.

If behind this firſt retrenchment there be a ſecond, the enemy, after being forced to quit the former, retires to the latter to capitulate. There they are to be attacked as in the former retrenchment, and at length they will be forced to ſurrender. It is very rare to ſee a defence carried ſo far as we have here ſuppoſed; but it was incumbent upon us to make this ſuppoſition, in order to give an idea of what is proper to be done, ſhould the enemy reſolve to defend the place to the laſt extremity.

§ 17. *Attack of a place covered with Fore-ditches, Lunettes, and other Outworks, &c.*

In order to give a more ſimple idea of the operations of a ſiege, we have explained and applied them to a place that had no other outworks than half-moons and a covert-way: but a greater number of works will make no alteration in the principles here eſtabliſhed: to take and keep poſſeſſion of thoſe works, the beſiegers have only to follow the ſame rules; which we ſhall ſhow in a few words.

Let us ſuppoſe a place ſurrounded by a fore-ditch, and a ſecond covert way, ſtrengthened with lunettes, and ſuppoſe the front by which it may be attacked is covered with a horn or crown work, &c.

Firſt of all the trenches are to be opened as uſual, in order to come to the foot of the glacis of the ſecond covert way; the ricochet batteries are to be placed on the produced faces of the works attacked, and of their defences; the faces of the lunettes of the front attacked ought to be enfiladed by the ricochet batteries.

The ſecond covert way is taken in the ſame manner as the common covert way; and then, if the fore-ditch is full of water, a good lodgment is to be ſecured along this ditch, and batteries are to be erected to make a breach in the lunettes, if the enemy do not think proper to quit them. It is very difficult for them to maintain themſelves in thoſe works, when their communication is ſeen; and they can hardly avoid being ſeen, when a lodgment is made all along the fore ditch. Be that as it may, ſuppoſing that they are lined with ſtone-work, or only with turf, that they are fraiſed and palliſaded, and that the enemy are obſtinate in their defence, a breach may be made in them, by placing ſome cannon oppoſite the middle of the faces, and the ditch may be paſſed over by filling it with faſcines or ſome other materials. As it is a great deal ſmaller than that before the body of the place, it is much eaſier to paſs.

When the beſiegers have made themſelves maſters of the lunettes which cover the front attacked, they begin to think of paſſing the fore-ditch. This is a very difficult taſk, becauſe it is performed under the grazing fire of the covert way; but this fire ought to be checked by the ricochet batteries, which ſhould plunge into the covert way on every ſide. This ditch is croſſed near the ſaliant angles of the glacis. It is always to be underſtood, however, that there is no poſſibility of croſſing any ditch without a good epaulement of faſcines, to cover the paſſage on the ſide which is ſeen by the place, or by the works that defend it.

When the lodgment is entirely finiſhed on the covert-way, then the other attacks are carried on in the manner before explained.

There are places which, without any fore-ditch, have lunettes oppoſite to the ſaliant and re-entering angles of the glacis, which are alſo enveloped by a ſecond covert way: ſometimes they are vaulted and bomb-proof, as at Luxemburg; and ſometimes they have only a ditch, a parapet, and a covert way.

Thoſe which are vaulted and bomb-proof are very difficult to take; becauſe the ricochet firing and the bombs can do them no miſchief. In that caſe they muſt either be turned or be taken by mines.

A work is ſaid to be turned, when the beſiegers get between that work and the place, and ſo cut off their communication. Sometimes the lunettes have communications under ground, and then there is hardly any other way of driving out the enemy but by mines. This is tedious work; but there is no remedy for it.

The lunettes and the ditch are always defended by branches of the covert way, with which they have alſo a communication, like thoſe of the lunettes, A, A, Plate DXXXVI. fig. 1.

This plate, which repreſents part of Landau and its attacks in 1713, may ſerve to give an idea of the manner in which a work is turned. The advanced lunette B, as well as the work C, called a *tenaille*, are turned; that is, the trenches cut off the communication betwixt them and the place.

When this communication cannot be cut off, there will be often a neceſſity for attacking the lunette and covert way at the ſame time; and the reaſon is, becauſe though the enemy ſhould be obliged to abandon the lunette, yet ſo long as they are maſters of the covert way, they have it in their power to return and retake it. Therefore, the ſure way of keeping poſſeſſion of it is to drive the beſieged out of the covert way, at the ſame time that they are forced to quit the lunette.

The garriſon may avail themſelves greatly of mines for the defence of theſe ſmall outworks, ſo as to oblige the beſiegers to pay very dear for their acquiſition, and be a long while in making it. But they muſt purſue the ſame methods as the beſieged; they muſt dig deep into the earth, they muſt endeavour to deſtroy the enemy's mines, to blow up their galleries, and to make themſelves maſters of the lower ground. This is an eſſential point, without which the enemy may blow up and deſtroy the lodgments ſeveral times. The celebrated M. de Valiere, in a Diſſertation on Mines, at the end of the third volume of M. Folard's Commentary on Polybius, ſhows, that in a ground 25 or 30 feet deep, the enemy may be blown up twenty times. Therefore it is impoſſible to be too cautious in endeavouring to get under the gallery of the beſieged, in order to prevent the miſchief they may do by their great number of mines.

In the neighbourhood of ſome places there are a ſort of ſmall half-moons, called *redoubts*. When they are diſtant from the place, the enemy cannot maintain themſelves there without expoſing their troops to be taken priſoners of war; but when they are covered and defended as they ought to be, and judiciouſly ſituated, they are an object worth attention. Endeavours ought to be uſed to cut off the communication between them and the place, and to oblige the enemy to abandon them by throwing in ſhells; it may even be proper to aſſault them and drive them out ſword in hand, provided they are not ſo near the place as to receive powerful ſuccours, and be able to withſtand the attack. It is a matter of conſequence to get rid of theſe ſmall outworks as ſoon as poſſible, becauſe they may be of great hindrance to the progreſs of the attacks, by having a view of the trenches from the flanks, and enfilading them, &c.

In ſome ſieges, when the garriſon are obſtinate in their defence, ſmall outworks are made at the foot of the ſaliant and re-entering angles of the glacis; theſe conſiſt only of a parapet raiſed at the foot of the glacis upon theſe angles, each ſide of which has about 10 or 12 fathoms. Theſe ſmall works are called *arrows*. They may be ſeen in A, A, A, Plate DXXXVI. fig. 2. They communicate with the covert-way by a paſſage pierced on the ridge of the glacis, and palliſaded on both ſides. At the entrance of this paſſage is conſtructed a traverſe B, generally called the *tambour*, which hinders the beſiegers from being maſters of the arrow, or diſcovering the inſide of the place of arms belonging to the covert way.

To prevent the effect of theſe arrows, the beſt method is to ply them well with ricochet batteries, and with ſhells thrown in alſo *à ricochet*. Stone mortars may likewiſe be made uſe of, to annoy the enemy in their arrows; for as theſe works are but ſmall, the ſtone mortars produce a very good effect. We have already taken notice of almoſt all the works the beſiegers may meet with beyond the covert-way; there remains, therefore, only to ſee the manner of conducting the attacks of the other outworks moſt commonly uſed in fortified towns.

§ 18. *Attack of a Horn-work.*

A Horn-work is nothing more than the front of a fortification, which projects into the field, and is joined to the place by two long ſides. It is placed oppoſite to the curtains, and ſometimes alſo to the baſtions. The beſiegers ſhould endeavour, as much as poſſible, to avoid attacking the ſide covered by theſe works, becauſe they are very difficult to take, and of courſe will greatly lengthen out the ſiege. But ſuppoſing there is an abſolute neceſſity for attacking the place on the ſide covered by a horn-work oppoſite the baſtion, and that this horn-work has an half-moon oppoſite to its curtain: The trenches and parallels are to be made in the uſual manner; the ſame method is to be uſed in regard to the ricochet batteries, which will alſo enfilade the branches of the horn-work. The taking of the covert-way of the half-moon, and of the half baſtions of the horn-work, is carried on in the ſame manner as the attack of the half-moon, and the two baſtions of the body of the place. There remains, therefore only to ſhow how the lodgments are to be made in this work. We will ſuppoſe that there are two retrenchments withinſide, as in Plate DXXXV. fig. 5.

When the lodgments towards the point of the half baſtions are finiſhed, ſome guns are to be planted there, in order to batter the face of the oppoſite baſtion; and they are to be placed over-againſt the lodgments of the flanked angles of the half baſtions. Theſe lodgments are to be extended on both ſides towards the curtain, along which ſaps are carried on; as alſo towards the orillon of the half baſtions, if they are made with orillons: this will form a kind of ſmall parallel, the fire of which will help to cover the lodgments in front, in caſe the enemy ſhould make any ſallies to deſtroy them. In large fortifications, ſuch as horn and crown works, the lodgments ought to be carried on with the greateſt circumſpection, in order to be able to ſupport them againſt every attack of the enemy.

As all theſe lodgments are commanded by the baſtion, it will be requiſite to dig the ſaps ſufficiently deep, ſo as to be ſecure againſt their fire; and likewiſe to make traverſes near enough to each other for the ſame effect.

If the baſtion can be battered in breach from the rampart of the half baſtions of the horn-work, the beſiegers will for this purpoſe make uſe of batteries erected on theſe half-baſtions; and for the ſame end they will alſo plant a battery of ſix or eight guns towards the middle of the curtain.—Should it be impoſſible to ſink ſufficiently into theſe, ſo as to batter the lower part of the revetement of the baſtion, ſtill they might be uſefully employed in playing againſt the enemy's defences, and driving them out of their retrenchments. When the lodgments are well ſecured withinſide, it will be extremely difficult for the enemy to continue in the retrenchments, without running the riſk of being made priſoners of war; becauſe the communication between them and the place will become too difficult. They might indeed, by means of a bridge level with the water, retire into the collateral half-moons: but at the ſame time that the beſiegers endeavour to make themſelves maſters of the horn-work, they will alſo ſtrive to get poſſeſſion of theſe half-moons; the taking of which muſt inevitably follow that of this work.

As ſoon as the enemy are entirely driven out of the horn work, the beſiegers muſt poſſeſs themſelves of it by carrying on lodgments which ſhall occupy its whole extent; and if there be any occaſion to erect batteries within, in order to batter the baſtion in breach, they are to be erected along its counterſcarp, as may be ſeen in z (*ibid*).

Sometimes it ſhall happen, that the ground of the inſide of the horn-work will not permit lodgments to be extended there, as they are ranged in this figure, becauſe it may be too wet and marſhy, or elſe of too narrow a circumference. In that caſe there is no carrying on the lodgments but along the parapet of the front of this work, and along its branches, if the breadth of the platform of the rampart of theſe branches will permit. It muſt be made to defile by frequent zig-zags or turnings; but if it be too narrow, the only way for the beſiegers is to ſink very deep, in order to defile from the fire of the place, and to cover themſelves by traverſes made very near one another.

Explanation of Plate DXXXV. fig. 5.

a. Cavaliers of the trenches. *b*, Batteries of ſtone mortars. *c*, Batteries to breach the half-moon before the horn-work. *d*, Batteries againſt the defence of this half-moon. *e*, Paſſages over the ditch before this half-moon. *f*, Lodgments in it. *g*, Batteries againſt the flanks of the horn-work. *h*, Batteries to breach the half baſtions of the horn-work. *i*, Batteries againſt its curtain. *l*, Lodgments in the half baſtions and in the horn work. *m* Paſſages over the ditch before the retrenchments in the horn-work. *n*, Lodgments in theſe retrenchments. *o*, Batteries againſt the defences of the collateral half-moons. *p*, Batteries to breach theſe half-moons. *q*, Paſſages over the ditch before theſe works. *r*, Lodgments in the ſame. *s*, Batteries to breach the reduits of the half-moons. *t*, Paſſages over the ditch before the reduits. *u*, Lodgments in the reduits. *x*, Bridge of faſcines, or a road to carry the cannon to the horn-work, *y*, Batteries againſt the defences of the baſtion A. *z*, Batteries to breach this baſtion. B, Paſſages over its ditch. C. Lodgments in the baſtion A. D, Lodgments on the border of the ditch before the retrenchment of the baſtion A. E, Paſſages over the ditch before this retrenchment.

Plate DXXXVII. repreſents the plan of the lodgments made in the horn and crown work of Philipſburg in 1734.

A great deal more might be ſaid in regard to all theſe articles; but for the particulars, we refer the reader to the Memoirs of M. de Vauban, which diſplay the whole extent of genius of that great man, and ſhow how capable he was of finding out expedients for ſurmounting all obſtacles ariſing either from ſoil, ſituation, or different manners of fortifying.

§ 19. *To prevent ſuccours from being thrown into a town beſieged.*

NOT to interrupt the thread of the uſual operations of a ſiege, we have ſuppoſed that the general had taken every neceſſary meaſure to guard againſt all the attempts of the enemy, and to ſecure ſucceſs by the great ſuperiority of his forces. Sometimes, however, it may happen that an enemy who was looked upon as too weak to relieve the place, ſhall prepare to attack the army of the beſiegers, either in conſequence of drawing out moſt of the troops from the neighbouring garriſons, which are leaſt expoſed, or of having been reinforced from ſome other part. In ſuch caſe, there are two ways to follow. The firſt is, to wait for the enemy in the lines, and to hinder them from breaking through: the ſecond, to leave part of the army in the lines, in order to carry on the ſiege, and to oppoſe any ſallies of the garriſon; with the other to go and meet the enemy, and fight them out of the lines.

Both theſe ways are ſupported by the opinion of different generals; but the latter ſeems to have the moſt general approbation.

The inconvenience of waiting for the enemy in the lines, is the uncertainty on which ſide he intends to direct the attack; for which reaſon the beſiegers are obliged to be equally ſtrong in all their poſts; and when the line is very extenſive, the troops are at too great a diſtance from one another, to make any conſiderable reſiſtance on the ſide where the enemy forms his attack. Moſt lines of circumvallation, that were ever attacked, have been forced; ſo that both reaſon and experience ſeem to eſtabliſh it as a maxim, that it is preferable to go and meet the enemy, and not to let him come within reach of the lines.

Without pretending, however, to determine ſo important a matter, it ſeems, that when a line is not very extenſive, it may be defended to an advantage. And, firſt, it is beyond all doubt, that if the troops behind the line know how to avail themſelves of the ſeveral circumſtances in their favour, their ſituation is in many reſpects preferable to that of the aſſailants. The latter are expoſed to the fire of the line for a very conſiderable time before they can come up to the border of the ditch. This ditch muſt be filled up: and all the while they are expoſed to the ſame fire, which muſt kill a great many of their men, and throw their troops into ſome confuſion. And when they break into the line, they can make but a very narrow front; for which reaſon, they may be charged both in front and flank by the troops within; who, if they do their duty, muſt drive them into the ditch. For, ſuppoſe the firſt line of the defendant's infantry next the ditch ſhould be obliged to give way, the horſe that are behind them may and ought to fall upon the enemy's foot that have pierced through the line; and as the latter cannot force their way but in ſome confuſion, the former may eaſily drive them out again. We may therefore conclude, that if the troops are ſenſible of the many advantages of a good line, and are determined to defend it; if the ſeveral parts are likewiſe well ſupported, and all the neceſſary precautions have been taken to prevent being ſurpriſed; it will be extremely difficult for the enemy to force it.

Thus, at the ſiege of Philipſburg, in 1734, prince Eugene reconnoitred the lines of circumvallation, and found them ſo well diſpoſed, that he never once attacked them. They formed a kind of irregular ſemicircle round the place, of which the Rhine might be conſidered as the diameter. They were defended by a kind of fore-ditch, and by wells between this fore-ditch and the lines, as may be ſeen in Plate DXXIX. If the prince had attempted to paſs over this ditch and theſe wells, he would have loſt a great number of men by the fire of the lines. The wells were ſo near to one another, that there was no poſſibility of paſſing between them: they muſt have been filled up, as well as the fore-ditch, with faſcines; which would have been too tedious and dangerous an enterpriſe.

In ſuch a ſituation, therefore, the beſiegers may wait quietly in their lines; but if they ſhould be of ſo great an extent, as not to admit of being equally guarded, then it ſeems to be the ſafeſt way to draw out the troops, and meet the enemy, as marſhal Tallard did at Landau, in 1703. After he had defeated the army which was marching to the relief of the place, he returned and finiſhed the ſiege. The duke of Vendome acted juſt in the ſame manner at the ſiege of Barcelona, in 1697. Having had intelligence that the marquis of Valeſco, viceroy of Catalonia, was preparing to attack him, he went out to meet that general, gained a complete victory, and returned afterwards before the place, which was obliged to capitulate.

At the ſame time, we muſt allow that the ſafeſt way to conduct a ſiege, is to have a good army of obſervation advantageouſly poſted ſo as to cover the ſiege, and be near enough to receive ſuccours from the troops employed before the town, ſhould the enemy come to a reſolution of giving battle.

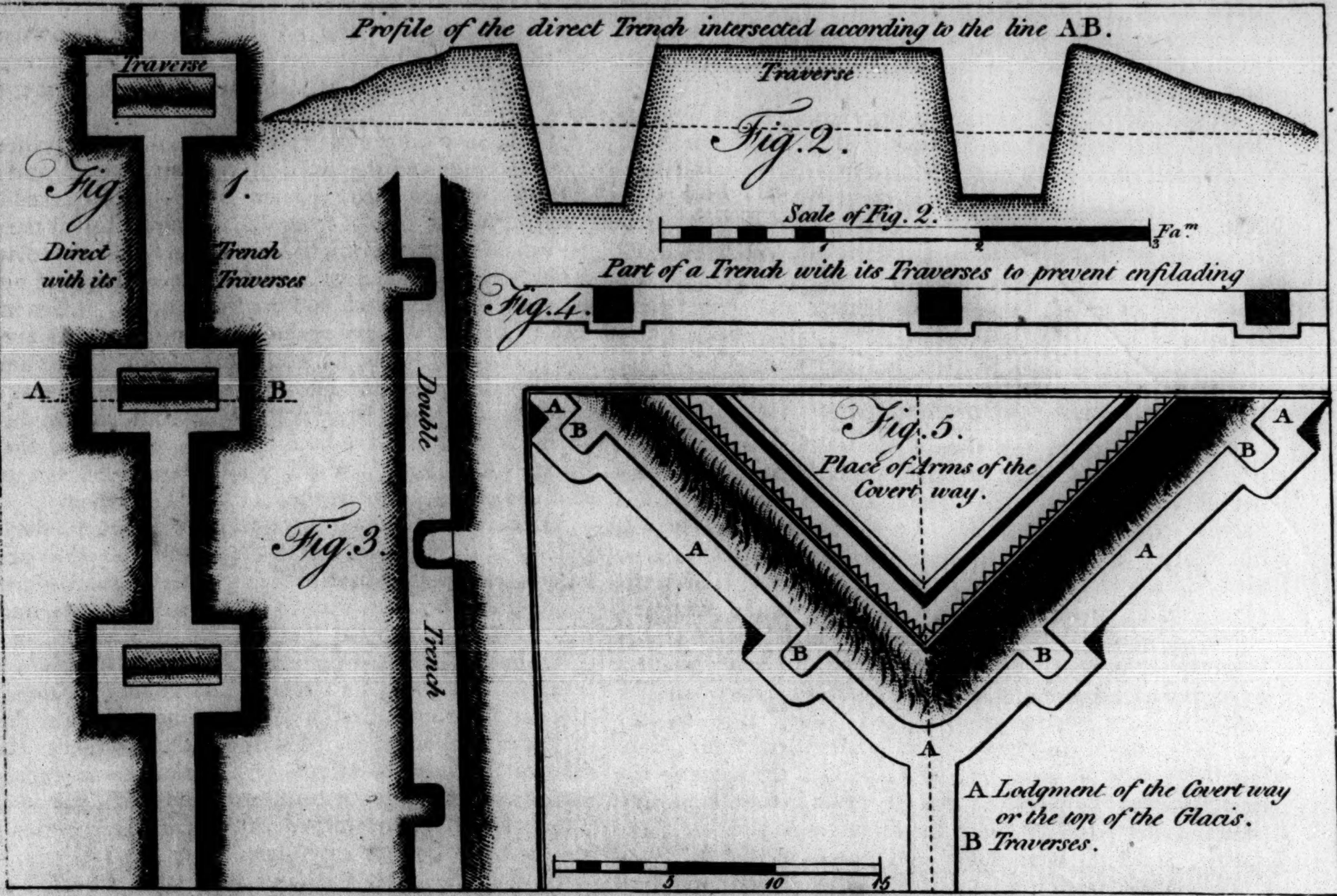
If the enemy do not think proper to attack the beſieging army, they may probably try to throw in ſome ſmall ſuccours of troops and ammunition into the town. The way to prevent them is to make the circumvallation very exact, and not to leave an opening in it, under any pretext whatſoever.

The enemy may likewiſe attempt the raiſing of the ſiege, by making themſelves maſters of the ſpot, or place, from whence the beſiegers draw their proviſions and ammunition. But before a general lays ſiege to a town, he ſhould take all the neceſſary precautions for ſecuring his magazines, covering his convoys, and guarding the ſeveral poſts through which the enemy might march to attack him.

Another expedient the enemy may think of for raiſing the ſiege, is to attack ſome place of importance, which the beſiegers have an intereſt in preſerving; in order to engage them to march to its aſſiſtance, and to abandon the ſiege they have in hand. But this expedient ought to have been foreſeen, and every precaution taken to prevent it. However, ſhould the enemy find means to engage in an enterpriſe of importance, and which requires an immediate relief, if a general thinks there is not time ſufficient to take the place he has laid ſiege to, and at the ſame time to oppoſe the enemy's deſigns, in that caſe he may raiſe the ſiege; but for ſo doing, there ſhould be very cogent reaſons. When king William laid ſiege to Namur, in 1695, marſhal Villeroy, in order

WAR.

Attack of Fortified Places.


Profile of the direct Trench intersected according to the line AB.
Traverse
Fig. 2.
Scale of Fig. 2.
1
2
3 Fa^ms
Fig. 1.
Traverse
Direct Trench with its Traverses
A
B
Fig. 3.
Double Trench
Part of a Trench with its Traverses to prevent enfilading
Fig. 4.
Fig. 5.
Place of Arms of the Covert way.
A
B
A
B
A
A
B
B
A
A Lodgment of the Covert way or the top of the Glacis.
B Traverses.
5
10
15

Plan shewing the disposition of the Lodgments and Batteries of the Covert way.

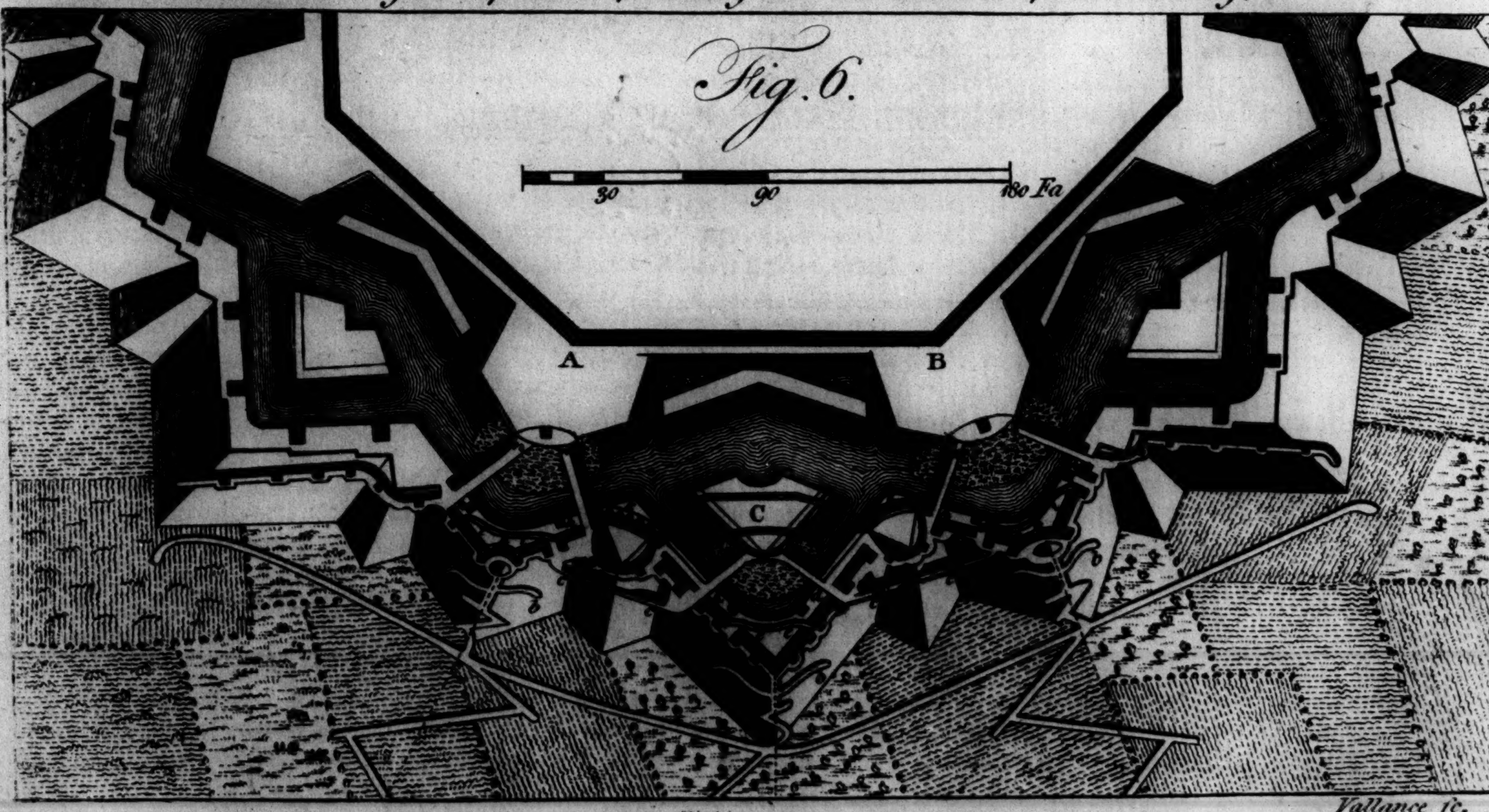


Fig. 6.
30
90
180 Fa
A
B
C

Vallance sc.

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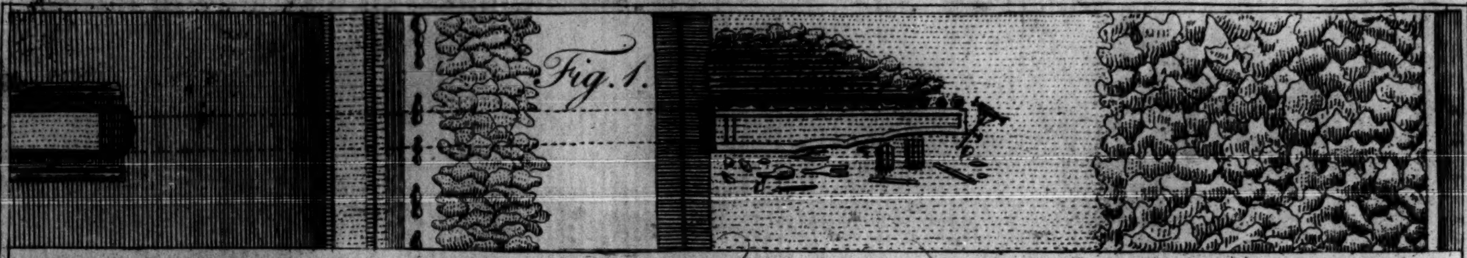
WAR.
attack of Fortified Places.

Plate DXXXIV.



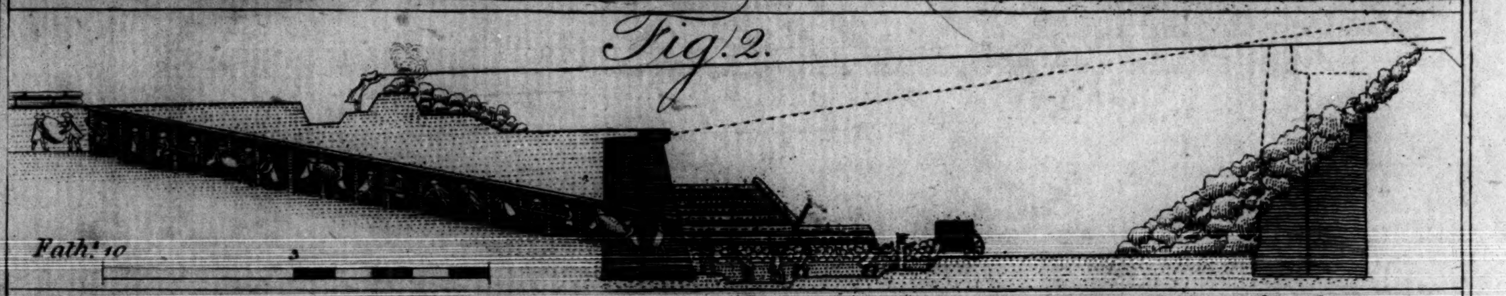
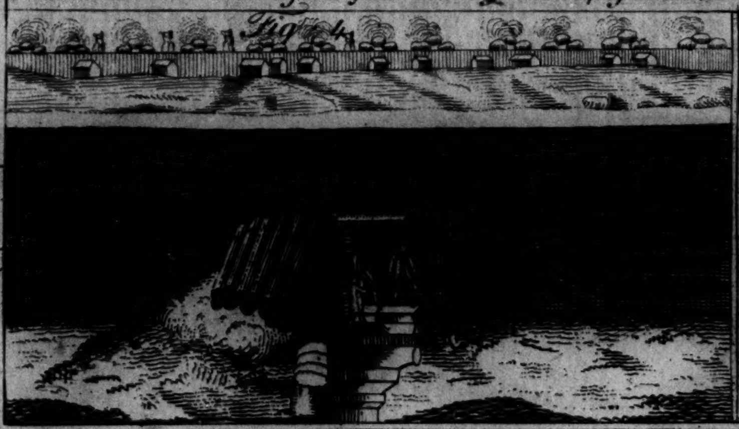


Fig. 2.
Fath.s 10
5

Entrance into the Descent of a dry Ditch view'd from the top of the Breach.



Opening of the Descent into the Dry Ditch view'd from the Country.

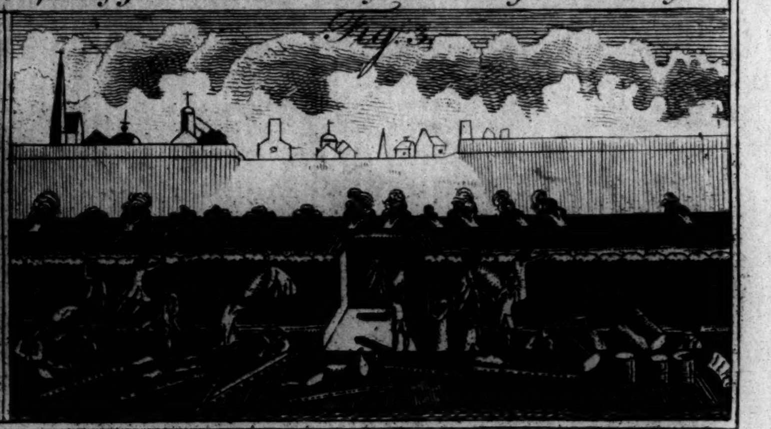
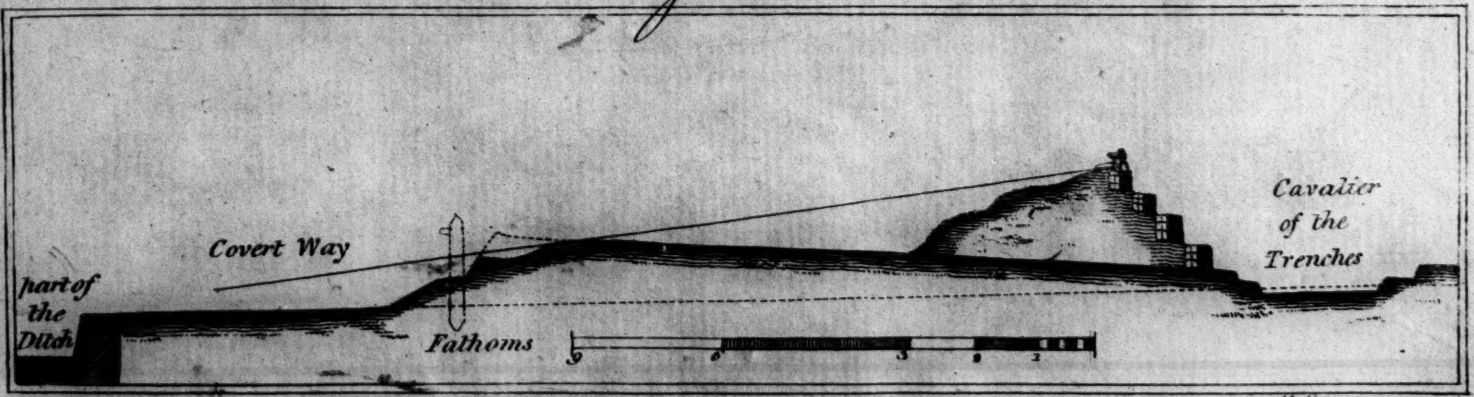


Fig. 5.


Covert Way
part of the Ditch
Fathoms
Cavalier of the Trenches

Vallance sc.

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WAR.

Attack of Fortified Places.

Plate DXXXV.

Fig. 1.

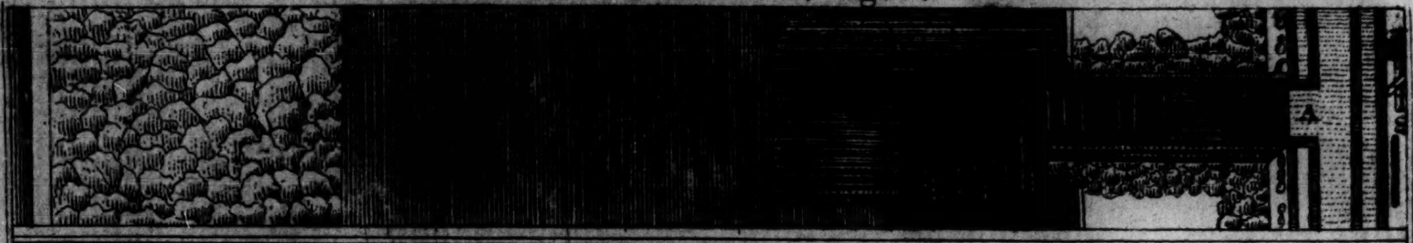
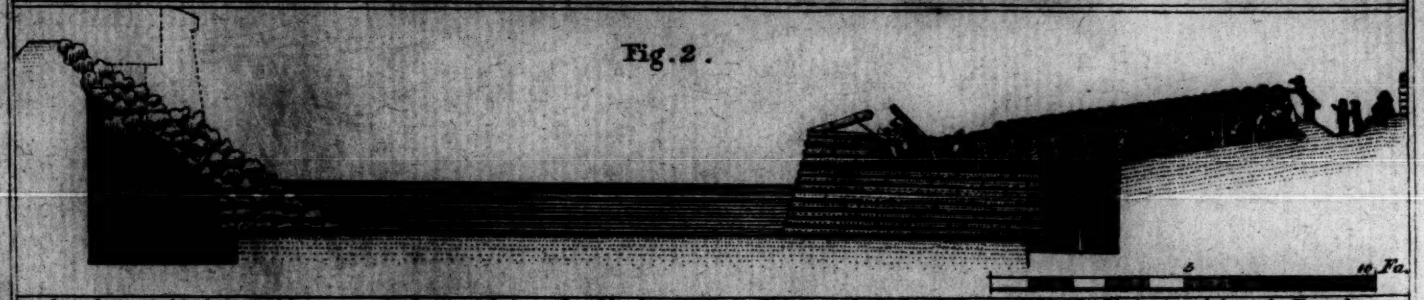
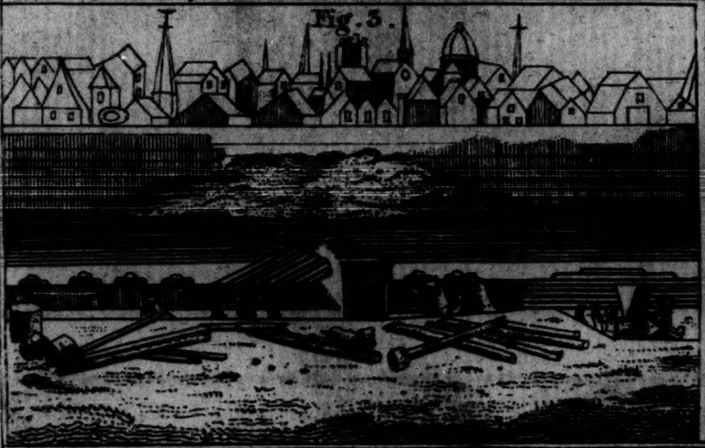


Fig. 2.



Opening of the deſcent into a wet ditch viewed from the Glacis.

Fig. 3.



Entrance into the deſcent of the wet ditch viewed from the Breach.

Fig. 4.

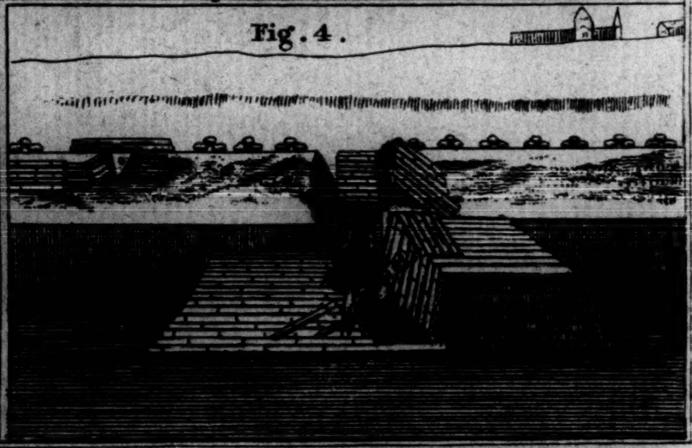
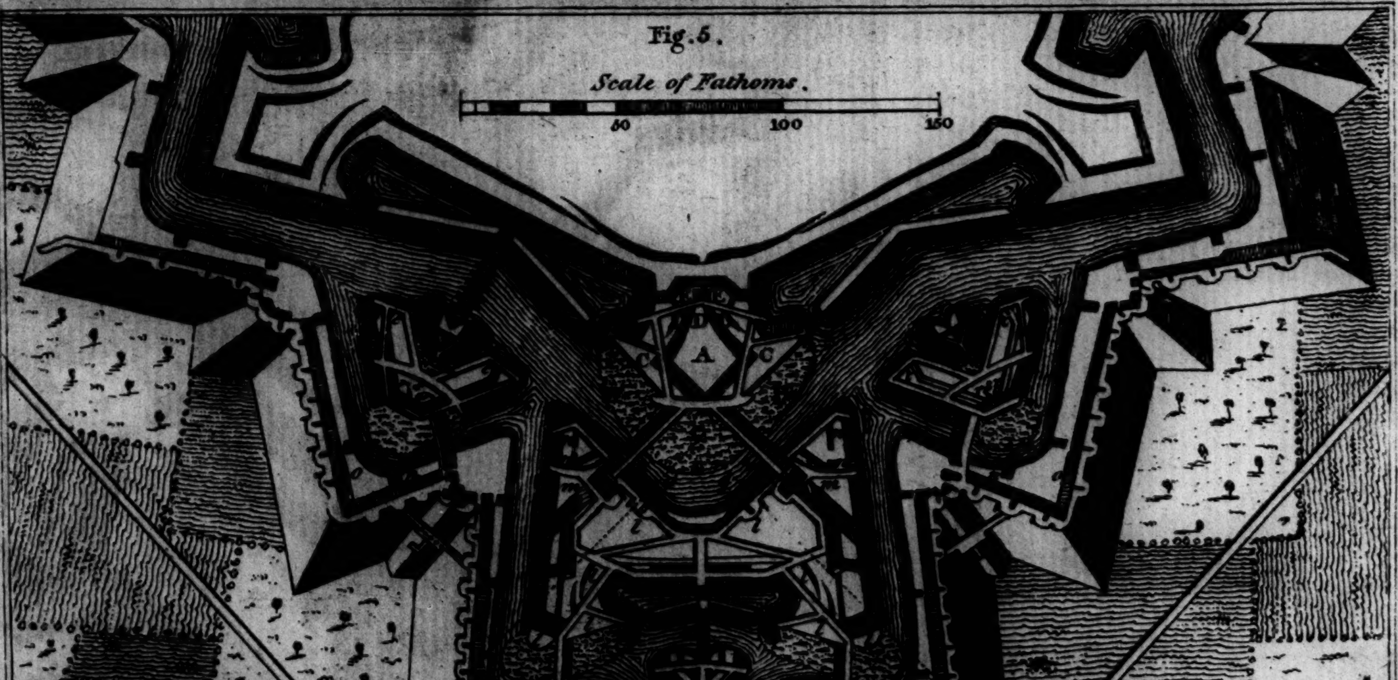


Fig. 5.


Scale of Fathoms.
50
100
150
A
C
2

Vallance ſc.

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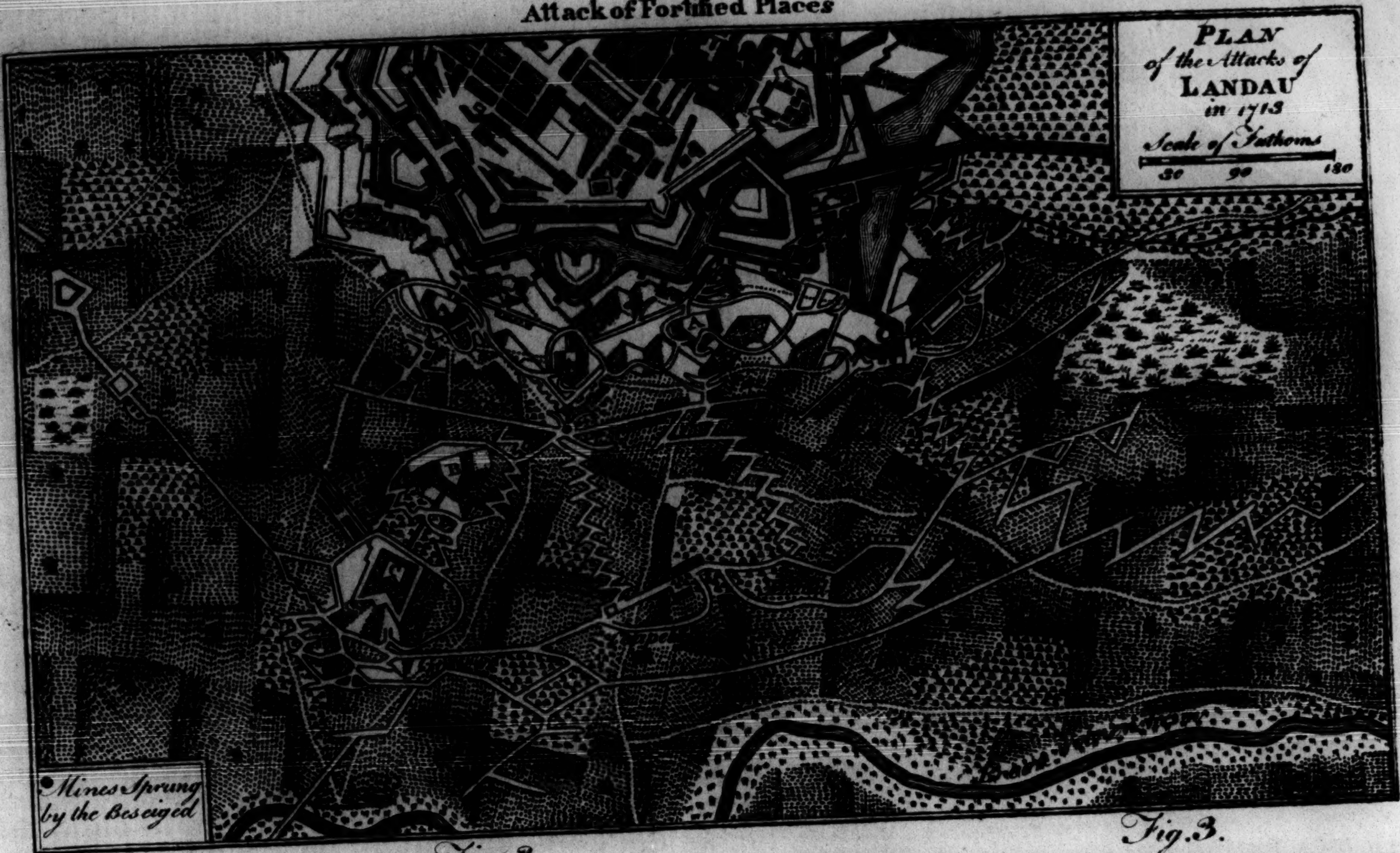

PLAN
of the Attacks of
LANDAU
in 1713
Scale of Fathoms
30
90
180
Mines Sprung
by the Besieged

Fig. 2.

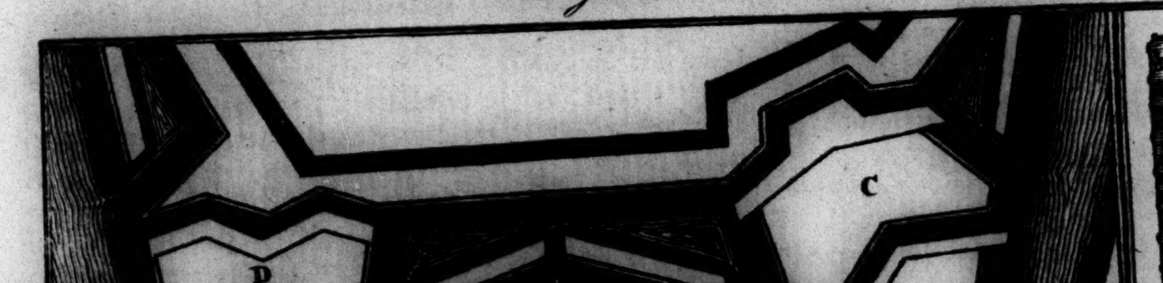
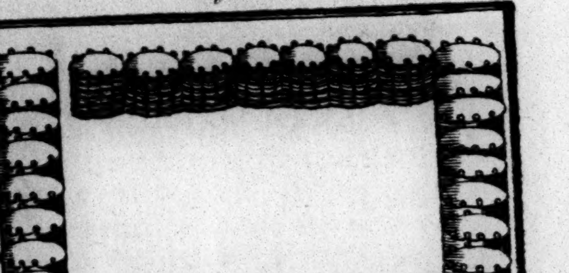

C
D
B
B
B
30
60
90 Fa

Fig. 3.



T. Clarke Sculpt.

BRITISH MUSEUM

order to divert him from his purpoſe, ſat down before Bruſſels, thinking he ſhould oblige that prince to march to its relief, and abandon his enterpriſe againſt Namur; but king William choſe rather to ſuffer that city to be bombarded, than to relinquiſh a very important conqueſt, in which he was in a manner ſure of ſucceeding.

Sect. II. *Of Defence.*

§ 1. *Of the Troops and Ammunition with which a fortified Town ought to be provided.*

As the goodneſs of the works, when a place is well provided with troops, ammunition, and proviſions, is what enables it to hold out againſt the attack of an enemy; ſo the want of any one of theſe three articles will not permit all the advantage to be reaped that was propoſed in fortifying a town. Men are properly the ſoul of a defence; and without them the beſt fortifications in the world are not able to make any great reſiſtance againſt the enemy.

Therefore we muſt firſt of all lay down as a maxim, that a governor cannot make a good defence, unleſs he hath the number of troops neceſſary for defending the ſeveral poſts, and obliging the enemy to pay dear for them. Immenſe ſums are expended in fortifying a place, in order to ſtop a ſtrong army with a ſmall force: but what reſiſtance can the place make without exerting a briſk fire; and what will thoſe heaps of walls avail, if they are not defended? The garriſon of a town beſieged ought to have a reaſonable ſtock of proviſions, in order to ſupport themſelves under the fatigue of military duty; they ought alſo to have powder, arms, and generally every thing that is requiſite to annoy the enemy, and to ſtop the progreſs of their operations.

It is not very eaſy to ſettle the number of troops neceſſary to defend a town; the nature of the ground on which the place is ſituated, and the number of outworks, ought to determine the ſtrength of the garriſon. M. Vauban in his Memoirs reckons, that in a place regularly fortified with good baſtions, half-moons, and covert-ways, we ſhould allow 500 or 600 men to each baſtion: That if the town has horn-works, 600 men may be likewiſe aſſigned to each of theſe; and in proportion for the other outworks, according to the relation which their defence may require to that of the horn-work; and the horſe ſhould be the tenth part of the number of the infantry.

This being premiſed, ſuppoſe a place has ſix baſtions, there muſt be a garriſon of ſix times ſix hundred foot, which makes 3600, and the tenth part of that number in horſe, which makes 360. Hence a ſufficient garriſon for ſuch a place will be 3960 men.

In order to compute, as near as poſſible, the quantity of ammunition and proviſions that may be required for ſuch a garriſon, we muſt calculate how many days they will be able to maintain a ſiege. The following are M. Vauban's remarks on this ſubject.

	Days.
For the inveſting the place and the tracing the lines	4
For the opening of the trenches to the attack of the covert-way	9
For the attack and taking of the covert-way, and making lodgments in it	4
For the deſcent and paſſage over the ditch before the half-moon	3
For fixing the miners, or for the batteries till the making of a reaſonable breach	4
Carry over	24
Brought over	24
For taking and ſecuring the interior part of the half-moon	3
For the paſſage over the great ditch before the two baſtions, ſuppoſed to be begun before the taking of the half-moon	4
For fixing the miners, or erecting batteries on the covert-way, to lay the place open and make a reaſonable breach	4
For the defence and ſupport of the breach after the place is laid open	2
For the miſtakes which the enemy may happen to commit, and their neglect in their works	4
Total of the defence	41

In this defence it is plain we ſuppoſe a town to be fortified only with half moons and a covert-way; but if the half-moon had a reduit with a revetement and rampart, it might hold out four days longer. If there were retrenchments in the baſtions, they might retard the taking of the place five or ſix days. If the ditch was ſtrengthened with tenailles and caponniers, the paſſage over it might be protracted two or three days. If there was a good horn-work, or ſome other like fortification properly ſtrengthened with a half-moon, a covert-way, and retrenchments within the work, the taking of it would coſt about 12 or 14 days. If this work had tenailles, the paſſage over its ditch would be later by two or three days. If there was a fore-ditch and a ſecond covert-way, the progreſs of the attacks would ſtill be leſs rapid, and we might reckon 10 or 12 days for the taking of this ſecond covert-way and the paſſage over its ditch. If there were redoubts near the place, they would ſtill protract the taking of it for ſome days.

From this eſtimate, though not very exact, an idea may be formed of the duration of a ſiege: a point abſolutely neceſſary for ſecuring, at leaſt, a ſufficient quantity of ammunition during the time; we ſay at leaſt, becauſe it is always prudent, if poſſible, to have a greater quantity of ammunition than is ſuppoſed to be wanted. When once the number of the garriſon, together with the duration of the ſiege, is fixed, it is then very eaſy to calculate the quantity of powder and ammunition with which the place is to be provided.

It is judged, that to be well provided with cannon, eight pieces ſhould be allowed to each baſtion. Therefore in a place of ſix baſtions there ought to be 48 pieces.

As a town is never attacked on all ſides, and there are ſeldom above two or three attacks at the moſt, the cannon belonging to thoſe baſtions that are not attacked, ſerve to ſtrengthen the baſtions attacked, and they are placed alſo in the outworks of the fronts attacked.

Among the cannon for the defence of the town there ſhould be ſome of 24, of 16, of 12, of 8, and of 4 pounders, and even of 2 and 1. The latter are of very great ſervice, becauſe of their being ſo convenient to remove with eaſe, and with few men, from one place to another; for this diſturbs the enemy, who find it difficult to deſtroy theſe ſmall pieces. The largeſt ſerve to fire againſt their batteries and their works. The ſmall ones are carried to the outworks, and to the covert-way, from whence they are fired *en barbette*. It is cuſtomary to make uſe of ſea carriages for theſe ſmall pieces.

Beſides cannon, the town ought to be provided with a great number of wall guns, carabines, muſkets, &c. We are to ſuppoſe that moſt of the ordinary arms will be broke in the ſervice, and therefore care muſt be taken to provide new ones when wanted.

The number of mortars neceſſary may be eſtimated at, two to every baſtion. They muſt be of different bores, of 12 and 8 inches diameter. There ought alſo to be ſeveral ſtone mortars.

The garriſon of a place of ſix baſtions, conſiſting, as we have already obſerved, of 3600 foot, are to be employed or diſtributed in the following manner.

We ſhould, firſt of all, reckon about 600 ſoldiers wounded and ſick, in the firſt 12 or 15 days of the ſiege, and for the ſervice of the batteries, the removing of ammunition, &c. And then there will remain 3000 for the defence of the place.

Theſe are to be divided into three equal bodies; one for the guard, the other for the biovac under arms, ready to march on the firſt notice where wanted, and the third to reſt.

The horſe are alſo divided into three bodies like the foot; that for the guard is chiefly placed on the right and left of the attack; that for the biovac is generally quartered by brigades, in different parts of the town, where they may be of ſervice, either to keep the inhabitants in awe, or to be ready to act in ſallies. In regard to the third corps, who are to reſt, their horſes muſt be ſaddled in the day; and the horſe or dragoons muſt be ready to mount inſtantly, ſhould there be any occaſion for their ſervice.

The guard of infantry and the biovac ought to be under arms, at the ſeveral poſts aſſigned them in the works of the place; and for the corps at reſt, they muſt be ready to ſupport the troops on guard, in caſe theſe ſhould have need of their aſſiſtance.

The guard of foot of 1000 men may be ſubdivided nearly into three equal bodies; two of which to defend the poſts attacked, and the third the other poſts not attacked. And in regard to the two firſt, they may be ſubdivided alſo into three equal bodies; two of which are to fire the firſt two hours of the night, the other is to relieve one of them at the end of that time, the next is relieved two hours after; and ſo on alternately, that there may be always two thirds of this guard in action, and the other third at reſt.

There is no occaſion for ſo briſk a firing by day as by night; becauſe the beſieged are more capable of ſeeing what the enemy are about, and of oppoſing their attempts; but in the night nothing but a ſtrong cannonading can guard againſt their enterpriſes. By day the troops fire from between baſkets, ſand-bags, or gabions, placed on the upper part of the parapet, to the end that being under cover they may take better aim at the enemy.

As the moſt perfect fortifications cannot hold out long without the neceſſary ammunitions, too much care cannot be taken in regard to this article.

“The ancients, ſays Mr Folard, were accuſtomed to lay in a great ſtore of proviſions, when a place was threatened with a ſiege; a ſtore ſufficient not only for three or four months, but for three or four years at leaſt. This they were induced to do for two reaſons; the fear of being blockaded; and the inviolable law of defending themſelves to the laſt extremity. The moderns take leſs precaution in reſpect to proviſions, as well as to every thing elſe; they think it ſufficient to lay in a ſtock for three or four months in towns of the greateſt ſtrength and importance; which is very wrong. I grant indeed (continues Mr Folard), that the law of holding out to the very laſt extremity is looked upon as chimerical at preſent, and entirely left to the ancients, but it ſhould be conſidered, that an enemy well acquainted with the ſtate of things will meaſure the ſtrength of the place by the quantity of proviſions contained therein; and making a calculation of the loſs of men in the attack, together with the expence of a long ſiege, they will chooſe, if they are wiſe (and certainly they will gain by it in the end), to take it rather by blockade than by a ſiege in form: at leaſt they will be ſure of becoming maſters of it in three or four months through want of proviſions; whereas a ſiege may laſt that time, if the garriſon are obſtinate. Such a town as Liſle in Flanders, and as Bergues, both of which are out of the line of communication of our frontier, cannot be too well ſtocked with proviſions. A wiſe and experienced miniſter will victual them at leaſt for eighteen months, becauſe they may be blockaded. It is much the ſame in regard to Straſburg and to Landau. The latter was never victualled for more than three or four months: how imprudent, therefore, muſt it be to lay ſiege to it, when it may be taken by a blockade almoſt as ſoon as by a ſiege, which is attended moreover with an infinite loſs of brave men, and a monſtrous expence?”

Theſe reflections of M. Folard are very ſolid; but circumſtances will not always permit a place to be ſo well provided as one could wiſh.

When a governor finds that the enemy threatens to lay ſiege to a town under his care, and that the place is in want of the chief things neceſſary for a vigorous defence, he is to exert all his abilities, in order to remedy this inconvenience as much as poſſible. The greateſt want of all is that of proviſions; he muſt therefore endeavour to get a ſupply, both from the country and from the people of the town; which is to be diſtributed among the garriſon with the greateſt economy. The uſeleſs mouths ſhould be all ſent out, and an inquiry ought to be made after thoſe who are ſuſpected of having hoarded any corn; and upon paying them for it, or upon giving them ſecurity of payment, they ſhould be obliged to deliver it up for the ſubſiſtence of the garriſon.

Hitherto we have made no mention of the inhabitants; yet they may be rendered ſerviceable in contributing to eaſe the garriſon. The governor ſhould make uſe of ſuch workmen who exerciſe handicraft trades for every thing relating to their reſpective branches; and thoſe who are not artificers, ſhould watch the fire that may be kindled by the ſhells and red-hot bullets; they ought likewiſe to tranſport the materials to the places aſſigned them; and even to work at the different retrenchments which the governor ſhould think fit to order in the town, provided however that they be not too much expoſed to the fire of the beſiegers. An article of the greateſt importance in regard to the inhabitants, is to oblige them to lay in a ſtock of proviſions for ſix months, and thoſe that are able ſhould be obliged to make ſtill a greater proviſion, which will be a reſource to the garriſon when their own ſtock is exhauſted.

§ 2. *Neceſſary Preparations for maintaining a Siege.*

When a town is threatened with a ſiege, the governor ought not only to take care to have a plentiful ſtock of ammunition and proviſions, but moreover he ſhould uſe all the precautions requiſite for retarding the enemy's approaches, and rendering them more difficult and dangerous.

He ought therefore to leave nothing in the neighbourhood that may ſerve to cover the enemy; he ſhould clear the adjacent country of all houſes that are within reach of cannon-ſhot, and fill up, if poſſible, the caverns or hollow ways that may be concealed, or build ſome redoubts and other works under the protection of the place, by which they may be enfiladed. He ought to cut down all the trees: in a word, he ſhould prevent the enemy's having any cover within reach of the cannon of the place; he ſhould ſee that the fortifications be all in a good condition, and that the covert-way be well paliſaded; in fine, he ſhould cauſe arrows to be built on the ſaliant angles of the glacis,

glacis. Retrenchments may alſo be made in the re-entering places of arms of the covert-way, by raiſing a parapet within them, and parallel to their faces, with a ſmall ditch before it. Nor ſhould the galleries for the mines be forgotten; on the contrary, they ought to be begun betimes, and carried out into the country as far as the ground will permit: and chambers ſhould be made under all the angles of the glacis. If there are any houſes within the rampart which may obſtruct the defence, the governor ought to ſee them demoliſhed; and nothing ſhould be left, either within or without, which can any way be of ſervice to the beſiegers. If there are new raiſed troops, care ſhould be taken to diſcipline them well.

The governor ſhould alſo ſee that the hoſpitals be in a good condition, that the ſick and wounded be taken care of, nor think it beneath his character to viſit them himſelf, and to let the ſoldiers ſee how greatly he has their preſervation at heart. This is the ſureſt way to gain their confidence and affection, and to engage them to do their utmoſt towards defending the place.

As it is now the cuſtom to throw a great number of ſhells into a town beſieged, it is neceſſary to have vaulted places under ground bomb-proof, where part of the garriſon not on duty may reſt in ſafety. They are not ſo much wanted in large cities, where there are always different quarters ſecure from the enemy's ſhells: but a ſmall town is in every part expoſed to the bombs; ſo that ſome places under ground are abſolutely neceſſary for the garriſon to take their reſt, and to prevent the troops from being continually incommoded. Theſe ſubterraneous caverns are generally made in the gorges of the baſtions, and ſometimes under the rampart behind the curtains.

Where there are none of thoſe ſubterraneous places, it will be neceſſary, as ſoon as the town is inveſted, to erect defences to ſhelter the men from the bombs; theſe are made of ſtrong pieces of timber, laid ſloping againſt the parts the leaſt expoſed, and they may be covered with thick planks laid in the ſame manner. The large houſes ſhould alſo be ſhored, that is, all the floors, from top to bottom, ſhould be ſupported with ſtrong upright timbers, and the upper floor covered with large beams laid acroſs one another, and theſe again with earth, faſcines, dung, &c. When they are thus fitted up, they may ſerve either for the accommodation of the troops or for hoſpitals, &c. But what deſerves a more ſpecial care, is the powder-magazines. They ought to be bomb-proof; but as there are very few that can reſiſt the ſhock of a great number of ſhells, they ſhould therefore be covered with ſeven or eight feet thick of earth, and a layer of faſcines, dung, and ſtrong planks laid over them, ſo as to form a kind of roof. But if it ſhould happen, either from their ſituation or height, that this cannot be done, then a range of large trees, well faſtened together, muſt be laid over them, ſo as to diminiſh the ſhock of the ſhells. The windows of the powder-magazines ſhould have no proſpect towards the beſiegers; and to prevent all accidents, nobody ſhould be permitted to go in or out of the doors, but when the fire of the enemy is ſlackened.

When there are no powder-magazines in a town, it is very difficult to preſerve the powder during a ſiege; all that can be done, is to diſtribute it in different places, as in cellars and caves made under the ramparts, or in gardens, &c. and to cover theſe places well with thick planks, earth, faſcines, &c.

The miſchief done by ſhells conſiſts not only in demoliſhing the buildings on which they fall, but likewiſe in ſetting fire to moſt places they fall upon; and when they are followed by red-hot balls, it is very difficult to hinder the town from being burnt. In order to remedy this evil, timely precautions ſhould be taken, and the inhabitants employed in extinguiſhing the fire.

Firſt of all, a great number of caſks, filled with water, ſhould be placed in the ſtreets; and the ſoldiers and inhabitants ought to be divided into companies, to prevent the ſpreading of the flames. It will be proper to divide theſe into ſmall bodies, and to allot different quarters to each of them, for extinguiſhing any fire that may happen to particular houſes. By theſe means each corps, or company, will become anſwerable, in ſome meaſure, for the houſes entruſted to their care, and uſe the utmoſt endeavours to preſerve them. The pavements muſt alſo be taken up, and dung laid in the ſtreets, to prevent further miſchief from the burſting of the ſhells.

§ 3. *Of the defence from the inveſting to the Attack of the Covert-way.*

WHEN the place is inveſted, and the beſiegers begin to work upon the line of circumvallation, the governor ought not at firſt to fire upon the enemy's troops with the largeſt cannon, but with his ſmall pieces only. For as the enemy ought to pitch their camp as near as poſſible to the place, provided they are out of reach of cannon-ſhot, they will think themſelves at a ſufficient diſtance when out of the reach of thoſe ſmall pieces; but as ſoon as they are encamped, the garriſon are to give them a full volley with their great guns, which will oblige them to decamp once more, and make them loſe time.

While the beſiegers are conſtructing the lines, their engineers ſpare no pains to get an exact knowledge of the adjacent ground, and to reconnoitre the fortifications, that they may form the plan of attack, which they will be ſure to make on the weakeſt ſide. To prevent this, M. Goulan propoſes the following ſcheme.

As ſoon as the town is inveſted, the governor ſhould ſend 200 or 300 men every night to that ſide which he knows to be the weakeſt, with orders to lie upon their faces, in the form of a ſemicircle, of which the paliſades of the covert-way may be conſidered as the diameter. Theſe men ſhould be divided into ſmall parties, of three or four men each, at the diſtance of 20 or 30 paces from one another, ſo as to occupy a large tract of ground. All theſe different parties ought to agree upon a ſignal, to give notice when any body paſſes by them, and they ſhould remain there in ſilence till day, without ſtirring, unleſs ſomebody happens to paſs by; in which caſe, the firſt that ſees them ſhould riſe, and give the ſignal to the reſt, who are to do the ſame; then all drawing cloſe together, and advancing to the paliſades, they will take thoſe who paſſed, as it were in a net, without any poſſibility of relief from their eſcort, who cannot be numerous enough to reſcue them from the hands of 200 or 300 men, protected by the fire of the covert-way. If the men who advance to reconnoitre the place, inſtead of paſſing through the intervals, ſhould fall in with ſome of theſe parties, and endeavour to get off, they muſt be fired upon: thus the enemy may be eaſily hindered from reconnoitering, and thereby acquiring a knowledge of the ground, or the ſide moſt proper to be attacked.

From the time the place is inveſted, the beſieged ſhould ſend every night ſmall parties of eight or ten men, commanded by a ſerjeant, with orders to lie upon their faces all round the border of the glacis, and to liſten carefully to every thing that paſſes. Whatever care the beſiegers may take to open the trenches in ſilence, ſtill it will be very difficult for this operation to be made, without ſuch a motion as muſt be heard or perceived from the neighbourhood of the glacis. Theſe ſmall parties may even advance a little further, obſerving ſilence, and taking care not to be ſurpriſed by the parties which the enemy alſo may ſend out on that ſide, to watch whether there are any troops of the garriſon ready to fall upon the workmen.

When the ſide on which the enemy open their trenches is known, the great pieces of ordnance are mounted on the rampart of the town *en barbette*, and the ſmall ones on the covert-way, from whence they are to fire briſkly upon the trenches. And to point more exactly, fire-balls are thrown from the mortars, which will give light enough to diſcover the workmen. Juſt at this time, the beſieged ſhould make the greateſt fire againſt the enemy, becauſe it is then they are moſt uncovered, and conſequently moſt expoſed. As the beſieged cannot have their batteries ready till the ſecond or third day after the opening of the trenches, during that time the guns may continue to fire *en barbette*; but it will hardly be poſſible to fire in that manner when the enemy's batteries are once erected. Mortars ſhould likewiſe be uſed for throwing ſhells on the workmen and thoſe employed on the batteries; in ſhort, the beſt uſe ſhould be made of the artillery, before the enemy are in a condition to ſilence it.

It is cuſtomary to make two or three attacks in order to divide the attention of the garriſon; and of theſe, generally ſpeaking, there is only one real: they muſt therefore endeavour to find out this real attack, and to uſe the utmoſt diligence in making good retrenchments, as well in the outworks, which the enemy muſt take before they can come to the body of the place, as in the gorge of the baſtion of the front attacked. But to render theſe retrenchments ſtrong and firm, they ſhould have been begun and even finiſhed before the opening of the trenches. A governor, who has a proper knowledge of fortification, ought to judge on which ſide a town is moſt acceſſible, and to preſume that here the enemy will commence their attack; conſequently he ought to think of every method of defence, the beſt adapted to retard the approaches, and diſpute every inch of ground.

The beſieged ſhould ſo diſpoſe their artillery at the beginning of a ſiege, as to enfilade the branches, and to direct their fire againſt the head of the trenches or the ſaps. This muſt be their principal effort; for it is by continually firing upon them that they may reaſonably hope to retard the works.

When the enemy have erected their batteries, it is very difficult for the beſieged to maintain theirs, eſpecially if they are placed on the produced faces of the pieces attacked. For as the cannon are continually firing *à ricochet* againſt theſe faces, and it being difficult to guard againſt this firing, it will be very dangerous for the ſoldiers to remain there: all that can be done is to make ſome traverſes, in order to diminiſh their effect; which is difficult indeed to compaſs, becauſe the ſhot falling upon the traverſes will bound between them. It is adviſable not to perſiſt in firing always from the ſame place againſt the enemy's batteries. By ceaſing to fire from that part where the beſiegers know there was a battery, they may be induced to think they have deſtroyed it, which will prevent their continuing to fire againſt it, and be a means of preſerving the battery for future ſervice. But in order to give them trouble, ſmaller guns may be placed in the outworks, on the faces of the baſtions, from whence the trenches and batteries of the beſiegers can be diſcovered; and they muſt often change place to perplex the enemy, who will find it very difficult to diſmount thoſe moving pieces. The beſieged however muſt endeavour to repair the parapets deſtroyed by the enemy, and to take proper meaſures for firing again from thence, as ſoon as the beſiegers have ſhifted their guns.

It is alſo adviſable that the batteries of the beſieged ſhould not fire in ſalvos, or all at a time; for it is well known, that the beſiegers place ſoldiers in the trenches to obſerve, through ſmall loop-holes made with ſand-bags in the parapet of the trench, when the batteries of the town are fired, and to give notice to thoſe who are at work in the trenches, which way the guns are pointed, that they may put themſelves under cover. If the beſieged have only ſix pieces on a battery, and they fire them all at a time, the enemy have ſome moments of ſecurity to look over the parapet and to examine the ground where they intend to work and to conduct the trenches: but when the garriſon vary their manner of firing, they give more uneaſineſs to thoſe who are at work in the trenches, who will not be ſo ready to look over the parapet; which, though it be neceſſary, in order to view the ſituation of the ground towards which the works are to be directed, is ever dangerous, but eſpecially when the trenches are brought within muſket-ſhot of the place.

§ 4. *Of Sallies.*

A Garriſon that keeps within a place without making ſallies, is, as the chevalier de Ville ſays, like thoſe who are not concerned when their neighbour's houſe is on fire, and will not ſtir to extinguiſh it till it has reached their own. And indeed, as the beſiegers continually carry on their approaches towards the town, it is of the utmoſt importance to endeavour, in time, to ſtop their progreſs; to which end, the making of ſallies is extremely conducive, eſpecially when they are well conducted, otherwiſe they would rather accelerate than retard the taking of the place.

How great ſoever the advantage of ſallies may be, they are proper only when a garriſon is numerous. A ſmall garriſon, although well ſtocked with all the kinds of neceſſary ammunitions for making a defence, and for holding out, ought to be very careful how they venture to make a ſally. But a numerous garriſon, not ſo well provided, ought to fatigue the enemy as much as poſſible by frequent ſallies. The ſame meaſure ought to be followed when a town is but ill fortified; the garriſon ſhould not ſhut themſelves up ſo as to be obliged to ſurrender, as it were, without making much reſiſtance. It is beſt in thoſe caſes to haraſs the enemy continually, to keep them at a diſtance as long as poſſible, and to uſe every ſtratagem and endeavour that may retard their approaching the glacis, and the taking of the covert-way. Thus it was that the marquis of Uxelles, afterwards marſhal of France, behaved at the ſiege of Mentz in 1689. He defended that large and ill fortified town upwards of two months, with the help of a very brave garriſon; but was obliged to capitulate for want of powder and ammunition, though he was ſtill maſter of the covert-way, and even in ſome meaſure of the glacis.

When the beſiegers are at a diſtance from the place, ſallies are very dangerous, becauſe the enemy may cut them off from the town with their horſe: but when they have made their ſecond parallel, and advanced the branches of the trenches towards the third parallel at the foot of the glacis, then is the time for the garriſon to ſally. They may even venture, though with great caution, when the beſiegers are at work upon the ſecond parallel, and before it is entirely finiſhed; but the moſt favourable opportunity of ſallying, is when the beſiegers are come to the third parallel, and want to make a lodgment on the glacis. Then there is no danger of being cut off; and the enemy may be ſurpriſed the more eaſily, as the garriſon have it in their power to fall upon them all at once, and to throw them into confuſion, without giving them time to recover themſelves.

Sallies may be either great or ſmall; the former ought to be with 500 or 600 men at leaſt, or proportioned to the guard in the trenches; the latter are only with 10, 15, or 20 men.

The intent of great ſallies ſhould be to deſtroy a conſiderable part of the works of the beſiegers, in order to oblige them to begin again; to nail up their guns; to retake ſome poſt which had been abandoned; and laſtly, to obſtruct the enemy's works as much as poſſible, and thereby retard the taking of the place.

In regard to ſmall ſallies, they ſerve for no other end than to interrupt the workmen at the head of the trenches, ſo as to frighten them, and oblige them to run away. As it requires ſome time to bring them back, and to make them return to their work, this will occaſion delay, and retard the approaches.

The beſt time for great ſallies, is two hours before daylight, the troops being then fatigued and ſleepy; therefore more eaſily ſurpriſed, and leſs capable of making a vigorous reſiſtance. And when it has rained very hard in the night, ſo that the guard in the trenches may be unable to make uſe of their fire arms, this is alſo a favourable circumſtance: in ſhort, no opportunity ſhould be neglected to ſurpriſe the enemy; for ſallies ſeldom prove advantageous any other way. The following is the order which M. Vauban propoſes to be obſerved.

There ſhould be a detachment of 90 men drawn up, 30 in front, and three deep; to which muſt be added a fourth rank of 30 grenadiers. The three firſt ranks of this detachment ſhould be armed with cuiraſſes; each ſoldier ſhould have a ſword and piſtol at his belt, and a partizan, or long iron fork with a hook, in his hand. This detachment is to be followed by another of 180 men, 30 in front, and ſix deep; the firſt rank of theſe is to be armed as the former, with cuiraſſes and long weapons, the reſt as uſual. The firſt rank in this detachment is to make up the rear in the retreat. After this ſecond detachment 200 workmen are to follow with proper tools to deſtroy the enemy's works, and ſeveral of theſe with combuſtibles to burn what they cannot otherwiſe deſtroy. Some of them are to be provided with long nails of ſteel, and of different magnitude, to ſpike the cannon; there muſt be ſome of a very large ſize, becauſe the touch-holes happen frequently to be ſo very wide, that common nails will not fill them up exactly.

Beſides the two detachments and workmen above mentioned, another body of 300 or 400 men ſhould be ordered to ſupport them, and to follow them ſlowly as far as the head of the trenches; where, if they find that thoſe who went before them have no need of aſſiſtance, they ſhould halt to be ready to act if occaſion requires it. If the guard of the trenches ſhould make a vigorous attack upon the ſally, this detachment will ſupport them, and jointly encounter the beſiegers. If the latter are repulſed, which muſt be the caſe if the ſally is not foreſeen and expected, the workmen muſt ſet about demoliſhing the works, and filling up the trenches as faſt as poſſible. Theſe troops ſhould alſo endeavour to penetrate as far as the batteries, in order to nail up the cannon, and to maintain themſelves in the trenches long enough for the workmen to deſtroy great part of them. When they have done what they propoſed, they retreat to the covert-way in good order; and if the enemy ſhould be ſo imprudent as to purſue them as far as the glacis, they muſt be received with a briſk fire as well from the cannon of the ramparts as from the troops in the covert-way.

In ſallies, and generally in all actions performed by night, the ſoldiers ſhould put ſomething in their hats, as a white paper or handkerchief, to know one another in the dark. The troops deſigned for this purpoſe are drawn up in the place of arms within the town, or in the ditch if it be dry, or elſe in the covert-way. When they are to march out by different gates, ſome ſignal ſhould be agreed upon, that they may all move at the ſame time. If there are more attacks than one againſt the town, as generally is the caſe, then ſeveral ſallies may be made at the ſame time upon theſe attacks. It might be proper to make a great noiſe on one ſide, in order to draw all the attention of the enemy that way; and while they are buſy in the repulſe, to act vigorouſly on the other ſide; for then they will meet with leſs reſiſtance, and will be more capable of hurting the beſiegers. However, as a ſally which has not all the ſucceſs that might be expected, ought not to diſcourage the garriſon from repeating the attempt; ſo one that has been crowned with ſucceſs ought not to render them too confident, or inſpire them with too great a contempt for the enemy. The miſtakes the latter may have committed, will rouſe their attention, and put them upon their guard. We ought ever to ſuppoſe, that they will do all that we ſhould do, were we in their place, and that they will take proper meaſures to remove every obſtacle that may oppoſe them.

Hitherto we have taken no notice of the uſe of cavalry in ſallies; and yet on ſome occaſions they may be of ſervice, which is when the beſiegers are at a diſtance from the place. In this caſe, two detachments of horſe are ordered to the right and left to ſupport the ſallies, and to hinder the enemy's horſe from falling upon them. Theſe detachments ſerve alſo to protect their retreat, and to prevent their being cut off; but when the beſiegers have finiſhed their third parallel, the ſallies are then made with foot only, and ſhould, as we have above obſerved, be often repeated, provided the garriſon is numerous enough to diſpute every inch of ground with the enemy.

As ſoon as the troops are returned from the ſally, fireballs ſhould be thrown into the trenches, to diſcover the workmen who are employed in repairing the miſchief that has been done, and are at that time in ſome meaſure uncovered. The fire of the place well ſerved at this juncture, muſt kill a great many of the enemy. So far relates to great ſallies.

The ſmall ſallies, which are intended merely to diſturb the beſiegers without being able to do them much hurt, are conducted in the manner following. The governor orders out parties of 10, 15, or 20 ſtout men only, as hath been already obſerved, who are to advance ſoftly to the head of the trenches, and to jump into them quickly, making a great noiſe, and throwing grenades; after which they are to retire with all expedition: the alarm which they will occaſion is ſufficient to make the workmen take to their heels, who deſire nothing better than to have a ſpecious pretence, as M. Goulon obſerves, to run away upon the leaſt alarm; and it is impoſſible to prevent it, or to bring them back the ſame night; ſo that the beſiegers muſt loſe all this time. If, ſays the ſame author, the beſiegers become accuſtomed to theſe little ſallies, ſo as to grow ſecure and take no notice of them, the beſieged obſerving this muſt make one in good earneſt, which coming unexpected, will eaſily overturn the workmen and the troops that cover them; after which they may retire without fighting, leſt they ſhould draw the whole guard of the trenches upon their backs.

§ 5. *Of the Defence of the Glacis and the Covert-way.*

BESIDES the ſallies which retard the lodgment of the beſiegers on the glacis, mines may increaſe the difficulty of approaching. We have already taken notice of theſe in the ſection of *Attack*; we have only to obſerve here in general, that the beſieged muſt make the beſt uſe of them poſſible, in order to blow up the enemy as often as the ground will permit; this is the ſureſt way to keep the beſiegers in awe, and to oblige them to advance with the greateſt circumſpection.

Beſides the galleries and mines which ought to be under the glacis, the beſieged may alſo lay oppoſite to its angles large planks, ſtuck full of very long nails, with the points upwards, to incommode the enemy in paſſing over the glacis. Theſe planks ought to be ſtrongly fixed, to prevent their being eaſily taken away. The burying of caiſſons in the glacis is alſo productive of a good effect; but they ought never to be placed nearer than ſix or eight feet to the inſide of the covert-way, leſt they ſhould do any damage to the troops that defend this poſt.

When the enemy endeavour to make a lodgment on the glacis, the garriſon muſt repeat their ſallies with greater vigour; which may be done without any inconvenience, becauſe of the facility of retreating. When the troops are returned from the ſally, fire is ſet to the chambers and caiſſons, which will greatly diſconcert the beſiegers. If the chambers are well diſpoſed, they muſt hurt their lodgments prodigiouſly; and as ſoon as they are ſprung, the beſieged may fall upon the enemy, this being a favourable opportunity for ſurpriſing them in diſorder, and conſequently of deſtroying part of their works. This manner of proceeding ſhould be often repeated, in order to fatigue the beſiegers, and to retard the taking of the covert-way.

When the enemy are ready to ſtorm it, the garriſon muſt prepare to give them a warm reception. The difficulty of making a lodgment in the covert-way may be increaſed by a double row of paliſades: the ſecond ſhould be lower than the firſt, to the end that the enemy may not perceive them. Theſe two rows ought to be at the diſtance of four or five feet from one another, to prevent the beſiegers from jumping over them into the covert-way. Between them may be made a ſmall ditch; into which moſt of the enemy's grenades will fall, and cauſe leſs miſchief to the troops. Care muſt be taken to make ſtrong retrenchments in the places of arms, either by raiſing a parapet withinſide, and parallel to their faces, with a ſmall ditch at the foot of it, or by ſimple rows of paliſades, which will hinder the enemy from forcing their way ſo eaſily as they would otherwiſe be capable of doing. In each place of arms there ſhould be one or two barrels of powder, with balls and ſmall arms neceſſary for the defence of the covert-way.

All the batteries muſt be got ready to fire with the utmoſt briſkneſs upon the enemy, when they are at work upon their lodgment. Every part of the place that looks into the covert-way ought to be lined with troops, who are to fire upon the beſiegers; but there ought to be no troops in the parts oppoſite to the places of arms, that the troops poſted there may not be hurt by the fire from the body of the place.

The garriſon ſhould endeavour to be informed by deſerters at what time the enemy intend to make their attack; the motions of the latter may be alſo obſerved by perſons poſted on ſteeples; and as ſoon as the troops are perceived to make an extraordinary motion, and the trenches to be filled more than uſual, this is a ſign that they are going to attack. The vicinity of the enemy's works may alſo enable the beſieged to judge of their forwardneſs; and all this together direct them to take ſuch meaſures as are proper for giving a warm reception to the beſiegers.

As ſoon as the garriſon perceive that the enemy are marching out of their trenches, they ſhould keep firing upon them continually with great and ſmall arms from all the works facing the attack. This will deſtroy a great many of their men before they can reach the paliſades: the two rows of which in the covert-way will prevent their jumping into it directly. They will be under a neceſſity of breaking them ſucceſſively with hatchets; and while this is doing, a general diſcharge is to be made from the batteries of the town, which will do great execution. When, after a vigorous reſiſtance, the garriſon find themſelves hard preſſed by the enemy, they may abandon the covert-way, and retire into the places of arms; and while the beſiegers are working upon their lodgment, they will be expoſed to the fire of the place, which takes them in front; and to that of the places of arms, by which they are taken in flank; ſo that their loſs muſt increaſe conſiderably. If they have mines ready, as we ſuppoſe they have, they muſt ſpring them, after having ſuffered the enemy to work for ſome time upon their lodgments; and after having kept firing againſt them continually with great and ſmall arms, then immediately they ſhould make a ſtrong ſally from the places of arms, and taking advantage of the diſorder into which the beſiegers muſt inevitably be thrown, they will oblige them to abandon the covert-way.

If there is no poſſibility of hindering the enemy from making lodgments on the creſt of the covert-way, or, which is the ſame thing, on the ridge of the glacis, the beſieged muſt endeavour to retard them, and to diſpute as long as poſſible their taking poſſeſſion of the places of arms. On this occaſion fougaſſes are employed with ſucceſs, and ſhould be repeated ſeveral times if the ground will permit. When the beſiegers have once completed their lodgment, and ſupported it in a proper manner, they want nothing further than a little time to extend themſelves, and to become maſters of the covert-way. The obſtinacy of the beſieged can only retard, but not abſolutely hinder, the taking of this outwork.

Let us ſuppoſe that the enemy reſolve to approach the covert-way by ſap, and that they have raiſed cavaliers in the trenches to plunge into this outwork, the beſieged muſt ſtrive to retard this operation by every ſtratagem imaginable; for when the cavaliers are once conſtructed, it will be very dangerous to abide any longer in the covert-way. They muſt ſtop the beſiegers at every ſtep with mines; they muſt haraſs them with a conſtant diſcharge of fire-arms, and diſpute every inch of ground, defending themſelves behind every traverſe, and in the places of arms, as well as they can, without running too great a riſk of having their retreat cut off.

§ 6. *Of the Defence of the Paſſage over the Ditch before the Half-moon.*

The enemy having made themſelves maſters of the covert-way, and perfected all their lodgments, will erect their batteries for making a breach, and prepare for the deſcent into the ditch. All this while the beſieged muſt keep firing both with their great and ſmall arms, in order to incommode the enemy in the conſtruction of their batteries. If the ditch is dry, the ſoldiers may mount with ladders along the counterſcarp, and from thence throw grenades into the enemy's works; and when they cover themſelves in the covert-way with ſand-bags, gabions, &c. againſt the fire of the place, theſe very ſoldiers ſhould, with great ſap-hooks, pull down part of them, and afterwards jump nimbly into the ditch, leaving the enemy expoſed to the fire of the town while they are putting their materials again into order. Mines may be likewiſe uſed here with great advantage; they furniſh various means to haraſs the enemy, to obſtruct their works, and to make them loſe time and men.

The batteries of the beſiegers being deſtroyed by mines made under them, muſt oblige them to loſe a great deal of time in repairing them, and in endeavouring to make themſelves maſters of the mines, otherwiſe they can never be ſecure. When the beſieged have blown up the batteries that were to open the breach, they muſt make good uſe of the time which the enemy will ſpend in repairing them, and ſtrive to perfect the retrenchments, which ſhould have been ſet about at the commencement of the ſiege, in the gorge of the half-moon, and in thoſe of the baſtions of the front attacked.

The mines for blowing up the batteries of the covert-way may be diſpoſed in ſuch a manner as to tumble the guns into the ditch, as may be ſeen in the courſe of mathematics by M. Belidor, who performed it with ſucceſs at the academy of La Fere.

It is certainly a great advantage thus to be able to become maſters of the cannon of the beſiegers, and to oblige them to erect new batteries, which muſt take them up a conſiderable time. A doubt here may ariſe, whether if theſe batteries are oppoſite to that part where the enemy intend to paſs the ditch, this would not be helping to fill it up, ſhould the beſieged blow up the guns: but this inconvenience is of no great conſequence, eſpecially as it may eaſily be remedied, by clearing away the rubbiſh of the mine which tumbles into the ditch along with the battery.

As the beſiegers work at the deſcent into the ditch at the ſame time that they are preparing their batteries, the beſieged muſt think of retarding both theſe operations alſo at the ſame time. If the deſcent into the ditch is made under ground, miners ſhould be employed to interrupt the work; and if the ditch is dry, ſmall detachments, as M. Goulon obſerves, of five or ſix men, may be placed near the counterſcarp, to watch the moment that the enemy break through it, and immediately to fire into the gallery: this diſcharge will either kill or frighten the miners; and at leaſt will retard the works. Thoſe who have fired, ſhould retire on each ſide of the opening to load their arms again, which may be repeated ſeveral times. Fire-balls and grenades may be likewiſe thrown into this opening, which will oblige the ſappers to retreat.

If the ditch is filled with water, the ſame operations may likewiſe be performed with ſmall boats made on purpoſe; and to cover theſe boats a kind of parapet ſhould alſo be raiſed by means of ſtrong boards, with holes to fire through upon the ſoldiers, who upon opening the gallery will throw faſcines into the ditch. At the ſiege of Liſle, marſhal Boufflers contrived ſome boats of this kind to retard the paſſage over the ditch, before the grand lunettes or tenaillons in the front attacked, and that before the half-moon.

When the enemy make their opening into the dry ditch, they muſt be oppoſed with a ſtrong fire, as well from the face of the baſtion which flanks the ditch before the half-moon, as from the place of arms or traverſe, which ought to be conſtructed the whole breadth of the ditch, in order to ſtrengthen the defence. By night ſmall ſallies ſhould be made from this place of arms, with a view to interrupt the paſſage over the ditch, and to retard, as much as poſſible, the fixing of the miner.

There are two ways of paſſing the dry ditch, and of bringing the miner to the foot of the revetement which he is to enter. The firſt conſiſts in making a gallery ſix feet wide, with a double row of barrels. Theſe muſt be filled with ſand-bags, and ſo muſt the ſpaces between them, in order to render the paſſage of the gallery more ſafe; and that there may be a ſhelter from fire works, ſtrong planks are laid over it, and theſe again are covered with raw hides, or with earth and dung. This gallery is continued within three or four feet of the revetement; and in this ſpace a good epaulement is raiſed with ſand-bags to cover the miner on the ſide expoſed to the place. In regard to the other ſide, it is of no uſe to ſtop it up; nay, it ſerves for an opening to fill the ditch with the earth dug out of the galleries, which the miners are making in the rampart of the work attacked. It is eaſy to oppoſe the progreſs of this gallery with a continual fire, and with ſeveral leſſer works conſtructed within the ditch.

The other way, which, as we have already ſeen in treating of the attack, conſiſts only in getting to the foot of the breach by ſap, with an epaulement on the ſide expoſed to the place, may be covered, in order to protect the paſſage from the fire-works and grenades of the beſieged. But this ſap may be retarded by ſallies; the beſieged may likewiſe ſteal away the earth by night from the epaulements, and endeavour with hooks, &c. to diſplace the gabions and faſcines.

If the ditch is filled with water, the beſieged muſt interrupt the enemy's bridge with a continual fire from their great and ſmall guns, as well as with grenades and ſhells, if they are in a condition to fire upon the bridge and its epaulement. If the water has a ſtrong current, they muſt open ſluices in order to break down the bridge, or at leaſt to carry away the faſcines. They ſhould alſo attempt to ſet fire to it with artificial works prepared for this purpoſe. They may likewiſe approach the epaulement in the night, and draw away the faſcines with hooks. They may even throw anchors upon it; and by means of capſtans placed in thoſe parts which flank the ditch, they may draw theſe anchors with cords faſtened to them, and tumble part of the epaulement into the ditch. In ſhort, every expedient muſt be tried that may poſſibly retard the enemy's approaches: for when once they have perfected their bridge, they will ſoon be maſters of the outwork to which that bridge leads, whatever precaution the garriſon may take to defend the breach; becauſe, as the beſiegers can always pour in freſh men to ſupply the room of thoſe that are loſt in the attack, they muſt at length ſurmount all oppoſition.

§ 7. *Of the Defence of the Half-moon.*

While the enemy are effecting the paſſage over the ditch, beſides the difficulties that are raiſed to retard the work, all proper precautions ſhould be uſed to defend the breach, and prevent the taking of the half-moon. For this purpoſe guns are placed in all the works from which the breach may be ſeen; and they ſhould be placed on carriages or on pieces of wood, as the garriſon find moſt commodious, of leaſt hindrance to the defence, and productive of the beſt effect.

If the half-moon has no reduit, as here we ſuppoſe it has none, the retrenchments, which ought to have been made there, muſt be put into good condition; a row of paliſades muſt be placed before it, in order to ſtop the firſt fury of the enemy after they have made themſelves maſters of the breach; in a word, the beſieged muſt prepare to diſpute every inch of ground, and to retire from the half-moon into the town, when they find themſelves hard preſſed and no longer able to maintain that poſt.

When the enemy preſent themſelves at the foot of the breach, a great number of grenades, and ſacks filled with powder, are thrown among them, with a view to fling them into diſorder. Glaſs or earthen bottles filled with powder, and burning matches twiſted round them, are capable of doing them a deal of miſchief. A great quantity of looſe powder may be ſcattered about the breach when the enemy are ready to mount to the aſſault; and when they are mounted, lighted matches or burning coals may be thrown among the powder to ſet it on fire; which will burn and diſable a number of thoſe who are in the breach. It will be proper alſo to throw into the breach a quantity of harrows, ſtuck full of large nails with the points upwards; and to prevent the enemy from removing them, they muſt be faſtened with chains, or with great cords. It is adviſable to be provided with crows-feet, and to ſpread them about; as alſo with chevaux-de-friſe, and with heriſſons, that ſhall extend the whole width of the breach (ſee **Herisson.**) Shells alſo faſtened to the ends of chains, in order to confine them to that part where they may do moſt damage to the enemy, are an excellent contrivance. Their fuſees are made ſhorter than uſual, to the end that they may produce their effect more readily. Faſcines, ſmeared over with tar, and, in ſhort, every ſtratagem ought to be tried to hinder the enemy from lodging themſelves in the breach.

When the beſiegers have ſurmounted all theſe obſtacles, and at laſt have got poſſeſſion of the breach, the mines are ſprung in order to blow them up, and chevaux-de-friſe are placed along the whole breadth of the breach. The troops poſt themſelves behind, and continue to make a vigorous fire upon the beſiegers while they are uſing their utmoſt endeavours to penetrate into the half-moon; and when they begin to force their way, the firſt rank of men that defend it, being armed with partiſans or halberts, and ſupported by the other troops, ought to fall upon the enemy, and cut them in pieces. But if the beſiegers at length by dint of numbers ſhould drive the garriſon from the breach, the latter ought to retire into the retrenchment, and from thence make a very briſk firing; and when they find that this is alſo upon the point of being forced, then they are to withdraw their cannon, and whatever ammunition they may have, into the place; and laſt of all, if they have any mines under that ſpot, they muſt ſpring them as they retire, in order to do all the miſchief and to create all the confuſion they can to the beſiegers.

Sometimes it ſhall happen that the enemy, after having made themſelves maſters of the half-moon, omit to leave a ſufficient number of troops to guard the lodgment, upon a preſumption that the beſieged will not attempt to retake it. Whenever they ſhow a confidence of this kind, a ſtrong body of the garriſon ſhould return in the night and ſtorm this work, either by the gorge, or by ſome other part. There are great odds, but ſuch a vigorous and ſudden ſurpriſe will be productive of a very good effect; at leaſt there is no great riſk in trying, if the ſtrength of the garriſon will permit; and ſhould they ſucceed, the taking of the town will be retarded ſeveral days.

Here we have ſuppoſed that the enemy are reſolved to ſtorm the half moon; but if they ſhould attempt to get poſſeſſion of it by means of ſaps, in that caſe the workmen muſt be continually haraſſed by blowing up mines, and kept as long as poſſible from the breach by means of fire-works of all kinds. When they begin to make a lodgment in the breach, then the beſieged ſhould fall upon them briſkly, and deſtroy the lodgment; in ſhort, every artifice imaginable ſhould be uſed to retard their progreſs.

This laſt method is leſs bloody than the other; but on the other hand, it may be very tedious, when the beſieged ſpare no pains to diſturb the enemy's ſappers and miners.

One thing that greatly deſerves attention, and may render it very difficult for the beſiegers to mount to the aſſault, or to lodge themſelves in the breach by means of ſaps, is to clear away the rubbiſh in the breach. In a dry ditch this may be eaſily done; but in a wet one, the thing is more difficult: on the other hand, in the latter caſe the breach is more eaſy to defend than in the former; becauſe as the enemy cannot come to the foot of it but by the bridge of faſcines, which is made in the ditch, and is ſeldom above 10 or 12 feet wide, they cannot of courſe preſent themſelves with ſo large a front before the breach as in a dry ditch; conſequently the garriſon muſt find it much eaſier to repel them.

§ 8. *Of the Defence of the Paſſage over the Ditch before the Baſtion.*

At the ſame time that the enemy are carrying on the attacks of the half-moon, they work at the paſſage over the ditch before the baſtion. What has been ſaid in regard to the defence of the ditch before the half-moon, may be applied on this occaſion; we have only to add, that when this ditch is dry, the caponier will be of great uſe to fire upon the enemy in their paſſage over the ditch, and to ſally from thence in order to deſtroy their works. If the ditch be wet, it muſt be defended in the ſame manner as that before the half-moon: here only we ſhall add, that if there is a tenaille oppoſite to the curtain of the front attacked, the fire from thence will greatly annoy thoſe who are employed in filling up the ditch. Beſides, the boats by which we obſerved that the enemy might be incommoded in the paſſage over the ditch, the beſieged may likewiſe have recourſe to a kind of floats, made with double joiſts, at the end of which are faſtened empty barrels, to prevent their ſinking too deep in the water; and theſe floats ſhould be loaded with ſhells, barrels of gunpowder, faſcines, pitch and tar; and in ſhort, with all ſorts of combuſtibles proper for ſetting fire to the bridge, and to the enemy's epaulement: theſe are brought forward and faſtened to the epaulement, and afterwards they are ſet on fire with a match, or with tow laid amidſt the combuſtibles.

When there are dikes or ſluices, by means of which the ditch may be filled with water at any time, every art muſt be tried to defend it while it is dry; and when all the defences are exhauſted, then the water is let in, and the enemy will be obliged to begin their work again.

§ 9. *Of the Defence of the Baſtions in the Front attacked.*

Here the reader muſt recollect what has been ſaid in regard to the defence of the breach in the half-moon. The defence of the baſtions is more eaſy, becauſe it is not ſo difficult to retreat from thence by means of the retrenchment: and this retrenchment ſhould be larger, and more ſpacious than that of the half-moon, and more difficult to force.

Beſides all the precautions we have been mentioning, as mines under the breaches, within the baſtions, &c. the beſieged ſhould alſo mount ſeveral pieces of cannon on the breach, charged with cartridge-ſhot, and pointed downwards, ſo as to be able to ſweep the whole ſurface of the ground on which the enemy muſt form in order to march to the aſſault. Care muſt alſo be taken, leſt the enemy, diſcouraged with the difficulty of ſtorming the breach, attempt to ſcale the baſtion, as hath been practiſed ſeveral times, and particularly by the duke de Noailles, marſhal of France, at the ſiege of Gironne, in 1712. The way to guard againſt this attempt, is to place along the parapet of the works that may be inſulted, large pieces of timber, which are to be tumbled upon the ladders as ſoon as the enemy offer to mount. They ſhould alſo have loaded ſhells all along the rampart, faſtened to chains, and to let down towards the middle of the ladders, where they will burſt and kill thoſe who are mounted. They ſhould likewiſe be provided with combuſtibles of different kinds, to throw upon the beſiegers, and to keep them off from the foot of the revetement. When the garriſon are well prepared againſt this attempt, it will be very difficult for the enemy to ſucceed.

The entrance of the baſtion may likewiſe be defended, by making a ditch in the upper part of the breach, and filling it with all ſorts of combuſtible matter. This will form an impenetrable barrier againſt the enemy, at leaſt for ſome days; which time is to be employed in ſtrengthening the retrenchments, and throwing up others, one behind another, if the ground will permit, and it be reſolved to defend the place to the laſt extremity. Though it is uſual for the enemy to force their way into the town by the baſtion, and therefore the principal retrenchments for defending the entrance of the place ſhould be raiſed in this part; yet it is proper not to neglect the curtain. The enemy may be appriſed of theſe retrenchments, and as it is not the practice to make any behind the curtain, they may take it into their heads to batter it in breach, and to conſtruct a bridge in the ditch before it, in order to penetrate into the town. Thus did prince Eugene act at Liſle; as the back part of the curtain was open, the place was obliged to capitulate. The breaches may likewiſe be defended by repairing them with large trees laid acroſs one another, the branches pointed towards the enemy. Cannon will make no great impreſſion on this kind of wall; which was the principal defence of the ancients when a breach was made.

When the beſiegers have triumphed over all theſe obſtacles, ſo as to be maſters of the breach, and to extend their lodgments on the baſtion; then it is no longer poſſible to defer capitulating, unleſs there are ſeveral retrenchments one behind the other. In that caſe, indeed, the beſieged, if they think proper, may defend themſelves to the very laſt; but this deſperate defence is very rare, becauſe every wiſe governor chooſes to preſerve the garriſon, and to ſave the town from being plundered, which would be the caſe, according to the laws of war, if it was taken by ſtorm.

§ 10. *Of Precautions to be uſed againſt the ſurpriſing of Towns, Scalades, ſudden Attacks, &c.*

The right way to prevent ſurpriſes, is to think that the enemy have a deſign upon the town, and to uſe all the precautions poſſible in order to fruſtrate their deſigns. With this view a governor ſhould put the fortifications into a good ſtate of defence, ſhould ſee that the ſeveral poſts, whether acceſſible or inacceſſible, be well guarded, that parties be ſent to range in all the principal avenues of the place; in a word, he ſhould moſt exactly obſerve whatever is preſcribed in the military ordinances concerning the guard of towns, the opening and ſhutting of gates, &c. We ſhall make no mention of any of theſe particulars, becauſe a very ſhort ſtay in a garriſon is ſufficient for learning every thing that may relate to the daily and cuſtomary duty, as well for the ſafety of the town, as for the preſerving peace and good order among the inhabitants, and for preventing any ſtrangers or ſuſpected perſons from entering the place, &c.

We ſhall only obſerve, that when a fortreſs is ſituated upon a river, care ſhould be taken to have boats in the night, filled with ſoldiers, both above and below the town, to hinder any body from getting in that way undiſcovered. If the ditches are filled with water, in froſty weather the ice ſhould be broke every day; in ſhort, nothing ſhould be neglected that tends to ſecure the place againſt any enterpriſe either from within or without.

But chiefly on fair or market days this vigilance ſhould be exerted; the guards ought to be doubled at all the gates, and the garriſon ſhould be diſpoſed in ſuch a manner as to be ready to fly to their arms upon the firſt beat of drum: care ſhould be alſo taken to make the cavalry mount on horſeback, ready to act in all events. By uſing theſe precautions, it will be very difficult for the enemy to ſurpriſe the town; nay, the conſequence may be, that hearing of the exact diſcipline obſerved by the garriſon, they will relinquiſh their deſign; for ſurpriſes ſeldom ſucceed, except through neglect of military duty, and too great ſecurity in the governor.

With regard to precautions againſt ſcalades, they conſiſt in having ſmall parties continually about the avenues of the place, in order to be better informed of the enemy's motions, and to keep a patrole all night, to ſee that nobody ſhall enter the ditch unperceived. A cuvett (F) may be likewiſe dug within the ditch, and paliſades planted within ſome diſtance of the wall, to hinder the enemy from fixing their ladders to it; the flanks of the baſtions ſhould be furniſhed with cannon, charged with cartridge-ſhot, with balls of a quarter of a pound weight, or with pieces of old iron, to fire upon thoſe who ſhould attempt to ſcale the place oppoſite the curtains; in the corps de gardes, within reach of the rampart, a proviſion ſhould be made of halberts, with all other offenſive weapons fit for repelling the enemy when they appear on the top of the ladder, and for driving them into the ditch; the ramparts ſhould be ſtocked with a great quantity of cylindrical timber, to roll down upon the ladders, and thoſe that are upon them; and if the garriſon are not ſo numerous as to be able to cover the whole ramparts, they ſhould fix chevaux-de-friſe, or ſomething elſe, to the upper part of the parapet, which will hinder the enemy from getting over, in order to jump upon the rampart. There ought alſo to be a ſtock of ſhells and grenades all loaden upon the walls, in order to roll them down into the ditch upon the enemy. There ſhould likewiſe be fire-works ready to throw upon them, as faſcines done over with pitch and tar, powder-barrels, fire-pots, &c.; a great number of fire-balls ſhould be alſo flung into the ditch in order to give light, and that the cannon of the place may do good execution upon thoſe who are got into it; the ditch ſhould likewiſe be filled with crows feet, or little holes dug and covered with hurdles and earth, ſo that the enemy ſhall not perceive them, but tumble into them: in the middle of theſe little ditches there ſhould be a paliſade, or ſome long iron-ſpikes, ranged in ſuch a manner as to run thoſe through that ſhall fall upon them. Neither are the gates to be neglected; the enemy will not fail to try to fix a petard to them, while the troops are endeavouring to make themſelves maſters of the rampart. Soldiers muſt be placed in a convenient ſituation for firing on the perſon that fixes the petard: in all events the gates muſt be ſtrengthened withinſide, and large trees muſt be got ready to debar the enemy from entering the town, ſhould they be able to break open the gate.

At the firſt alarm of an attack, all the troops ought to run to the place aſſigned them, in order to be led from thence to the ramparts. With regard to the cavalry, they ought alſo to mount on horſeback, and to divide themſelves into ſeveral ſmall bodies, which are to be at the foot of the rampart, ready at all events to charge the enemy, ſhould they find means to penetrate by ſome way or other into the town.

If the enemy make ſeveral attacks at the ſame time, it will not be proper to quit thoſe parts where they do not ſhow themſelves; this perhaps is a feint only to draw the troops from the ſide which they really intend to attack; therefore the garriſon ſhould be equally on their guard on all ſides, and leave no poſts naked, unleſs the enemy have forced their way into the town: then indeed the buſi-

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(F) A cuvett is a ſmall ditch dug in the middle of the large one.

ſineſs is to charge them vigorouſly, in order to oblige them to retire.

Upon the whole, it is eaſy to withſtand a ſcalade when there is no ſurpriſe; and therefore it rarely happens that a governor, who takes the neceſſary precautions againſt any ſuch accidents, will loſe a town by this kind of attack.

A ſcalade may be attempted in the day as well as by night; the latter indeed is more favourable to the aſſailants, yet they will not ſucceed a whit the better, if they find that the garriſon are prepared to receive them, agreeable to what we have already mentioned.

There remains only to mention a word or two in regard to accelerated ſieges; which is, that a governor will not be expoſed to this ſort of ſiege, if he takes the proper precautions to be informed of the ſteps and approaches of the beſiegers.

If the enemy pretend to carry on a ſiege in form, and at the ſame time accelerate their approaches on one ſide of the place, the garriſon muſt fall vigorouſly upon them, and ſpare no pains to drive them out of what works they have ſeized upon. One may ſuſpect their deſign, if it appears that they do not make their attack on the ſide of the town where naturally they ought to make it, that they want to become maſters of the place with greater eaſe; and then the beſieged ſhould double their guard on that ſide. In general, there ſhould be a conſtant attention to all the fronts of the place, and they ſhould be all equally guarded, till it appears clearly by the enemy's works on which ſide they form their attack, and which way they direct their works; neither are the other ſides to be even then neglected, leſt the enemy ſhould lay hold of this opportunity to attack them. It is always to be ſuppoſed that they are informed of every thing that paſſes within the town, either by their ſpies, or by deſerters; for which reaſon the poſt that ſeems leaſt acceſſible ought not to be neglected.

§ 11. *Of Capitulations.*

The capitulation being the laſt tranſaction, both in the attack and defence of a town, this ſeems to be the moſt natural place for ſpeaking of it, as it ſeems to be the moſt proper ſubject for terminating this article.

When the governor, who defends a town, finds himſelf reduced to the laſt extremity, or is ordered by his court to ſurrender, with a view of obtaining better conditions of the enemy, both for the town and garriſon, he orders the chamade to be beat. For this purpoſe one or more drummers are directed to beat their drums on the rampart, on the ſide next to the attack, to give notice to the beſiegers that the governor has ſomething to propoſe to them; one or more white colours are likewiſe hung out for the ſame purpoſe, and one of them remains either on the rampart or on the breach during the time of negociation. The ſame is practiſed in demanding a ſuſpenſion of arms, after a very violent attack, to bury the dead, carry off the wounded, &c.

As ſoon as the chamade is beat, the firing ceaſes on both ſides, and the governor ſends ſome officers of diſtinction to the general who commands the ſiege, with the conditions on which it is propoſed to ſurrender. As a ſecurity, or as hoſtages for thoſe officers, the beſiegers ſend at the ſame time the ſame number into the town; if the governor's propoſals are not agreeable to the commander of the beſieging army, he rejects them, and mentions what terms he is willing to grant. Generally ſpeaking, he threatens the governor to allow him no conditions at all, if he does not determine to ſurrender quickly; for inſtance, when the paſſage over the ditch of the place is finiſhed, or batteries are erected oppoſite the flanks, &c. If the beſieged find the conditions too hard, the hoſtages are reſtored, and the drums are beat again upon the rampart, to make every body withdraw before hoſtilities are renewed, which is done very ſoon after. It is to be obſerved, that during the negotiation they ought to be quiet on both ſides, and by no means ſhould go on with the operations of the ſiege. The governor ought during this time to be upon his guard, for fear of being ſurpriſed by ſtratagem; which might expoſe him to the diſcretion of the beſieger.

Suppoſe that the terms of capitulation are agreed upon, two or three of the principal officers of the garriſon are ſent as hoſtages to the enemy; and the general of the beſieging army ſends back the ſame number, and of equal degree, as a ſecurity for fulfilling the capitulation.

The conditions inſiſted upon by the beſieged muſt vary according to the different circumſtances and ſituations in which they find themſelves. But when the capitulation is entirely ſettled, an officer of artillery from the beſiegers enters the town, to take an inventory of all the artillery and ammunition remaining in the place, in conjunction with an officer of artillery from the garriſon. A commiſſory of ſtores enters likewiſe to take an account of the proviſions.

When a governor finds that he muſt ſurrender, and that there are conſiderable magazines of ammunition and proviſions, he ſhould deſtroy moſt of them before he offers to ſurrender, to the end that there may remain no more in the place than what is neceſſary for a capitulation, and that the enemy may reap no advantage from thence. If he ſhould not, before he enters into a capitulation, burn or deſtroy thoſe magazines, the enemy might inſiſt on their being preſerved; but they can think nothing of it when thoſe precautions are taken beforehand.

As ſoon as the beſieged have delivered up a gate of the town to the enemy, the firſt regiment of the army enters, and mounts guard.

When the day is come that the garriſon are to leave the place, the beſieging army is drawn up in two files of battalions and ſquadrons, and the garriſon are to paſs between them. The hour for their marching out being arrived, the general and the principal officers put themſelves at the head of the troops, to ſee the garriſon defile before them.

The governor puts himſelf at the head, followed by the principal officers; and he makes the garriſon march in the beſt order poſſible. The oldeſt regiments move commonly in the van and the rear, and the others in the centre with their baggage. When there is any cavalry, it is divided in the ſame manner into three corps, for the van, the centre, and the rear. Small detachments of horſe and foot are made to march along with the baggage, and to take care of its not being rifled.

The artillery granted by the capitulation marches after the firſt battalion. When the garriſon arrive at the place agreed upon, they deliver up the hoſtages of the beſiegers to the eſcort; and when the latter have rejoined the army, they ſend back the hoſtages which the beſieged left for the ſecurity of the eſcort, with the waggons, and other things granted by the beſieging army for eſcorting the garriſon.

When the garriſon are made priſoners of war, they are likewiſe eſcorted to the town agreed upon by the terms of the capitulation.

Every thing ſettled in the capitulation ought to be ſacred and inviolable, and ſhould be underſtood in its genuine and moſt natural ſenſe: yet as this is not always practiſed, the governor ſhould take the utmoſt precaution to have no word inſerted that ſhall be in the leaſt equivocal, or liable to different interpretations. There are a great many examples which prove the neceſſity of this precaution.

When the garriſon of a town capitulate in order to retire to the citadel, there are ſome particular conditions to be obſerved; ſuch as follow.

That the citadel ſhall not be attacked on the ſide next the town; that the ſick and wounded, who cannot be removed, ſhall ſtay in their preſent lodgings; and when they are recovered, they ſhall be provided with carriages and tranſports to retire in ſafety to the place agreed on in the capitulation. None ſhould be ſuffered to enter the citadel, but thoſe who may be of uſe in defending it; the reſt, who are called *uſeleſs mouths*, by no means ought to be admitted. Mention ſhould be made in the capitulation, that thoſe people ſhall be conducted to ſome neighbouring place in the dominions of their ſovereign, which ſhould be named. A certain time ought alſo to be allowed for the whole garriſon to enter the citadel; and it ſhould be expreſsly mentioned, that during this time the beſiegers ſhall conſtruct no works that are neceſſary for the reduction of the citadel.

A maritime town requires alſo ſome particular attention, in regard to the ſhips that may be in the harbour. It ſhould be ſtipulated, that they ſhall quit the harbour the ſame day as the garriſon march out of the town, or when the weather permits to ſail to the port agreed upon. They ſhould preſerve their artillery, rigging, ammunition and proviſions, &c. If they ſhould be obliged by ſtreſs of weather to put into any harbour of the beſiegers by the way, it ought to be mentioned in the capitulation, that they ſhall be received there, and ſupplied with neceſſaries for continuing their voyage; they ought alſo to be provided with paſſports, and, in a word, to have every kind of ſecurity, that they ſhall not be inſulted by the enemy's ſhips, but ſuffered without the leaſt obſtacle to ſteer to the port agreed upon.

War ‖ Warburton.

Man of WAR *Bird*. See PELICANUS.

War-Cry was formerly cuſtomary in the armies of moſt nations, when juſt upon the point of engaging. Sometimes they were only tumultuous ſhouts, or horrid yells, uttered with an intent to ſtrike terror into their adverſaries; ſuch as is now uſed by the Indians in America, called the *war-whoop*.

WARBLES, in farriery. See there § xxxii.

WARBURTON (William), who has been juſtly ſtyled *vir magnus, acer, memorabilis*, was deſcended from an ancient and conſiderable family in Cheſhire. His grandfather diſtinguiſhed himſelf in the civil wars of the laſt century; and being of the royal party, probably injured his fortune by his attachment to his king and the conſtitution of his country. He married a lady of the county of Nottingham, by whom he had three ſons; the ſecond of whom, George, being bred to the law, practiſed as an attorney at Newark in that county.

William, the ſubject of this memoir, and the ſecond ſon of Mr George Warburton, was born at Newark, December 24. 1698. He was firſt put to ſchool there under a Mr Twells, but had the chief part of his education at Okeham in Rutlandſhire, where he continued till the beginning of the year 1714, when, his couſin being made head maſter of the ſchool at Newark, he returned to his native place, and was for a very ſhort time under the care of that learned and reſpectable relation. In the month of April of the ſame year, he was put out clerk to Mr Kirke, an eminent attorney of Great Markham in Nottinghamſhire; and continued with that gentleman till the ſpring of the year 1719. He then returned to his family at Newark; but whether he practiſed there or elſewhere as an attorney, is not known to his accompliſhed biographer, the biſhop of Worceſter.

He had always expreſſed a ſtrong inclination to take orders; and the love of letters, which tended to retard, rather than forward, his progreſs in the profeſſion choſen for him by his friends, growing every day ſtronger in him, it was deemed expedient to give way to that inclination. In the ſtudies neceſſary to fit him for the church, he was directed by his couſin the ſchoolmaſter of Newark; to whom, long afterwards, when he ſtood himſelf in the very front of literature, he gratefully acknowledged his obligations. At length, on the 22d of December 1723, he was ordained deacon by archbiſhop Davis of York, and prieſt on the firſt of March 1727, by biſhop Gibſon of London.

Though he never liked the profeſſion of an attorney, he had certainly acquired a very conſiderable knowledge of the laws of England: for in a diſpute which aroſe in 1726, about the judicial power of the court of chancery, he combated with ſucceſs the opinions of no leſs a man than the lord chancellor Hardwicke, then attorney-general.

Warburton.

In 1728 he was preſented by Sir Robert Sutton to the rectory of Brand-Broughton, in the dioceſe of Lincoln, where he ſpent the greater part of his life, and compoſed all the great works which will carry his fame down to poſterity. In the ſame year he was put upon the king's liſt of Maſters of Arts, erected on his majeſty's viſit to the univerſity of Cambridge. He had already publiſhed ſome juvenile performances, which diſplayed genius and reading, and attracted conſiderable notice; but it was not till the year 1736 that he may be ſaid to have emerged from the obſcurity of a private life into the notice of the world.—The firſt publication which rendered him afterwards famous now appeared, under the title of "The Alliance between Church and State; or, the Neceſſity and Equity of an Eſtabliſhed religion and a Teſt Law; demonſtrated from the Eſſence and End of Civil Society, upon the fundamental Principles of the Law of Nature and Nations." In this treatiſe, ſays Biſhop Horſley [‡], the author "hath ſhown the general good policy of an eſtabliſhment, and the neceſſity of a TEST for its ſecurity, upon principles which republicans themſelves cannot eaſily deny. His work is one of the fineſt ſpecimens that are to be found perhaps in any language, of ſcientific reaſoning applied to a political ſubject."

At the cloſe of the Alliance was announced the ſcheme of the Divine Legation of Moſes, in which he had then made a conſiderable progreſs. The firſt volume of this work was publiſhed in January 1738, under the title of "The Divine Legation of Moſes demonſtrated on the Principles of a Religious Deiſt, from the Omiſſion of the Doctrine of a future State of Rewards and Puniſhments in the Jewiſh Diſpenſation, in ſix books, by William Warburton, M. A. author of the Alliance between Church and State;" and met with a reception which neither the ſubject, nor the manner in which it was treated, ſeemed to authoriſe. It was, as the author afterwards obſerved, fallen upon in ſo outrageous and brutal a manner as had been ſcarce pardonable, had it been "The Divine Legation of Mahomet."—It produced ſeveral anſwers, and ſo much abuſe from the authors of "The Weekly Miſcellany," that in leſs than two months he was conſtrained to defend himſelf, in "A Vindication of the Author of the Divine Legation

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[‡] Review of the Caſe of the Proteſtant Diſſenters, Lond. 1787. PREF.

gation of Moſes, from the Aſperſions of the Country Clergyman's Letter in the Weekly Miſcellany of February 24. 1737-8, 8vo."

Mr Warburton's extraordinary merit had now attracted the notice of the heir apparent to the crown, in whoſe immediate ſervice we find him in June 1738, when he publiſhed "Faith working by Charity to Chriſtian Edification, a Sermon, preached at the laſt epiſcopal Viſitation for Confirmation in the Dioceſe of Lincoln; with a Preface, ſhowing the Reaſons of its Publication; and a Poſtſcript, occaſioned by ſome Letters lately publiſhed in the Weekly Miſcellany, by William Warburton, M. A. Chaplain to his Royal Highneſs the Prince of Wales."

In March 1737, the world was in danger of being deprived of this extraordinary genius by an intermitting fever, which with ſome difficulty was relieved by a plentiful uſe of the bark.

The "Eſſay on Man" had been now publiſhed ſome years; and it is univerſally ſuppoſed, that the author had, in the compoſition of it, adopted the philoſophy of the Lord Bolingbroke, whom, on this occaſion, he had followed as his guide, without underſtanding the tendency of his principles. In 1738. M. de Crouſaz wrote ſome remarks on it, accuſing the author of Spinoziſm and Naturaliſm; which falling into Mr Warburton's hands, he publiſhed a defence of the firſt epiſtle, and ſoon after of the remaining three, in ſeven letters; of which ſix were printed in 1739, and the ſeventh in June 1740, under the title of "A Vindication of Mr Pope's Eſſay on Man, by the author of the Divine Legation." The opinion which Mr Pope conceived of theſe defences, as well as of their author, will be beſt ſeen in his letters. In conſequence, a firm friendſhip was eſtabliſhed between them, which continued with undiminiſhed fervour until the death of Mr Pope; who, during the remainder of his life, paid a deference and reſpect to his friend's judgment and abilities, which will be conſidered by many as almoſt bordering on ſervility.

Towards the end of the year 1739, Mr Warburton publiſhed a new and improved edition of the firſt volume of the Divine Legation; and in May 1741, appeared the ſecond part, which completed the argument, though not the entire plan of that work. "A work, ſays Biſhop Hurd [‡], in all views of the moſt tranſcendant merit, whether we conſider the invention or the execution. A plain ſimple argument, yet perfectly new, proving the divinity of the Moſaic law, and laying a ſure foundation for the ſupport of Chriſtianity, is there drawn out to a great length by a chain of reaſoning ſo elegantly connected, that the reader is carried along it with eaſe and pleaſure; while the matter preſented to him is ſo ſtriking for its own importance, ſo embelliſhed by a lively fancy, and illuſtrated from all quarters by exquiſite learning and the moſt ingenious diſquiſition, that in the whole compaſs of modern or ancient theology, there is nothing equal or ſimilar to this extraordinary performance."

[‡] Life of Warburton prefixed to his Works.

This is the panegyric of a man reflecting with tenderneſs on the memory of his friend and benefactor; but it approaches much nearer to the truth than the cenſures of thoſe cabaliſtic critics, who, faſtening upon ſome weak part of the Divine Legation, or perhaps never having looked into it, have ridiculouſly contended that the author was far from being eminent as a ſcholar (A), and that his work is inimical to the cauſe of Chriſtianity! Putting partiality aſide, there is in the Divine Legation of Moſes abundant evidence of the malignant folly of this charge, as no man can read and underſtand that work without being convinced that its author was a Chriſtian, not only ſincere but zealous; that he was, what Johnſon calls him [*], "a man of vigorous faculties, of a mind fervid and vehement, ſupplied by unlimited and inceſſant inquiry, with a wonderful extent and variety of knowledge, which had neither depreſſed his imagination nor clouded his perſpicuity; and that to every work, and this work in particular, he brought a memory full fraught, with a fancy fertile of original combinations, exerting at once the powers of the ſcholar, the reaſoner, and the wit." But we think it muſt be acknowledged, that his learning was too multifarious to be always exact, and his inquiries too eagerly puſhed to be always cautious. We have no heſitation, however, to ſay, that to the divine this great work, with all its imperfections, is, in our opinion, one of the moſt valuable that is to be found in any language.

[*] Life of Pope.

In the ſummer 1741, Mr Pope and Mr Warburton, in a country ramble, took Oxford in their way. The univerſity was naturally pleaſed at the arrival of two ſuch ſtrangers, and ſeemed deſirous of inrolling their names among their graduates. The degree of D. D. was intended for the divine, and that of L. L. D. for the poet: but intrigue and envy defeated this ſcheme; and the univerſity loſt the honour of decorating at the ſame time the two greateſt geniuſes of the age, by the fault of one or two of its members. Pope retired with ſome indignation to Twickenham, where he conſoled himſelf and his friend with this ſarcaſtic reflection—"We ſhall take our degree together in fame, whatever we do at the univerſity."

The friendſhip of this eminent poet was of ſervice to Mr Warburton in more reſpects than that of increaſing his fame. He introduced and warmly recommended him to moſt of his friends, and among others to Mr Murray, afterwards earl of Mansfield, and Ralph Allen, Eſq; of Prior-park. In conſequence of this introduction, we find Mr Warburton at Bath 1742; where he printed a ſermon which had been preached at the Abbey-church on the 24th of October, for the benefit of Mr Allen's favourite charity, the General Hoſpital or Infirmary. In this year alſo he printed a Diſſertation on the origin of books of chivalry, at the end of Jarvis's Preface to a tranſlation of Don Quixote, which Mr Pope tells him, he had not got over two paragraphs of, before he cried out, *Aut Eraſmus, aut Diabolus*.

In 1742, Mr Warburton publiſhed "A Critical and Philoſophical Commentary on Mr Pope's Eſſay on Man. In which is contained a Vindication of the ſaid Eſſay from the Miſrepreſentation of M. de Reſnal, the French tranſlator, and of M. de Crouſaz, Profeſſor of Philoſophy and Mathematics in the Academy of Lauſanne, the Commentator." It was at this period, when Mr Warburton had the entire confidence of Mr Pope, that he adviſed him to complete the Dunciad, by changing the hero, and adding to it a fourth book. This was accordingly executed in 1742, and publiſhed early in 1743, with notes by our author; who, in conſequence of it, received his ſhare of the abuſe which Mr Cibber liberally beſtowed on both Mr Pope and his annotator. In the latter end of the ſame year he publiſhed complete editions of "The Eſſay on Man," and "The Eſſay on Criticiſm;" and from the ſpecimen which he there exhibited of his abilities, it may be preſumed Mr Pope

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(A) We have heard this affirmed by narrow-minded clergymen, who were deſtitute themſelves of every ſpark of ſcience, and had no other claim to literature than what aroſe from a ſlight acquaintance with Hebrew critics of a very peculiar caſt; to whom, it muſt be owned, that no great reſpect was indeed ever paid by the author of the Divine Legation of Moſes.

Pope determined to commit the publication of thoſe works which he ſhould leave to Mr Warburton's care. At Mr Pope's deſire, he, about this time, reviſed and corrected the "Eſſay on Homer," as it now ſtands in the laſt edition of that tranſlation.

The publication of "The Dunciad" was the laſt ſervice which our author rendered Mr Pope in his lifetime. After a lingering and tedious illneſs, the event of which had been long foreſeen, this great poet died on the 30th of May 1744; and by his will, dated the 12th of the preceding December, bequeathed to Mr Warburton one half of his library and the property of all ſuch of his works already printed as he had not otherwiſe diſpoſed of or alienated, and all the profits which ſhould ariſe from any edition to be printed after his death: but at the ſame time directed that they ſhould be publiſhed without any future alterations.

"In 1744, Mr Warburton turned his attention to the ſeveral attacks which had been made on the "Divine Legation," and defended himſelf in a manner which, if it did not prove him to be poſſeſſed of much humility or diffidence, at leaſt demonſtrated that he knew how to wield the weapons of controverſy with the hand of a maſter. His firſt defence now appeared, under the title of "Remarks on ſeveral occaſional Reflections, in Anſwer to the Reverend Dr Middleton, Dr Pococke, the Maſter of the Charter-Houſe, Dr Richard Grey, and others; ſerving to explain and juſtify divers Paſſages in the Divine Legation, objected to by thoſe learned Writers. To which is added, A General Review of the Argument of the Divine Legation, as far as it is yet advanced; wherein is conſidered the Relation the ſeveral Parts bear to each other and the whole. Together with an Appendix, in Anſwer to a late Pamphlet intitled, An Examination of Mr W——'s ſecond Propoſition." This was followed next year by "Remarks on ſeveral occaſional Reflections, in Anſwer to the Reverend Doctors Stebbing and Sykes; ſerving to explain and juſtify the Two Diſſertations in the Divine Legation, concerning the Command to Abraham to offer up his Son, and the Nature of the Jewiſh Theocracy, objected to by theſe learned Writers. Part II. and laſt." Both theſe anſwers are couched in thoſe high terms of confident ſuperiority, which marked almoſt every performance that fell from his pen during the remainder of his life.

On the 5th of September 1745, the friendſhip between him and Mr Allen was more cloſely cemented by his marriage with Miſs Tucker, who ſurvived him, and is now, if alive, Mrs Stafford Smith of Prior-park. At that important criſis our author preached and publiſhed three ſeaſonable ſermons: 1. "A faithful Portrait of Popery, by which it is ſeen to be the Reverſe of Chriſtianity, as it is the Deſtruction of Morality, Piety, and Civil Liberty. Preached at St James's, Weſtminſter, October 1745." 2. "A Sermon occaſioned by the preſent unnatural Rebellion, &c. Preached in Mr Allen's Chapel at Prior-park, near Bath, November 1745." 3. "The Nature of National Offences truly ſtated.—Preached on the General Faſt-day, December 18. 1745-6." On account of the laſt of theſe ſermons, he was again involved in a controverſy with his former antagoniſt Dr Stebbing, which occaſioned "An Apologetical Dedication to the Reverend Dr Henry Stebbing, in Anſwer to his Cenſure and Miſrepreſentations of the Sermon preached on the General Faſt, &c."

Notwithſtanding his great connections, his acknowledged abilities, and his eſtabliſhed reputation, a reputation founded on the durable baſis of learning, and upheld by the decent and attentive performance of every duty incident to his ſtation; yet we do not find that he received any addition to the preferment given him in 1728 by Sir Robert Sutton (except the chaplainſhip to the prince of Wales), until April 1746, when he was unanimouſly called by the Society of Lincoln's Inn to be their preacher. In November he publiſhed "A Sermon preached on Thankſgiving appointed to be obſerved the 9th of October, for the Suppreſſion of the late unnatural Rebellion." In 1747 appeared his edition of Shakeſpear, and his Preface to Clariſſa; and in the ſame year he publiſhed, 1. "A Letter from an Author to a member of Parliament concerning Literary Property." 2. "Preface to Mrs Cockburn's Remarks upon the Principles and Reaſonings of Dr Rutherford's Eſſay on the Nature and Obligations of Virtue," &c. 3. "Preface to a Critical Inquiry into the Opinions and Practice of the ancient Philoſophers, concerning the Nature of a Future State, and their method of teaching by double Doctrine," (by Mr Towne) 1747, ſecond edition. In 1748, a third edition of "The Alliance between Church and State, corrected and enlarged."

"In 1749, a very extraordinary attack was made on the moral character of Mr Pope, from a quarter where it could be the leaſt expected. An inſignificant pamphlet, under the name of *A Patriot King*, was that year publiſhed by Lord Bolingbroke, or by his direction, with a preface to it, reflecting highly on Mr Pope's honour. The provocation was ſimply this: The manuſcript of that trivial declamation had been intruſted to the care of Mr Pope, with the charge (as it was pretended) that only a *certain* number of copies ſhould be printed. Mr Pope, in his exceſſive admiration of his *guide*, *philoſopher*, and friend, took that opportunity, for fear ſo invaluable a treaſure of patriot eloquence ſhould be loſt to the public, to exceed his commiſſion, and to run off more copies, which were found, after his death, in the printer's warehouſe. This charge, however frivolous, was aggravated beyond meaſure; and, notwithſtanding the proofs which Lord Bolingbroke had received of Pope's devotion to him, envenomed with the utmoſt malignity. Mr Warburton thought it became him to vindicate his deceaſed friend; and he did it ſo effectually, as not only to ſilence his accuſer, but to cover him with confuſion‡."

About this time the publication of Dr Middleton's Inquiry concerning the miraculous Powers of the Chriſtian Church, gave riſe to a controverſy, which was managed with great warmth and aſperity on both ſides, and not much to the credit of either party. On this occaſion Mr Warburton publiſhed an excellent performance, written with a degree of candour and temper, which, it is to be lamented, he did not always exerciſe. The title of it was "*Julian*; or a Diſcourſe concerning the Earthquake and fiery Eruption which defeated that Emperor's attempt to rebuild the Temple at Jeruſalem, 1750." A ſecond edition of this diſcourſe, "with Additions." appeared in 1751, in which year he gave the public his edition of Mr Pope's Works, with Notes, in nine volumes 8vo; and in the ſame year printed "An Anſwer to a Letter to Dr Middleton, inſerted in a Pamphlet intitled, The Argument of the Divine Legation fairly ſtated," &c.; and "An Account of the Prophecies of Ariſe Evans, the Welſh Prophet in the laſt Century," annexed to the firſt volume of Dr Jortin's Remarks on Eccleſiaſtical Hiſtory, which afterwards ſubjected him to much trouble.

In 1752, Mr Warburton publiſhed the firſt volume of a courſe of ſermons, preached at Lincoln's Inn, intitled, "The Principles of Natural and Revealed Religion, occaſionally opened and explained;" and this was two years afterwards followed by a ſecond. After the public had been ſome time promiſed, it may, from the alarm which was taken, be almoſt ſaid threatened with, the appearance of Lord Bolingbroke's Works, they were about this time printed. The known abilities and infidelity of this nobleman had created apprehenſions in the minds of many people, of the pernicious effects of his doctrines; and nothing but the appearance of his whole force could have convinced his friends, how little there was to be dreaded from arguments againſt religion ſo weakly ſupported. Many anſwers were ſoon publiſhed, but none with more acuteneſs, ſolidity, and ſprightlineſs, than "A View of Lord Bolingbroke's Philoſophy, in two Letters to a Friend, 1754;" the third and fourth letters were publiſhed in 1755, with another edition of the two former; and in the ſame year a ſmaller edition of the whole; which, though it came into the world without a name, was univerſally aſcribed to Mr Warburton, and afterwards publicly owned by him. To ſome copies of this is prefixed an excellent complimentary epiſtle from the Preſident Monteſquieu, dated May 26. 1754.

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‡ Hurd's Life of Warburton.

At this advanced period of his life, that preferment which his abilities might have claimed, and which had hitherto been withheld, ſeemed to be approaching towards him. In September 1754, he was appointed one of his Majeſty's chaplains in ordinary, and in the next year was preſented to a prebend in the cathedral of Durham, on the death of Dr Mangey. About this time the degree of Doctor of Divinity was conferred on him by Dr Herring, then archbiſhop of Canterbury. A new impreſſion of The Divine Legation being now called for, he printed a fourth edition of the firſt part of it, corrected and enlarged, divided into two volumes, with a dedication to the earl of Hardwicke. The ſame year appeared "A Sermon preached before his Grace Charles Duke of Marlborough, Preſident, and the Governors of the Hoſpital for the Small-pox and for inoculation, at the Pariſh-church of St Andrew, Holborn, April the 24th, 1755." And in 1756. "Natural and Civil Events the Inſtruments of God's Moral Government; a Sermon, preached on the laſt public Faſt-day, at Lincoln's Inn Chapel."

In 1757, Dr Warburton meeting with Mr Hume's tract, entitled, The Natural Hiſtory of Religion, filled the margin of the book, as well as ſome interleaved ſlips of paper, with many ſevere and ſhrewd remarks on the infidelity and naturaliſm of the author. Theſe he put into the hands of his friend Dr Hurd, who, making a few alterations of the ſtyle, added a ſhort introduction and concluſion, and publiſhed them in a pamphlet, entitled' "Remarks on Mr David Hume's Natural Hiſtory of Religion, by a Gentleman of Cambridge, in a Letter to the Reverend Dr Warburton." This lively attack upon Mr Hume gave him ſo much offence, that he thought proper to vent his ſpleen on the ſuppoſed author, in the poſthumous diſcourſe which he called his *Life*; and thus to do greater honour to Dr Hurd than to any other of his numerous antagoniſts.

Towards the end of the year 1757, Dr Warburton was promoted to the deanery of Briſtol; and in the beginning of the year 1760, he was, through Mr Allen's intereſt with Mr Pitt, afterwards earl of Chatham, advanced to the biſhoprick of Glouceſter. That great miniſter is known to have declared, "that nothing of a private nature, ſince he had been in office, had given him ſo much pleaſure as bringing our author on the bench." There was, however, another miniſter, who dreaded his promotion, and thought that he ſaw a ſecond Atterbury in the new biſhop of Glouceſter; but Warburton, ſays biſhop Hurd, had neither talents nor inclination for parliamentary intrigue or parliamentary eloquence: he had other inſtruments of fame in his hands, and was infinitely above the vanity of being caught

"With the fine notion of a buſy man‡."

He was conſecrated on the 20th of January 1760, and on the 30th of the ſame month preached before the houſe of lords. In the next year he printed "A Rational Account of the Nature and End of the Sacrament of the Lord's Supper." In 1762, he publiſhed "The Doctrine of Grace; or the Office and Operations of the Holy Spirit vindicated from the Inſults of Infidelity and the Abuſes of Fanaticiſm," 2 vols 12mo; and in the ſucceeding year drew upon himſelf much illiberal abuſe from ſome writers of the popular party, on occaſion of his complaint in the houſe of lords, on the 15th of November 1763, againſt Mr Wilkes, for putting his name to certain notes on the infamous "Eſſay on Woman."

In 1765 he publiſhed a new edition of the ſecond part of the Divine Legation, in three volumes; and as it had now received his laſt hand, he preſented it to his great friend Lord Manſfield, in a dedication which deſerves to be read by every perſon who eſteems the well-being of ſociety as a concern of any importance. It was the appendix to this edition which produced the well-known controverſy between him and Dr Lowth, which we have noticed elſewhere (ſee Lowth), as doing no great honour, by the mode in which it was conducted, to either party. In the next year he gave a new and much improved edition of the Alliance between the Church and State. This was followed, in 1767, by a third volume of ſermons, to which is added, his firſt Triennial Charge to the Clergy of the Dioceſe of Glouceſter; which may be ſafely pronounced one of the moſt valuable diſcourſes of the kind that is to be found in our own or any other language. With this publication he cloſed his literary courſe; except that he made an effort towards publiſhing, and actually printed, the ninth and laſt book of the Divine Legation. This book, with one or two occaſional ſermons, and ſome valuable directions for the ſtudy of *theology*, have been given to the world in the ſplendid edition of his works in ſeven volumes 4to, by his friend and biographer the preſent biſhop of Worceſter. That prelate confeſſes, that the ninth book of the Divine Legation diſplays little of that vigour of mind and fertility of invention which appear ſo conſpicuous in the former volumes; but he adds, perhaps truly, that under all the diſadvantages with which it appears, it is the nobleſt effort which has hitherto been made to give a *rationale* of Chriſtianity.

While the biſhop of Glouceſter was thus exerting his laſt ſtrength in the cauſe of religion, he projected a method by which he hoped to render it effectual ſervice after his death. He tranſferred L. 500 to Lord Manſfield, Sir Eardley Wilmot, and Mr Charles Yorke, upon truſt, to found a lecture, in the form of a courſe of ſermons, to prove the truth of revealed religion in general, and of the Chriſtian in particular, from the completion of the prophecies in the Old and New Teſtament, which relate to the Chriſtian church, eſpecially to the apoſtacy of Papal Rome. To this foundation we owe the admirable Introductory Lectures of Hurd, and the well-adapted Continuation of Halifax and Bagot.

It is a melancholy reflection, that a life ſpent in the conſtant purſuit of knowledge, frequently terminates in the loſs of thoſe powers, the cultivation and improvement of which are attended to with too ſtrict and unabated a degree of ardour. This was in ſome degree the miſfortune of Dr Warburton. Like Swift, and the great duke of Marlborough, he gradually ſunk into a ſituation in which it was a fatigue to him to enter into general converſation. There were, however, a few old and valuable friends, in whoſe company, even to the laſt, his mental faculties were exerted in their wonted force; and at ſuch times he would appear cheerful for ſeveral hours, and on the departure of his friends retreat as it were within himſelf. This melancholy habit was aggravated by the loſs of his only ſon, a very promiſing young gentleman, who died of a conſumption but a ſhort time before the Biſhop, who himſelf reſigned to fate in the 81ſt year of his age. A neat marble monument has been erected to him in the cathedral of Glouceſter, with this inſcription—

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‡ Dryden.

To the Memory of
William Warburton, D. D.
For more than 19 Years Biſhop of this See;
A Prelate
Of the moſt ſublime Genius, and exquiſite Learning.
Both which Talents
He employed through a long Life,
In the Support
Of what he firmly believed,
The Christian Religion;
And
Of what he eſteemed the beſt Eſtabliſhment of it,
The Church of England.
He was born at Newark upon Trent,
Dec. 24. 1698.
Was conſecrated Bishop of Glouceſter,
Jan. 20. 1760.
Died at his Palace, in this city,
June 7. 1779.
And was buried near this Place.

WARD (Dr Seth,) an Engliſh prelate, chiefly famous for his knowledge in mathematics and aſtronomy, was born at Buntingford in Hertfordſhire, about the year 1617. He was admitted of Sidney college, Cambridge, where he applied with great vigour to his ſtudies, particularly to the mathematics, and was choſen fellow of his college. He was involved not a little in the conſequences of the civil war, but ſoon after the Reſtoration obtained the biſhopric of Exeter; in 1667, he was tranſlated to Saliſbury; and in 1671 was made chancellor of the order of the garter; he was the firſt Proteſtant biſhop that enjoyed that honour, and he procured it to be annexed to the ſee of Saliſbury. Biſhop Ward was one of thoſe unhappy perſons who have the misfortune to ſurvive their ſenſes, which happened in conſequence of a fever ill cured; he lived to the revolution, without knowing any thing of the matter, and died in 1690. He was the author of ſeveral Latin works in mathematics and aſtronomy, which were thought excellent in their day; but their uſe has been ſuperſeded by later diſcoveries and the Newtonian philoſophy.

Ward (Dr John), was the ſon of a diſſenting miniſter, and born at London in 1679. He for ſome years kept a ſchool in Tenter-alley, Moorfields; but rendered himſelf ſo eminent in the ſtudy of antiquity, that in 1720 he was choſen profeſſor of rhetoric in Greſham college: and in 1723, during the preſidency of Sir Iſaac Newton, he was elected a fellow of the Royal Society; and in 1752, one of the vice-preſidents, in which office he was continued to his death. He was elected one of the truſtees of the Britiſh Muſeum in 1753, and died at Greſham college in 1758. The work for which he is beſt known, is his Lives of the Profeſſors of Greſham College; which is a conſiderable addition to the hiſtory of learning in our country. His Lectures on Oratory were publiſhed after his death, in two volumes 8vo.

Ward, is variouſly uſed in our old books: a ward in London is a diſtrict or diviſion of the city, committed to the ſpecial charge of one of the aldermen; and in London there are 26 wards, according to the number of the mayor and aldermen, of which every one has his ward for his proper guard and juriſdiction. A foreſt is divided into wards; and a priſon is called a *ward*. Laſtly, the heir of the king's tenant, that held *in capite*, was termed a *ward* during his nonage; but this wardſhip is taken away by the ſtatute 12 Car. II. c. 24.

Ward-Holding, in Scots law. See Law, n° clxv. 1. and clxvi. 3.

Ward-Hook, or *Wadd-hook*, in gunnery, a rod or ſtaff, with an iron end turned ſerpentwiſe, or like a ſcrew, to draw the wadding out of a gun when it is to be unloaded.

WARDEN, or Guardian, one who has the charge or keeping of any perſon, or thing, by office. Such is the warden of the Fleet, the keeper of the Fleet priſon; who has the charge of the priſoners there, eſpecially ſuch as are committed from the court of chancery for contempt.

WARDHUYS, a port of Norwegian Lapland, 120 miles ſouth-eaſt of the North Cape. E. Long. 31. 12. N. Lat. 70. 23.

WARDMOTE, in London, is a court ſo called, which is kept in every ward of the city; anſwering to the *curiata comita* of Rome.

WARDROBE, a cloſet or little room adjoining to a bed-chamber, ſerving to diſpoſe and keep a perſon's apparel in; or for a ſervant to lodge in, to be at hand to wait, &c.

Wardrobe, in a prince's court, is an apartment wherein his robes, wearing apparel, and other neceſſaries, are preſerved under the care and direction of proper officers.

In Britain, the *Maſter or Keeper of the Great Wardrobe* was an officer of great antiquity and dignity. High privileges and immunities were conferred on him by king Henry VI. which were confirmed by his ſucceſſors; and king James I. not only enlarged them, but ordained that this office ſhould be a corporation or body politic for ever.

Beatſon's Political Index, vol. ii.

It was the duty of this office to provide robes for the coronations, marriages, and funerals of the royal family: to furniſh the court with hangings, cloths of ſtate, carpets, beds, and other neceſſaries; to furniſh houſes for ambaſſadors at their firſt arrival; cloths of ſtate and other furniture, for the lord lieutenant of Ireland, and all his majeſty's ambaſſadors abroad; to provide all robes for foreign knights of the garter, robes for the knights of the garter at home; robes and all other furniture for the officers of the garter; coats for kings, heralds, and purſuivants at arms; robes for the lords of the treaſury, and chancellor of the exchequer, &c. livery for the lord chamberlain, grooms of his majeſty's privy chamber, officers of his majeſty's robes; for the two chief juſtices, for all the barons of the exchequer, and ſeveral officers of theſe courts; all liveries for his majeſty's ſervants, as yeomen of the guard, and wardens of the Tower, trumpeters, kettle-drummers, drummers, and fifers; the meſſengers, and all belonging to the ſtables, as coachmen, footmen, littermen, poſtilions, and grooms, &c. all the king's coaches, chariots, harneſſes, ſaddles, bits, bridles, &c. the king's water-men, game-keepers, &c. alſo furniture for the royal yachts, and all rich embroidered tilts, and other furniture for the barges.

Beſides the maſter or keeper of the wardrobe, who had a ſalary of L. 2000, there was his deputy, who had L. 150, and comptroller and a patent clerk, each of whom has a ſalary of L. 300. Beſides many other inferior officers and ſervants, who were all ſworn ſervants to the king.

There was likewiſe a removing wardrobe, who had its own ſet of officers, and ſtanding wardrobe-keepers at St James's, Windſor Caſtle, Hampton Court, Kenſington, and Somerſet Houſe; but the whole of the wardrobe eſtabliſhment was aboliſhed by act of Parliament in 1782, and the duty of it in future to be done by the lord chamberlain.

WARDSHIP, in chivalry, one of the incidents of tenure

Wardſhip. nure by knight-ſervice. See *Feodal Syſtem*, *Knight Service*, and Tenure.

Upon the death of a tenant, if the heir was under the age of 21, being a male, or 14, being a female, the lord was intitled to the wardſhip of the heir, and was called the *guardian in chivalry*. This wardſhip conſiſted in having the cuſtody of the body and lands of ſuch heir, without any account of the profits, till the age of 21 in males, and 16 in females. For the law ſuppoſes the heir-male unable to perform knight ſervice till 21; but as for the female, ſhe was ſuppoſed capable at 14 to marry, and then her huſband might perform the ſervice. The lord therefore had no wardſhip, if at the death of the anceſtor the heir-male was of the full age of 21, or the heir female of 14: yet if ſhe was then under 14, and the lord once had her in ward, he might keep her ſo till 16, by virtue of the ſtatute of Weſtminſter, 1. 3 Edw. I. c. 22. the two additional years being given by the legiſlature for no other reaſon but merely to benefit the lord.

This wardſhip, ſo far as it related to land, though it was not nor could be part of the law of feuds, ſo long as they were arbitrary, temporary, or for life only; yet when they became hereditary, and did conſequently often deſcend upon infants, who by reaſon of their age could neither perform nor ſtipulate for the ſervices of the feud, does not ſeem upon feodal principles to have been unreaſonable. For the wardſhip of the land, or cuſtody of the feud, was retained by the lord, that he might out of the profits thereof provide a fit perſon to ſupply the infant's ſervices till he ſhould be of age to perform them himſelf. And if we conſider a feud in its original import, as a ſtipend, fee, or reward, for actual ſervice, it could not be thought hard that the lord ſhould withhold the ſtipend ſo long as the ſervice was ſuſpended. Though undoubtedly to our Engliſh anceſtors, where ſuch ſtipendary donation was a mere ſuppoſition or figment, it carried abundance of hardſhip; and accordingly it was relieved by the charter of Henry I. which took this cuſtody from the lord, and ordained that the cuſtody, both of the land and the children, ſhould belong to the widow or next of kin. But this nobe immunity did not continue many years.

The wardſhip of the body was a conſequence of the wardſhip of the land; for he who enjoyed the infant's eſtate was the propereſt perſon to educate and maintain him in his infancy: and alſo in a political view, the lord was moſt concerned to give his tenant a ſuitable education, in order to qualify him the better to perform thoſe ſervices which in his maturity he was bound to render.

When the male heir arrived to the age of 21, or the heir-female to that of 16, they might ſue out their livery or *ouſterlemain*; that is, the delivery of their lands out of their guardian's hands. For this they were obliged to pay a fine, namely, half-a-year's profits of the land; though this ſeems expreſsly contrary to *magna charta*. However, in conſideration of their lands having been ſo long in ward, they were excuſed all reliefs, and the king's tenants alſo all primer ſeiſins. In order to aſcertain the profits that aroſe to the crown by theſe fruits of tenure, and to grant the heir his livery, the itinerant juſtices, or juſtices in eyre, had it formerly in charge to make inquiſition concerning them by a jury of the country, commonly called an *inquiſitio poſt mortem*; which was inſtituted to inquire (at the death of any man of fortune) the value of his eſtate, the tenure by which it was holden, and who, and of what age, his heir was; thereby to aſcertain the relief and value of the primer ſeiſin, or the wardſhip and livery accruing to the king thereupon. A manner of proceeding that came in proceſs of time to be greatly abuſed, and at length an intolerable grievance; it being one of the principal accuſations againſt Empſon and Dudley, the wicked engines of Henry VII. that by colour of falſe inquiſitions they compelled many perſons to ſue out livery from the crown who by no means tenants were thereunto. And afterwards a court of wards and liveries was erected, for conducting the ſame inquiries in a more ſolemn and legal manner.

When the heir thus came of full age, provided he held a knight's fee, he was to receive the order of knighthood, and was compellable to take it upon him, or elſe pay a fine to the king. For in thoſe heroical times no perſon was qualified for deeds of arms and chivalry who had not received this order, which was conferred with much preparation and ſolemnity. We may plainly diſcover the footſteps of a ſimilar cuſtom in what Tacitus relates of the Germans, who, in order to qualify their young men to bear arms, preſented them in a full aſſembly with a ſhield and lance; which ceremony is ſuppoſed to have been the original of the feodal knighthood. This prerogative, of compelling the vaſſals to be knighted, or to pay a fine, was expreſsly recogniſed in parliament by the ſtatute *de militibus*, 1 Edw. II.; was exerted as an expedient for raiſing money by many of our beſt princes, particularly by Edw. VI. and Q. Elizabeth; but this was the occaſion of heavy murmurs when exerted by Charles I.; among whoſe many misfortunes it was, that neither himſelf nor his people ſeemed able to diſtinguiſh between the arbitrary ſtretch and the legal exertion of prerogative. However, among the other conceſſions made by that unhappy prince before the fatal recourſe to arms, he agreed to diveſt himſelf of this undoubted flower of the crown; and it was accordingly aboliſhed by ſtatute 16 Car. I. c. 20.

WARE, a town of Hertfordſhire, with a market on Tueſdays, and a fair on the laſt Tueſday in April, and Tueſday before St Matthew's day (Sep. 21.) for horſes and other cattle. It is a large, well frequented, and well inhabited thoroughfare town, ſeated on the river Lea, 21 miles north of London. It carries on a great trade in malt and corn, which they are continually ſending in large quantities to London. E. Lon. 0. 3 N. Lat. 51. 50.

WARN, in law, is to ſummon a perſon to appear in a cour tof juſtice.

WARNING *of Tenants*, in Scots law. See Law, n° cvlxii. 16.

WARP, in the manufactures, a name for the threads, whether of ſilk, wool, linen, hemp, &c. that are extended lengthwiſe on the weaver's loom; and acroſs which the workman, by means of his ſhuttle, paſſes the threads of the woof, to form a cloth, riband, fuſtian, or the like.

Warp, a ſmall rope employed occaſionally to remove a ſhip from one place to another, in a port, road, or river. And hence,

To Warp, is to change the ſituation of a ſhip, by pulling her from one part of a harbour, &c. to ſome other, by means of warps, which are attached to buoys; to anchors ſunk in the bottom; or to certain ſtations upon the ſhore, as poſts, rings, trees, &c. The ſhip is accordingly drawn forwards to thoſe ſtations, either by pulling on the warps by hand, or by the application of ſome purchaſe, as a tackle, windlaſs, or capſtern, upon her deck.

When this operation is performed by the ſhip's leſſer anchors, theſe machines, together with their warps, are carried out in the boats alternately, towards the place where the ſhip is endeavouring to arrive: ſo that when ſhe is drawn up cloſe to one anchor, the other is carried out to a competent diſtance before her, and being ſunk, ſerves to fix the other warp, by which ſhe is farther advanced.

Warping is generally uſed whe the ſails are unbent, or when they cannot be ſucceſsfully employed, which may either ariſe from the unfavourable ſtate of the wind, the oppoſition of the tide, or the narrow limits of the channel.

WARRANDICE, in Scots law. See Law, N° clxiv. 11.

WARRANT, is a power and charge to a conſtable or other officer to apprehend a perſon accuſed of any crime. It may be iſſued in extraordinary caſes by the privy council, or ſecretaries of ſtate; but moſt commonly it is iſſued by juſtices of the peace. This they may do in any caſes where they have a juriſdiction over the offence, in order to compel the perſon accuſed to appear before them; for it would be abſurd to give them power to examine an offender, unleſs they had alſo power to compel him to attend and ſubmit to ſuch examination. And this extends to all treaſonable felonies, and breaches of the peace; and alſo to all ſuch offences as they have power to puniſh by ſtatute. Before the granting of the warrant, it is fitting to examine upon oath the party requiring it, as well to aſcertain that there is a felony or other crime actually committed, without which no warrant ſhould be granted; as alſo to prove the cauſe and probability of ſuſpecting the party againſt whom the warrant is prayed.

Blackſt. Comment. vol. iv. p. 290.

This warrant ought to be under the hand and ſeal of the juſtice; ſhould ſet forth the time and place of making, and the cauſe for which it is made; and ſhould be directed to the conſtable, or other peace officer, or it may be to any private perſon by name. A general warrant to apprehend all perſons ſuſpected, without naming or particularly deſcribing any perſon in ſpecial, is illegal and void for its uncertainty; for it is the duty of the magiſtrate, and ought not to be left to the officer, to judge of the ground of ſuſpicion. Alſo a warrant to apprehend all perſons guilty of ſuch a crime, is no legal warrant; for the point upon which its authority reſts, is a fact to be decided on a ſubſequent trial; namely whether the perſon apprehended thereupon be guilty or not guilty. When a warrant is received by the officer, he is bound to execute it, ſo far as the juriſdiction of the magiſtrate and himſelf extends. A warrant from any of the juſtices of the court of king's bench extends over all the kingdom, and is teſted or dated *England*: but a warrant of a juſtice of the peace in one county, muſt be backed, that is, ſigned, by a juſtice of another county, before it can be executed there. And a warrant for apprehending an Engliſh or a Scotch offender may be indorſed in the oppoſite kingdom, and the offender carried back to that part of the united kingdom in which the offence was committed.

WARRANTY, Warrantia, in law, a promiſe, or covenant, by deed, made by the bargainer for himſelf and his heirs, to warrant and ſecure the bargainee and his heirs, againſt all men, for enjoying the thing agreed on or granted between them.

WARREN (Sir Peter), an admiral, diſtinguiſhed by his virtue, learning, and undaunted courage, was deſcended from an ancient family in Ireland, and received a ſuitable education to qualify him for a command in the royal navy, in which he ſerved for ſeveral years with great reputation; but the tranſaction which placed his great abilities in their full light, was the taking of Louiſbourg in the year 1745, when he was appointed commodore of the Britiſh ſquadron ſent on that ſervice. He joined the fleet of tranſports from Boſton in Canſo bay on the 25th of April, having under his command the Superb of 60, and the Launceſton and Eltham of 40 guns; he was afterwards joined by ſeveral other men of war ſent from England, and took poſſeſſion of Louiſbourg on the 17th of June. The French, exaſperated at this loſs, were conſtantly on the watch to retake it; and in 1747 fitted out a large fleet for that purpoſe, and at the ſame time another ſquadron to proſecute their ſucceſs in the Eaſt Indies. Theſe ſquadrons ſailed at the ſame time; but the views of the French were rendered abortive by the gallant admiral Anſon and Sir Peter Warren, who had been created rear-admiral, who with a large fleet of ſhips fell in with the French, defeated the whole fleet, and took the greateſt part of the men of war. This was the laſt ſervice Sir Peter rendered to his country as a commander in the Britiſh fleet; for a peace being concluded in the ſucceeding year, the fleet was laid up in the ſeveral harbours.

He was now choſen one of the repreſentatives in parliament for Weſtminſter; and in the midſt of his popularity he paid a viſit to Ireland, his native country, where he died of an inflammatory fever in 1752, ſincerely lamented by all ranks of people; and an elegant monument of white marble was erected to his memory in Weſtminſter abbey.

Warren, is a franchiſe or place privileged by preſcription or grant from the king, for the keeping of beaſts and fowls of the warren; which are hares and coneys, partridges pheaſants, and ſome add quails, woodcocks, and water-fowl, &c. Theſe being *feræ naturæ*, every one had a natural right to kill as he could: but upon the introduction of the foreſt laws at the Norman conqueſt, theſe animals being looked upon as royal game, and the ſole property of our ſavage monarchs, this franchiſe of free-warren was invented to protect them, by giving the grantee a ſole and excluſive power of killing ſuch game, ſo far as his warren extended, on condition of his preventing other perſons. A man therefore that has the franchiſe of warren, is in reality no more than a royal game-keeper: but no man, not even a lord of a manor, could by common law juſtify ſporting on another's ſoil, or even on his own, unleſs he had the liberty of free warren. This franchiſe is almoſt fallen into diſregard ſince the new ſtatutes for preſerving the game; the name being now chiefly preſerved in grounds that are ſet apart for breeding hares and rabbits. There are many inſtances of keen ſportſmen in ancient times, who have ſold their eſtates, and reſerved the free-warren, or right of killing game, to themſelves: by which means it comes to paſs that a man and his heirs have ſometimes free-warren over another's ground.

A warren may lie open; and there is no neceſſity of incloſing it as there is of a park. If any perſon offend in a free-warren, he is puniſhable by the common law, and by ſtatute 21 Edw. III. And if any one enter wrongfully into any warren, and chaſe, take, or kill, any coneys without the conſent of the owner, he ſhall forfeit treble damages, and ſuffer three months impriſonment, &c. by 22 and 23 Car. II. c. 25. When coneys are on the ſoil of the party, he hath a property in them by reaſon of the poſſeſſion, and action lies for killing them; but if they run out of the warren and eat up a neighbour's corn, the owner of the land may kill them, and no action will lie.

WARSAW, a large city of Poland, the capital of that country, and of the province of Maſovia. It is built partly in a plain, and partly on a gentle aſcent riſing from the banks of the Viſtula, which is about as broad as the Thames at Weſtminſter, but very ſhallow in ſummer. This city and its ſuburbs occupy a vaſt extent of ground, and are ſuppoſed to contain 70,000 inhabitants, among whom are a great number of foreigners. The whole has a melancholy appearance, exhibiting the ſtrong contraſt of wealth and poverty, luxury and diſtreſs, which pervades every part of this unhappy country. The ſtreets are ſpacious, but ill paved; the churches and public buildings are large and magnificent: the palaces of the nobility are numerous and ſplendid ; but the greateſt part of the houſes, particularly in the ſuburbs, are mean and ill conſtructed wooden hovels.—Warſaw is 160 miles ſouth-eaſt by ſouth of Dantzic, 130 north north-eaſt of Cracow, and 300 north-eaſt by north of Vienna. E. Long. 21. 6. N. Lat. 50. 14.

WART. See *Surgery-Index*.

WARWICK, the capital of Warwickſhire in England, and from which this county derives its name. It is very ancient, and ſuppoſed by Cambden to be the place called by the Romans *Præſidium*, where the Dalmatian horſe were poſted. It ſtands on a rock of free-ſtone, of which all the public edifices in the town are built. At the Norman invaſion it was a conſiderable place ; and had many burgeſſes, of whom 12 were obliged by their tenure to accompany the king in his wars. It is ſupplied with water brought in pipes from ſprings half a mile from the town, beſides what it derives from the wells within it made in the rock : and it is eaſily kept clean, by being ſituated upon a declivity. Four ſtreets, from the four cardinal points of the compaſs, meet in the centre of the town. The principal public buildings are St Mary's, a very ſtately edifice, an hoſpital, a town-houſe of free-ſtone, three charity ſchools, and a noble bridge over the Avon. It has had ſeveral charters ; but is governed at preſent by a mayor, 12 brethren, 24 burgeſſes, &c. It is a very handſome populous town, and gives title of earl to the family of the Grevilles. W. Long. 1. 36. N. Lat. 52. 20.

WASH, among diſtillers, the fermentable liquor uſed by the malt diſtillers. See Brewery.

WASHING, in painting, is when a deſign, drawn with a pen or crayon, has ſome one colour laid over it with a pencil, as Indian ink, biſtre, or the like, to make it appear the more natural, by adding the ſhadow of prominences, apertures, &c. and by imitating the particular matters whereof the thing is ſuppoſed to conſiſt.

Thus they waſh with a pale red, to imitate brick and tile ; with a pale Indian blue, to imitate water and ſlate ; with green for trees and meadows ; with ſaffron or French berries, for gold or braſs ; and with ſeveral colours for marbles.

Washing of Ores, the purifying an ore of any metal, by means of water, from earths and ſtones, which would otherwiſe render it difficult of fuſion.

WASHINGTON, a city of North America, now building for the metropolis of the United States. It is ſeated at the junction of the rivers Potomac and the Eaſtern Branch, extending about four miles up each, including a tract of territory ſcarcely to be exceeded, in point of convenience, ſalubrity, and beauty, by any in the world. This territory, which is called *Columbia*, lies partly in the ſtate of Virginia, and partly in that of Maryland, and was ceded by theſe two ſtates to the United States of America, and by them eſtabliſhed to be the ſeat of government after the year 1800. It is divided into ſquares or grand diviſions, by ſtreets running due north, and ſouth, and eaſt, and weſt, which form the ground-work of the plan. However, from the Capitol, the preſident's houſe, and ſome of the important areas in the city, run diagonal ſtreets, from one material object to another, which not only produce a variety of charming proſpects, but remove the inſipid ſameneſs which renders ſome other great cities unpleaſing. The great leading ſtreets are all 160 feet wide, including a pavement of 10 feet, and a gravel walk of 30 feet planted with trees on each ſide, which will leave 80 feet of paved ſtreet for carriages. The reſt of the ſtreets are in general 110 feet wide, with a few only 90 feet, except North, South, and Eaſt Capitol Streets, which are 160 feet. The diagonal ſtreets are named after the reſpective ſtates compoſing the Union, while thoſe running north and ſouth are, from the Capitol eaſtward, named *Eaſt Firſt Street*, *Eaſt Second Street*, &c. and thoſe weſt of it are in the ſame manner called *Weſt Firſt Street*, *Weſt Second Street*, &c. Thoſe running eaſt and weſt are from the Capitol northward named *North A Street*, *North B Street*, &c. and thoſe ſouth of it are called *South A Street*, *South B Street*, &c. The ſquares or diviſions of the city amount to 1150. The rectangular ſquares generally contain from three to ſix acres, and are divided into lots of from 40 to 80 feet in front, and their depth from about 110 to 300 feet, according to the ſize of the ſquare. The irregular diviſions produced by the diagonal ſtreets are ſome of them ſmall, but generally in valuable ſituations. Their acute points are all to be cut off at 40 feet, ſo that no houſe in the city will have an acute corner. All the houſes muſt be of brick or ſtone. The area for the Capitol (or houſe for the legiſlative bodies) is ſituated upon the moſt beautiful eminence in the city, about a mile from the Eaſtern Branch, and not much more from the Potomac, commanding a full view of every part of the city, as well as a conſiderable extent of the country around. The preſident's houſe will ſtand upon a riſing ground, not far from the banks of the Potomac, poſſeſſing a delightful water proſpect, with a commanding view of the Capitol, and ſome other material parts of the city.

The city being ſituated upon the great poſt road, exactly equidiſtant from the northern and ſouthern extremities of the Union, and nearly ſo from the Atlantic Ocean to the river Ohio, upon the beſt navigation, and in the midſt of the richeſt commercial territory in America, commanding the moſt extenſive internal reſources, is by far the moſt eligible ſituation for the reſidence of congreſs ; and it is now preſſing forward, by the public-ſpirited enterpriſe, not only of the people of the United States, but alſo of foreigners.

WASP, in zoology. See Vespa.

Watch, in the art of war, a number of men poſted at any paſſage, or a company of the guards who go on the patrole.

Watch, in the navy, the ſpace of time wherein one diviſion of a ſhip's crew remains upon deck, to perform the neceſſary ſervices, whilſt the reſt are relieved from duty, either when the veſſel is under ſail or at anchor.

The length of the ſea-watch is not equal in the ſhipping of different nations. It is always kept four hours by the Britiſh ſeamen, if we except the dog-watch, between four and eight in the evening, that contains two reliefs, each of which are only two hours on deck. The intent of this is to change the period of the night-watch every 24 hours ; ſo that the party watching from 8 till 12 in one night, ſhall watch from midnight till four in the morning on the ſucceeding one. In France the duration of the watch is extremely different, being in ſome places ſix hours, and in others ſeven or eight ; and in Turky and Barbary it is uſually five or ſix hours.

A ſhip's company is uſually claſſed into two parties ; one of which is called the *ſtarboard* and the other the *larboard* watch. It is however, occaſionally ſeparated into three diviſions, as in a road or in particular voyages.

In a ſhip of war the watch is generally commanded by a lieutenant, and in merchant-ſhips by one of the mates ; ſo that if there are four mates in the latter, there are two in each watch ; the firſt and third being in the larboard, and the ſecond and fourth in the ſtarboard-watch : but in the navy, the officers who command the watch uſually divide themſelves into three parties, in order to lighten their duty.

Watch, is alſo uſed for a ſmall portable movement, or machine, for the meaſuring of time ; having its motion regulated by a ſpiral ſpring.

Watches, ſtrictly taken, are all ſuch movements as ſhow the parts of time; as clocks are ſuch as publiſh it, by ſtriking on a bell, &c. But commonly the name *watch* is appropriated to ſuch as are carried in the pocket; and *clock* to the large movements, whether they ſtrike the hour or not. See Clock.

The invention of ſpring or pocket-watches belongs to the preſent age. It is true, we find mention made of a watch preſented to Charles V. in the hiſtory of that prince: but this, in all probability, was no more than a kind of clock to be ſet on a table, ſome reſemblance whereof we have ſtill remaining in the ancient pieces made before the year 1670. There was alſo a ſtory of a watch having been diſcovered in Scotland belonging to king Robert Bruce; but this we believe has turned out altogether apocryphal. The glory of this very uſeful invention lies between Dr Hooke and M. Huyghens; but to which of them it properly belongs, has been greatly diſputed; the Engliſh aſcribing it to the former, and the French, Dutch, &c. to the latter. Mr Derham, in his Artificial Clockmaker, ſays roundly, that Dr Hooke was the inventer; and adds, that he contrived various ways of regulation. One way was with a loadſtone: Another with a tender ſtraight ſpring, one end whereof played backwards and forwards with the balance; ſo that the balance was to the ſpring as the bob to a pendulum, and the ſpring as the rod thereof: A third method was with two balances, of which there were divers ſorts; ſome having a ſpiral ſpring to the balance for a regulator, and others without. But the way that prevailed, and which continues in mode, was with one balance, and one ſpring running round the upper part of the verge thereof: Though this has a diſadvantage, which thoſe with two ſprings, &c. were free from; in that a ſudden jerk, or confuſed ſhake, will alter its vibrations, and put it in an unuſual hurry.

The time of theſe inventions was about the year 1658; as appears, among other evidences, from an inſcription on one of the double balance watches preſented to king Charles II. *viz.* Rob. Hooke *inven.* 1658. T. Tompion *fecit*, 1675. The invention preſently got into reputation, both at home and abroad; and two of them were ſent for by the dauphin of France. Soon after this, M. Huygens's watch with a ſpiral ſpring got abroad, and made a great noiſe in England, as if the longitude could be found by it. It is certain, however, that his invention was later than the year 1673, when his book *de Horol. Oſcillat.* was publiſhed; wherein he has not one word of this, though he has of ſeveral other contrivances in the ſame way.

One of theſe the lord Brouncker ſent for out of France, where M. Huygens had got a patent for them. This watch agreed with Dr Hooke's in the application of the ſpring to the balance; only M. Huygens's had a longer ſpiral ſpring, and the pulſes and beats were much ſlower. The balance, inſtead of turning quite round, as Dr Hooke's, turns ſeveral rounds every vibration.

Mr Derham ſuggeſts, that he has reaſon to doubt M. Huygens's fancy firſt was ſet to work by ſome intelligence he might have of Dr Hooke's invention from Mr Oldenburg, or ſome other of his correſpondents in Egland; and this, notwithſtanding Mr Oldenſworth's attempt to vindicate himſelf in the Philoſophical Tranſactions, appears to be the truth (A). Huygens invented divers other kinds of watches, ſome of them without any ſtring or chain at all; which he called, particularly, *pendulum watches*.

Striking Watches are ſuch as, beſides the proper watch-part for meaſuring of time, have a clock part for ſtriking the hours, &c.

Repeating Watches, are ſuch as by pulling a ſtring, &c. repeat the hour, quarter, or minute, at any time of the day

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(A) To expect perfection in a work of this extent would be unreaſonable, and we truſt to the candour of our readers for their acceptance of our beſt endeavours: we hold ourſelves much obliged to them for their communications of every remark which may enable us to render the Encyclopædia Britannica more worthy of that moſt encouraging reception which it has met with from the Public. To the regular ſeries of articles, the preſent Editor had once reaſon to believe that a Supplement was to be annexed, which ſhould include not only thoſe additions which have been made to the circle of the ſciences during the progreſs of the work, but likewiſe ſuch articles as he or his predeceſſor had, through their unremitting occupation or their ignorance, ſuffered to eſcape their notice. In that Supplement he would have corrected all ſuch errors or miſtakes in the work as might have been diſcovered by himſelf or pointed out to him by his Correſpondents. But he is no Proprietor, and cannot announce the publication of a Supplement but as an event of great uncertainty. He is therefore much obliged to his highly reſpected friend and correſpondent who has put it in his power at preſent to do juſtice to the memory of Dr Robert Hooke; one of the greateſt ornaments of the Royal Society of London during the time of its infant ſtate and juvenile vigour, and one of the moſt extenſive and inventive geniuſes that the world has ever ſeen.

In the article Hautefeuille, we aſcribe to that author the invention of the regulating or balance ſpring of a watch, by which its motion is made as truly equable as by a pendulum. This is verified by the watches of Harriſon, Arnold, and others, which do not deviate from equable motion above one ſecond in ſeveral days. That the importance of this is acknowledged by the intelligent Public, is evident from the ſerious and repeated deliberations of the Britiſh Senate, and the high rewards which it has given to the makers of ſuch watches; and we truſt that this will appear to ſuch of our readers as are not ſo much intereſted in mechanical performances a ſufficient excuſe for our anxiety to give the honour of the invention to its right owner. We had collected from our ſearches that Mr Huyghens had diſcovered, by his analyſis of pendulous motions, what kind of motion would be produced by any kind of varying force, and that a force varying in the proportion of its diſtance from the place of reſt would produce iſochronous vibrations, whatever might be their extent; and had made experiments on the force of ſprings, and found them to vary according to this very law. In conſequence of this, he ſaw that a balance-watch might be made to anſwer the ſame end with his cycloidal pendulum-clock, which he had been for ſeveral years trying to fit for the diſcovery of the longitude of a ſhip at ſea, under the protection of the States of Holland and the court of France, having obtained a patent monopoly from the States and from Louis XIV. When, after repeated diſappointments, he introduced his propoſed watches, with ſanguine hopes of their performance, but before any trial, and applied for ſuch an extenſion of his patent as ſhould alſo comprehend a balance regulated by a ſpring, he was oppoſed by the watch-makers. They had willingly acquieſced in his excluſive right to the pendulum-clock, which was entirely his own demeſne; but they could not help conſidering this extenſion of his patent as an encroachment on a common which they had poſſeſſed from time immemorial. The oppoſition was general both in or night.—This repetition was the invention of Mr Barlow, and firſt put in practice by him in larger movements or clocks about the year 1676. The contrivance immediately ſet the other artiſts to work, who ſoon contrived divers ways of effecting the ſame. But its application to pocket-watches was not known before king James the Second's reign; when the ingenious inventer above-mentioned, having directed Mr Tompſon to make a repeating watch, was ſoliciting a patent for the ſame. The talk of a patent engaged Mr Quare to reſume the thoughts of a like contrivance, which he had had in view ſome years before: he now effected it; and being preſſed to endeavour to prevent Mr Barlow's patent, a watch of each kind was produced before the king and council; upon trial of which, the preference was given to Mr Quare's. The difference between them was, that Barlow's was made to repeat by puſhing in two pieces on each ſide the watch-box; one of which repeated the hour, and the other the quarter: whereas Quare's was made to repeat by a pin that ſtuck out near the pendant, which being thruſt in (as now it is done by thruſting in the pendant itſelf), repeated both the hour and quarter with the ſame thruſt.

Of the Mechaniſm of a WATCH, properly ſo called. Watches, as well as clocks, are compoſed of wheels, and pinions, and a regulator to direct the quickneſs or ſlowneſs of the wheels, and of a ſpring which communicates motion to the

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Holland and in France, and naturally came to the knowledge of Mr Hauteſeuille. This perſon was conſcious of a double right to oppoſe this encroachment, having alſo, though perhaps empirically, and without principle, diſcovered that a ſpring, applied to the balance of a watch, produced a ſurpriſing equability of vibration; and hoped by its means to produce a perfect iſochroniſm. By Mr Hauteſeuille's oppoſition the effect of the French patent was ſtopped for want of regiſtration. The Dutch patent was however expeded, and trials were made. But their reſult was unfavourable; many things were wanting beſides the true adjuſtment of the regulating power of the balance-ſpring. Scientific mechanics was then in its infancy, Galileo was dead, Newton was but beginning his glorious career; Huyghens therefore had few aſſiſtants.

The Royal Society of London was juſt founded, and Charles II. or his brother the duke of York, ſaw, *like a prince*, how conducive their labours would be to public proſperity, and particularly to the improvement of navigation. The king therefore enjoined them to turn much of their attention to this object; he eſtabliſhed the Royal Obſervatory at Greenwich *for this expreſs purpoſe*; and the parliament held out encouragement for the diſcovery of the longitude. It was natural therefore for Mr Huyghens to look to this quarter for encouragement; and if any one will take the pains to compare the dates of Mr Huyghens's mathematical labours, after his diſſertation on the pendulum, and his correſpondence with the Britiſh literati, till he was elected member of the Royal Society, his *private* correſpondence afterwards with Mr Oldenburgh, a German, their ſecretary, and his public correſpondence with him as ſecretary for the Society, he will obſerve the operation of ſomething more than ſcientific zeal.

This correſpondence, however, did not anſwer Mr Huyghens's hopes; for it informed him that the ground had been preoccupied by Mr Hooke, who had long before diſcovered, that a ſpring properly applied to a watch-balance would produce iſochronous vibrations, and had alſo long ago applied for a royal patent for the monopoly. The hiſtory of this application is curious, as a mere matter of anecdote; and it is inſtructive, while it is humiliating to human vanity, ſhowing us, that even in the greateſt characters, genius and talents, and noble and undoubted virtues, may exiſt along with ſome of our leſs honourable propenſities, and cannot altogether hinder their operation. There never was a time in which it was more proper that every one of us ſhould have a monitor, who ſhould ſometimes call out aloud to us, "Remember that thou art a man," than the preſent, when fanatic vanity, under the falſe and abuſed name of *philoſophy*, is waging war with every thing that is good or true, and threatens to plunge the cultivated portions of the human race into their former barbariſm, with the horrid addition of the habits of ſavage atrocity; while the voice of religion, which would call us together as the children of one parent, is ſtifled amidſt the yells of brother fiends. We hope for indulgence, then, while we endeavour, in a few words, to make the hiſtory of this invention as clear as can be expected in a ſubject which does not ſo ſenſibly intereſt the public in general, and after ſuch a long interval of time.

Mr Hooke, from his infancy, had a ſtrong predilection for mechanics; he had alſo a ſtrong propenſity to ſyſtem-making; and, from his firſt years of ſerious occupations, entertained a notion, that every thing might be formed into a ſyſtem, and that nothing could be proſecuted with any well-founded proſpect of improvement unleſs it was ſo treated. His amazingly comprehenſive genius graſped at every thing which came under his obſervation; and he immediately began to form a ſyſtem about it.—His writings are full of ſcraps of ſuch ſyſtematic views; many of them, it muſt be acknowledged, haſty, inaccurate, and futile, but ſtill ſyſtematical. He called them algebras, and conſidered them as having a ſort of inventive power, or rather as means of diſcovering things unknown by a proceſs ſomewhat ſimilar to that art. He valued himſelf highly on account of this view of ſcience, which he thought peculiar to himſelf; and he frequently ſpeaks of others, even of the moſt eminent, as childiſhly contenting themſelves with partial views of the corners of things. He was likewiſe very apt to conſider other inventors as encroachers on his ſyſtems, which he held as a kind of property, being ſeriouſly determined to proſecute them all in their turn, and never recollecting that any new object immediately called him off, and engaged him for a while in the moſt eager purſuit. His algebras had already given him many ſignal helps; and he had no doubt of their carrying him through in every inveſtigation. Stimulated by this overfond expectation, when a diſcovery was mentioned to him he was too apt to think and to ſay, that he had long ago invented the ſame thing; when the truth probably was, that the courſe of his ſyſtematic thoughts on the ſubject with which it was connected had really ſuggeſted it to him, with ſuch vivacity, or with ſuch notions of its importance, as to make him ſet it down in his regiſter in its own ſyſtematic place (for this was his conſtant practice, worthy of ſuch a genius, and of immenſe ſervice to all inquiſitive men.) But it was put out of his mind by ſome new object of purſuit. We, at this time, can hardly conceive the ardour with which every thing was treated in thoſe youthful days of ſcientific novelty.

His favourite algebra, of which he frequently ſpeaks as an invaluable treaſure, and the ſource of all his reputation, was his Mechanical Algebra or Method of Mechanic Invention. He ſays, that no queſtion in mechanics could be propoſed to him, but he could quickly tell whether it were poſſible to ſolve it, and could get into the proper track for the ſolution. Unfortunately, Watch.

Plate DXXXVII

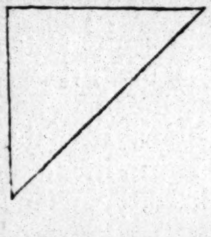
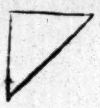
the whole machine. But the regulator and ſpring of a watch are vaſtly inferior to the weight and pendulum of a clock, neither of which can be employed in watches. In place of a pendulum, therefore, we are obliged to uſe a balance (fig. 1.) to regulate the motion of a watch; and a ſpring (fig. 2.) which ſerves in place of a weight, to give motion to the wheels and balance.

The wheels of a watch, like thoſe of a clock, are placed in a frame formed of two plates and four pillars. Fig. 3. repreſents the inſide of a watch, after the plate (fig. 4.) is taken off. A is the barrel which contains the ſpring (fig. 2.); the chain is rolled about the barrel, with one end of it fixed to the barrel A (fig. 5.), and the other to the fuſee B.

When a watch is wound up, the chain which was upon the barrel winds about the fuſee, and by this means the ſpring is ſtretched; for the interior end of the ſpring is fixed by a hook to the immoveable axis, about which the barrel revolves; the exterior end of the ſpring is fixed to the inſide of the barrel, which turns upon an axis. It is therefore eaſy to perceive how the ſpring extends itſelf, and how its elaſticity forces the barrel to turn round, and conſequently obliges the chain which is upon the fuſee to unfold and turn the fuſee; the motion of the fuſee is communicated to the wheel C (fig. 5.); then, by means of the teeth, to the pinion *c*, which carries the wheel D; then to the pinion *d*, which carries the wheel E; then to the pinion *e*, which

Watch.

Unfortunately this periſhed in the burning of Greſham College, where Mr Hooke had apartments from the Royal Society; and he does not ſeem to have replaced it. It was perhaps, like the reſt, nothing more than ſcraps. The Correſpondent who favours us with theſe obſervations ſaw, in 1768, many papers of Mr Hooke's writings in the Society's archives, which had evidently been reſcued from the flames, and had been in the poſſeſſion of Mr Waller; part of which he publiſhed, and would have given more had he lived. Many of the leaves were ſcraps, perhaps ſingle lines; many had dates; many of them were ſuch as would be fragments of this mechanical algebra. Mr Hooke poſitively ſays, that it was by this ſyſtem that he diſcovered the regulating power of a ſpring. And this brings us to the ſubject in hand, to which we hope the foregoing obſervations will not be thought too long a preface.

In 1655 he was admitted into the Invisible Society at Oxford, and was particularly patroniſed by Dr Ward, afterwards biſhop of Saliſbury, who inſtructed him in aſtronomy, and ſtrongly recommended to his mechanical genius the diſcovery of ſome method of maintaining the vibrations of a pendulum, as of immenſe ſervice to the aſtronomer. This Hooke accompliſhed immediately, and thought of uſing pendulum clocks for diſcovering the longitude at ſea; and *his method* of mechanic inventions *quickly* led him, he ſays, to the diſcovery of the regulating power of ſprings as equivalent (nay, he ſays, ſuperior) to that of gravity. This is remarkable; for it appears that he had at that time mathematics enough to inform him, that nothing would produce iſochronous vibrations but an accelerative force proportional to the ſpace *to be paſſed through*, a truth neither obvious nor eaſily come at; and that the accelerative action of gravity on a common pendulum was not exactly in this proportion: but he did not then know the mechanical properties of the cycloid, a diſcovery reſerved to do honour to Mr. Huyghens. Our correſpondent farther informs us, that he recollects ſeeing, among the ſcraps of Mr. Hooke's writing, words nearly to the following purpoſe: "To produce a tranſlation of a moveable thus ———————— or thus ——— in the ſame time, requires a preſſing power thus  or thus ." This will evidently appear to be a haſty expreſſion of a force at the diſtance to be run through. He had found by experiments, made probably with other views, that the force of a ſpring was proportional to its deviation from its quieſcent ſhape, and this whatever was its ſhape. Of this truth he now ſaw the value, and marked it in his regiſter, and gave it to his friends, agreeably to the cuſtom of the times, in the form of a cipher *ce, iii, no, sss, tt, uu;* which was afterwards explained "*Ut tenſio, ſic vis.*"

Mr Boyle was then his chief patron, and to him he communicated his ſcheme of meaſuring time accurately by a balance-watch regulated by a ſpring; and ſhowed him watches ſo conſtructed, which performed with ſurpriſing accuracy. Immediately after the Reſtoration, Mr Boyle acquainted Lord Brouncker and Sir Robert Moray, the moſt eminent gentlemen of the age for mathematical learning, and for natural knowledge in general, with Mr Hooke's diſcovery and ſcheme; and thoſe gentlemen encouraged him to apply for a patent, and even drew up a form for an act of parliament, to give him a profit on his invention by a duty on ſhipping. This draught was ſhown to the king, and he granted a warrant for a patent to Mr Hooke for 14 years; which warrant was in the poſſeſſion of Mr Waller.

It appears that theſe gentlemen were ſo ſenſible of the merits of the invention, and ſo confident of its ſucceſs, that they aſſociated themſelves with Dr Hooke in the proſecution of it. But in what reſpect they were to contribute, beſides their influence in procuring the patent and the act of parliament, does not appear. There remained, however, in Mr Waller's poſſeſſion ſeveral ſcrolls and drafts of a mutual agreement between them to this effect: In one of them it was agreed, that if the profits ſhould exceed L. 6000, Mr Hooke ſhould have $\frac{1}{4}$ths of the overplus; if it ſhould be only L. 4000, he ſhould have $\frac{2}{3}$ds, &c. they having the reſt, and that Dr Hooke ſhould be declared the author and inventor. It is probable that they were to advance the money neceſſary for carrying on the trade of watchmaking.—Many alterations were made in the terms of agreement; and it appears, that before any thing definitive was done, Hooke was diſguſted, becauſe they inſiſted, that if they or any other perſon ſhould fall on any way of improving on theſe principles, they ſhould enjoy the benefit of it during the currency of the patent. This he flatly refuſed; ſaying that it was *facile inventis addere.* It is probable that his manner of refuſal, which never was gracious or polite, might offend perſons of their rank, and contribute to put an end to the whole affair; for it never went farther, and Hooke became much more retentive and cloſe than formerly.

But while things were on a friendly footing, there occurred ſufficient proofs of Dr Hooke's being the author of the invention, and that even Mr Huyghens could hardly fail of knowing ſomething of it when he was in England in 1663, ten or eleven years before he publiſhed his claim, and even before he had analyſed the motion of pendulous bodies. In page 247 of the Society's Regiſter, in 1660, mention is made of Hooke's watches for the pocket, where the motion is regulated by ſprings. Now Hooke, in his firſt watches, employed two oppoſite ſprings, ſtraight, and acting on the balance

Watch.

which carries the wheel F; then to the pinion *f*, upon which is the balance-wheel G, whoſe pivot runs in the pieces A called the *potance*, and B called a *follower*, which are fixed on the plate fig. 4. This plate, of which only a part is repreſented, is applied to that of fig. 3. in ſuch a manner that the pivots of the wheels enter into holes made in the plate fig. 3. Thus the impreſſed force of the ſpring is communicated to the wheels: and the pinion *f* being then connected to the wheel F, obliges it to turn (fig. 5.) This wheel acts upon the palettes of the verge 1, 2, (fig. 1.), the axis of which carries the balance HH, (fig. 1.) The pivot I, in the end of the verge, enters into the hole *c* in the potance A (fig. 4.) In this figure the palettes are repreſented; but the balance is on the other ſide of the plate, as may be ſeen in fig. 6. The pivot 3 of the balance enters into a hole of the cock BC (fig. 7.), a perſpective view of which is repreſented in fig. 8. Thus the balance turns between the cock and the potance *c* (fig. 4.), as in a kind of cage. The action of the balance-wheel upon the palettes 1, 2 (fig. 1.), is the ſame with what we have deſcribed with regard to the ſame wheel in the clock; *i. e.* in a watch, the balance-wheel obliges the balance to vibrate backwards and forwards like a pendulum. At each vibration of the balance a palette allows a tooth of the balance-wheel to eſcape; ſo that the quickneſs of the motion of the wheels is entirely determined by the quickneſs of the vibrations of the balance; and theſe vibrations of the balance and motion of the wheels are produced by the action of the ſpring.

But the quickneſs or ſlowneſs of the vibrations of the balance depend not ſolely upon the action of the great ſpring, but chiefly upon the action of the ſpring *a*, *b*, *c*, called *the ſpiral ſpring* (fig. 9.), ſituated under the balance H, and repreſented in perſpective (fig. 6.). The exterior end of the ſpiral is fixed to the pin *a*, (fig. 9.). This pin is applied near the plate in *a*, (fig. 6.); the interior end of the ſpiral is fixed by a peg to the centre of the balance. Hence if the balance is turned upon itſelf, the plates remaining immoveable, the ſpring will extend itſelf, and make the balance perform one revolution. Now, after the ſpiral is thus extended, if the balance be left to itſelf, the elaſticity of the ſpiral will bring back the balance, and in this manner the alternate vibrations of the balance are produced.

In fig. 5. all the wheels above deſcribed are repreſented in ſuch a manner, that you may eaſily perceive at firſt ſight how the motion is communicated from the barrel to the balance.

Watch ‖ Water.

In fig. 10. are repreſented the wheels under the dial-plate by which the hands are moved. The pinion *a* is adjuſted to the force of the prolonged pivot of the wheel D (fig. 5.), and is called a *cannon pinion*. This wheel revolves in an hour. The end of the axis of the pinion *a*, upon which the minute-hand is fixed, is ſquare; the pinion (fig. 10) is indented into the wheel *b*, which is carried by the pinion *a*. Fig. 11. is a wheel fixed upon a barrel, into the cavity of which the pinion *a* enters, and upon which it turns freely. This wheel revolves in 12 hours, and carries along with it the hour-hand. For a full account of the principles upon which watches and all time-keepers are conſtructed, we muſt refer our readers to a ſhort treatiſe, entitled *Thoughts on the Means of improving Watches*, by Thomas Mudge.

WATCH-glaſſes, in a ſhip, are glaſſes employed to meaſure the period of the watch, or to divide it into any number of equal parts, as hours, half-hours, &c. ſo that the ſeveral ſtations therein may be regularly kept and relieved, as at the helm, pump, look-out, &c.

WATCHING, in medicine, is when the patient cannot ſleep. In fevers it is a dangerous ſymptom, and if long continued ends in a delirium.

WATER, a well known fluid, diffuſed through the atmoſphere, and over the ſurface of the globe, and abounding in a certain proportion in animals, vegetables, and minerals.

1 Uſes of water.

The uſes of water are ſo univerſally known, that it would be ſuperfluous to enumerate them in this article. It is eſſential to animal and vegetable life; it makes eaſy the intercourſe between the moſt diſtant regions of the world; and it is one of the moſt uſeful powers in the mechanic arts. It is often found combined with various ſubſtances, and is then frequently beneficial in curing or alleviating diſeaſes.

Thoſe properties of water which fit it for anſwering mechanical purpoſes are explained in other articles of this Work (ſee HYDROSTATICS, PNEUMATICS, nº 3. RESISTANCE, and RIVERS); but it ſtill remains for us to give an account of the late celebrated diſcovery of the compoſition of water, and the various ſubſtances which are often found chemically united with it.

2 Not tranſmutable into earth.

The ancient philoſophers conſidered water as one of the four elements. During the age of the alchymiſts, when it was believed that different ſubſtances could be converted into gold, it was alſo an opinion, adopted by many, that water could be changed into earth. Even ſo late as the time of Mr Boyle

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lance by a ſilk fibre rolled round the cylindric axis of the balance. Mr Hooke, long after this complained to the Society of Mr Oldenburgh's communicating this and other things to Huyghens, with whom he had an intimate correſpondence. In 1665 Sir Robert Moray wrote a letter to Mr Oldenburgh, preſuming, from his intimacy with Mr Huyghens, that he would know how ſoon his watches would be ready, and deſired him to aſk Mr Huyghens, " Whether he did not apply a ſpring to *the axis* of the balance?" and if he ſhould ſay any thing to that purpoſe, then to tell him WHAT *Hooke had done in that way*, and that he intended more. *N. B.* Before this time the treaty had been dropped, and there appeared to Sir Robert no farther need of concealment.

From theſe and other facts that might be produced, we think it moſt evident that Mr Hooke invented the regulating ſpring of a watch, by which it is made perfectly adequate to the purpoſe of finding the longitude at ſea; that he invented it eight or ten years before Mr Huyghens thought of ſuch a thing, and fifteen years before he publiſhed it in the *Journal des Sçavans* in 1674.

Our readers cannot fail of making ſome remarks on this anecdote, which will perhaps extenuate a little Mr Hooke's moroſe behaviour, and explain, and perhaps excuſe, his diſpoſition to boaſt of his own inventions and arrogate thoſe of others. If any of the expreſſions in the article allotted to his name ſhould have made too unfavourable an impreſſion, this note may help to ſoften it. We do not think that it can be inferred from thoſe facts that either Hautefeuille or Huyghens *purloined* Hooke's invention. The one might fall upon it in the courſe of his many experiments; and the other, from his mathematical diſcoveries of the requiſites for iſochronous vibrations, might be induced to *try* whether ſprings afforded ſuch a force. But there can remain no doubt but that Hooke made the diſcovery LIKE A PHILOSOPHER. If to this Work any Supplement ſhall be given by the preſent Editor, he will endeavour ſtill farther to wipe away the obloquy which has been caſt upon the memory of Dr Hooke for his arrogance in claiming the merit of inventions *ſuppoſed* to be the property of others.

Boyle this ſentiment was not laid aſide. He relates, that a friend of his by diſtilling a quantity of water an hundred times, found at length that he had got ſix-tenths of the firſt quantity in earth: whence he concludes, that the whole water, by further proſecuting the operation, might be converted into earth. Others have made experiments to the ſame purpoſe, and ſeemingly with the ſame ſucceſs; but the deception is now found out. Water has the power of corroding the hardeſt bodies, even glaſs itſelf, by long digeſtion, eſpecially when aſſiſted by heat; and hence thoſe who have made the experiments juſt mentioned, have been themſelves deceived, by ſuppoſing the earth which really came from the containing veſſel to come from the water.

Margraaf made ſeveral experiments to determine whether water be tranſmutable into earth, and found that after every diſtillation a ſediment was left. Lavoiſier repeated Margraaf's experiments, and gave the explanation which we alluded to, that the ſediment conſiſted of portions of the glaſs ſeparated by the water. Dr Black, in the valuable courſe of lectures which he has for many years delivered, with ſo much honour to himſelf, and ſo much to the advancement of the ſcience of chemiſtry, goes ſtill farther: he ingeniouſly ſuppoſes, that the alkali, which is an eſſential ingredient in the compoſition of glaſs, unites with the water, and makes the glaſs ſwell, and thus occaſions ſmall portions of it to be detached.

Hiſtorical Account of the Diſcovery of the Compoſition of Water.

THAT water is not a ſimple but a compound ſubſtance, conſiſting of a mixture of vital and inflammable air, is one of the moſt aſtoniſhing and important diſcoveries which has been made ſince the origin of chemiſtry, or indeed ſince the origin of ſcience. The hiſtory of this curious and intereſting diſcovery we ſhall trace back with as much preciſion and impartiality as poſſible to the firſt hints which were thrown out upon the ſubject, and endeavour at the ſame time to aſſign to all who have contributed to the diſcovery the merit to which they are reſpectively entitled.

3
Mr Warltire's experiment gives the firſt hint.

The firſt thing that led chemiſts to make experiments concerning the compoſition of water, was a letter which Mr John Warltire, lecturer in natural philoſophy, wrote to Dr Prieſtley, dated Birmingham 18th April 1781, and publiſhed in the Appendix to the 5th volume of Dr Prieſtley's *Experiments and Obſervations*. This gentleman had long entertained an opinion that the queſtion "whether heat be a heavy body," might be determined by burning inflammable air mixed with atmoſpherical air. For ſome time he was deterred from trying the experiment, from an apprehenſion that the conſequences of paſſing the electrical ſpark through ſo combuſtible a mixture might be attended with danger; but at length, being encouraged by Dr Prieſtley, he prepared an apparatus for the purpoſe. He got a copper ball weighing 14 oz. and ſufficient to contain three wine pints, with a ſcrew ſtopper adapted to it, ſo that no air could eſcape. When he filled this ball with inflammable and common air, and made the electric ſpark to paſs through it, a loſs of weight was obſerved, upon an average, about two grains. When the ſame experiment was made in cloſe glaſs veſſels, the inſide of the glaſs, though clean and dry before the operation, became immediately wet with dew, and was lined with a ſooty ſubſtance. When Mr Warltire ſaw the moiſture, he ſaid to Dr Prieſtley, that it confirmed an opinion which he had long entertained, that common air depoſits its moiſture when it is phlogiſticated. After this experiment had been repeated by Dr Prieſtley and Mr Warltire in company, they next fired a mixture of vital and inflammable air; but the only effects which they obſerved were, that the light was much more intenſe, and the heat much greater.

4
Mr Cavendiſh repeats it with more ſucceſs.
Phil. Tranſ. for 1784, p. 126, &c.

During the ſame year, and after the publication of the volume of Dr Prieſtley's works, referred to above, Mr Cavendiſh repeated the experiments of Mr. Warltire; but though the veſſel which he uſed held 24,000 grains of water, and though the experiment was repeated ſeveral times with common and inflammable air, he could never perceive a loſs of weight of more than one-fifth of a grain, and commonly none at all. In all theſe experiments Mr Cavendiſh did not perceive the leaſt ſooty matter; but the inſide of the glaſs globe became dewy, as Mr Warltire had obſerved. The inflammable air was procured from zinc.

That he might examine the nature of the dew, he burned 500,000 grain meaſures of inflammable air with two and a half times that quantity of common air, and the burned air was made to paſs through a glaſs cylinder eight feet long, and three quarters of an inch diameter, in order to depoſit the dew. Theſe two kinds of air were mixed and ſet on fire by a lighted candle. In a ſhort time 135 grains of water were condenſed in the cylinder, which had no taſte nor ſmell, and which left no ſenſible ſediment when evaporated to dryneſs; neither did it yield any pungent ſmell during the evaporation: in ſhort, it ſeemed pure water. From this experiment Mr Cavendiſh concluded, that when inflammable and common air are exploded in a proper proportion, almoſt all the inflammable air, and near one-fifth of the common air loſe their elaſticity, and are condenſed into dew; which, when examined, is found to be pure water.

5
He obtains a quantity of water by firing vital and inflammable air.

He wiſhed next to examine the effect produced by firing a mixture of vital and inflammable air. He took a glaſs globe holding 8800 grain meaſures, furniſhed with a braſs cock, and an apparatus for firing air by electricity. The globe was exhauſted of its air by an air-pump, and then a mixture of 19,500 grain meaſures of dephlogiſticated air, and 37,000 of inflammable air, was conveyed ſucceſſively from a glaſs jar, inverted in water, into the globe, and there fired by electricity. At the end of the experiment, when the whole air was conſumed, a condenſed liquor was found in the globe, weighing about 30 grains, which was ſenſibly acid to the taſte; and, by ſaturation with fixed alkali and evaporation, yielded near two grains of nitre. This product of nitre muſt have been occaſioned by a mixture of azotic gas, which had combined with part of the oxygene, or dephlogiſticated air; which are now well known to be the component parts of the nitric acid. Theſe experiments, Mr Cavendiſh informs us, were made in 1781.

6
The experiments of Mr Cavendiſh repeated by Dr Prieſtley.

Mr Cavendiſh having mentioned theſe experiments to Dr Prieſtley, that gentleman made a courſe of experiments in order to inveſtigate the ſame ſubject; an account of which is publiſhed in the Philoſophical Tranſactions for 1783, and in the laſt volume of his Experiments. Having formerly obſerved ſeveral remarkable changes in fluid ſubſtances, in conſequence of long expoſure to heat in glaſs veſſels hermetically ſealed, Dr Prieſtley formed a deſign of expoſing all kinds of ſolid ſubſtances to great heats in cloſe veſſels. As many ſubſtances conſiſt of parts ſo volatile as to fly off before attaining any conſiderable degree of heat in the uſual preſſure of the atmoſphere, he imagined that if the ſame ſubſtances were compelled to bear great heats under a greater preſſure, they might aſſume new forms, and undergo remarkable changes. Happening to mention theſe ideas to Mr Watt, the ingenious improver of the ſteam-engine, Mr Watt mentioned a ſimilar idea of his, that it might be poſſible to convert water or ſteam into permanent air.

7 Account of Mr Watt's theory. Phil. Tranſ. for 1784, p. 335.

For many years before this period, Mr Watt tells us he had entertained an opinion, that air was a modification of water, which was originally founded on the facts, that in moſt caſes wherein air was actually made (which ſhould be diſtinguiſhed from thoſe wherein it is only extricated from ſubſtances containing it in their pores, or otherwiſe united to them in the ſtate of air), the ſubſtances were ſuch as were known to contain water as one of their conſtituent parts; yet no water was obtained in the proceſſes, except what was known only to be looſely connected with them, ſuch as the water of the cryſtallization of ſalts. This opinion aroſe from a diſcovery, that the latent heat contained in ſteam diminiſhed in proportion as the ſenſible heat of the water from which it was produced increaſed. In other words, the denſer the ſteam was, the leſs latent heat it contained.

Having been informed by Dr. Prieſtley of the reſult of the experiment of firing a mixture of dephlogiſticated and inflammable air, Mr Watt was enabled to form the very theory which has been ſince demonſtrated to be true. "Let us conſider (ſays he) what obviouſly happens in the caſe of the deflagration of the inflammable and dephlogiſticated air. Theſe two kinds of air unite with violence, they become red hot, and upon cooling totally diſappear. When the veſſel is cooled, a quantity of water is found in it equal to the weight of the air employed. The water is then the only remaining product of the proceſs; and water, light, and heat are all the products, unleſs there be ſome other matter ſet free which eſcapes our ſenſes. Are we not then authoriſed to conclude, that water is compoſed of dephlogiſticated air and phlogiſton deprived of part of their latent or elementary heat; that dephlogiſticated or pure air is compoſed of water deprived of its phlogiſton and united to elementary heat and light; and that the latter are contained in it in a latent ſtate, ſo as not to be ſenſible to the thermometer or to the eye; and if light be only a modification of heat, or a circumſtance attending it, or a component part of the inflammable air, then pure or dephlogiſticated air is compoſed of water deprived of its phlogiſton and united to elementary heat?"

Phil. Tranſ. for 1784, & Idées ſur la Meteor. par J. A. De Luc, tom. i p. 213,

We have ſaid that the theory of Mr Watt is now demonſtrated to be true. To this aſſertion an objection may be raiſed from the language in which he ſtates his theory; for he explains it by uſing the word *phlogiſton*, a word which is now exploded from philoſophy as the name of an imaginary ſubſtance. But it is ſufficient to reply, that Mr Watt uſes the word phlogiſton as ſynonymous with inflammable air. It may be proper alſo to add, that the paſſage quoted above was contained in a letter from Mr Watt to Dr Prieſtley, dated the 26th of April 1783.

Moſt of the experiments hitherto made favoured the concluſion which Mr Watt had drawn; but ſo many difficulties occurred to Mr Cavendiſh and Dr Prieſtley, that they ſeemed to heſitate about the theory. Dr Prieſtley in particular, after conſideration declared againſt it; while Mr Cavendiſh only waited till the difficulties ſhould be removed. In the mean time experiments were made in a different quarter, which gave the moſt inconteſtable proofs of the truth of the theory.

8 Which is eſtabliſhed by experiments at Paris. Idées ſur la Meteor. par De Luc, tom. ii. part iii. chap. iv.

M. de Luc had gone to Paris in January 1783. During his reſidence there, he received a letter from Dr Prieſtley, announcing the reſult of his experiments concerning the converſion of water into air. M. de Luc immediately communicated the contents of this letter to ſeveral members of the Academy of Sciences. But the difficulties which had occurred to Dr Prieſtley, prevented them from acquieſcing in Mr Watt's theory. In the month of June following, Dr Blagden, who was well acquainted with all the experiments both of Mr Cavendiſh and of Dr Prieſtley, and of the opinions of Mr. Watt, made a journey to Paris, in which he had an opportunity of converſing on this ſubject with the ſame gentlemen of the Academy to whom M. de Luc had formerly imparted the experiments of Dr Prieſtley. Notwithſtanding the additional facts which he was enabled to lay before them, he found them averſe from admitting the theory. They ſuppoſed that the water collected after the combuſtion of the two kinds of air had been diſſolved in them before. As the queſtion depended upon the proof of a fact, they reſolved however to make the proper experiments for examining it. The celebrated Lavoiſier took this experiment upon himſelf. It was made on the 24th of June in the preſence of Dr Blagden and many gentlemen of the academy; and the ſucceſs was as complete as the moſt ſanguine imagination could have conceived. It was repeated by Meſſrs Monge and Meunier, and the ſame reſult was found. The compoſition of water was now therefore put beyond doubt, and is now almoſt univerſally received as an unqueſtionable fact.

9 Attempt to eſtimate the merit of thoſe concerned in this diſcovery.

As we wiſh upon all occaſions to aſcribe to all eminent men the honour which they deſerve, we ſhould willingly eſtimate the comparative merit of thoſe philoſophers who were moſt active in this diſcovery; but though we feel ourſelves diſpoſed to be altogether impartial, it is attended with ſo many difficulties, that we will not preſume to affirm that our opinions are formed with perfect accuracy.

10 Merit of Mr Watt;

With reſpect to Mr Watt, we think it appears that he was the firſt perſon who formed the true theory. He had for many years before thought it probable, that if the latent heat of ſteam could be wholly converted into ſenſible heat by a great increaſe of heat, the ſteam might ſuffer ſome remarkable change, ſuch as into permanent air. And no ſooner had he heard of the deflagration of oxygenous and hydrogenous gas by Dr Prieſtley, than he formed this theory.

Phil. Tranſ. for 1784, p. 335.

11 Of Mr Cavendiſh.

Mr Cavendiſh had the merit of making a proper uſe of Dr Prieſtley's account of Mr Warltire's experiment, from which Dr Prieſtley had been able to draw no concluſions, but had conſidered it merely as a curious fact. Without knowing any thing of Mr Watt's ideas, as far as appears to us, he made a number of ingenious experiments, which led him to conclude, that it was highly probable that water was a compoſition of air. The air which he employed ſeems not to have been pure; ſo that beſides the water he procured a quantity of nitrous acid. He however acted like an able and candid philoſopher; he went as far as his experiments would permit him, and he went no farther. In one point he continued to differ from Mr Watt after his theory was made public. Mr Watt ſuppoſed that water conſiſted of dephlogiſticated air (oxygenous gas) and phlogiſton (hydrogenous gas according to him), deprived of part of their latent heat; whereas Mr Cavendiſh thought there was no ſuch thing as elementary heat. We muſt further add, that it was Mr Cavendiſh who taught Dr Prieſtley to turn to a proper account the experiment of Mr Warltire; and therefore, that it was in fact from Mr Cavendiſh's experiments ultimately, that Mr Watt was enabled to eſtabliſh his theory.

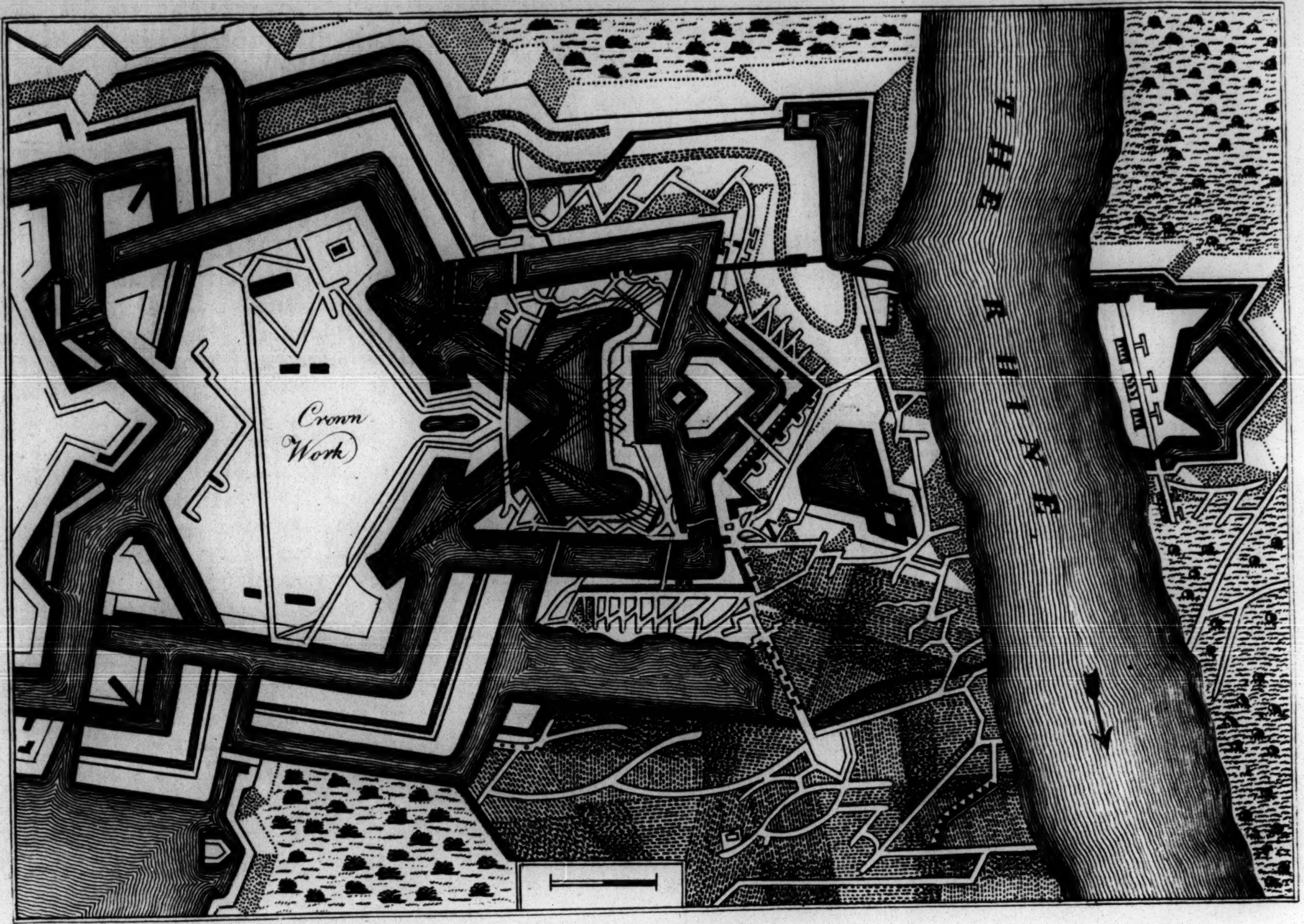
12 Of Dr Prieſtley.

The merit of Dr Prieſtley lies wholly in his being the inſtrument of promoting this diſcovery. He firſt publiſhed the experiment of Mr Warltire; and when Mr Cavendiſh had informed him of the ſucceſs he had met with in repeating that experiment, he began alſo to ſtudy the ſame ſubject. His diſcoveries were more uſeful to Mr Watt than to the author himſelf; for Mr Watt formed the theory which he had formerly been meditating: but Dr Prieſtley never came to a ſteady concluſion on the ſubject. We have read over carefully all his papers concerning the converſion of

WAR.

Plate DXXXVII.

Attack of Fortified Places.


Crown Work
THE RHINE

WATCH Work.

Fig. 1.

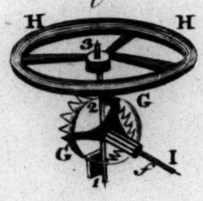


Fig. 2.

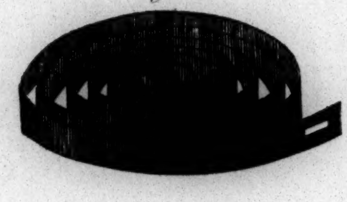


Fig. 3.

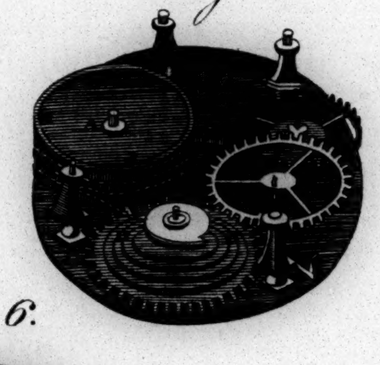


Fig. 4.

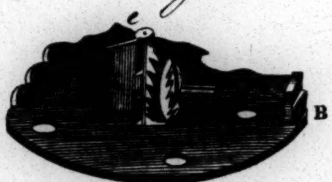


Fig. 5.

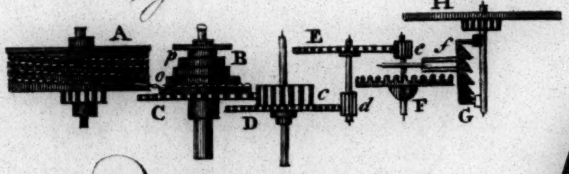

A
H
B
E
C
D
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Fig. 6.

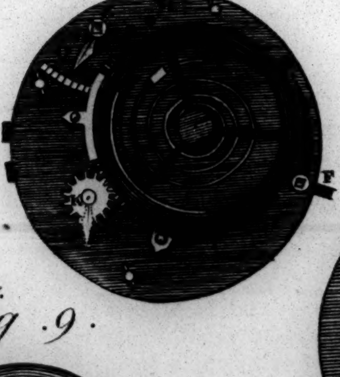


Fig. 7.

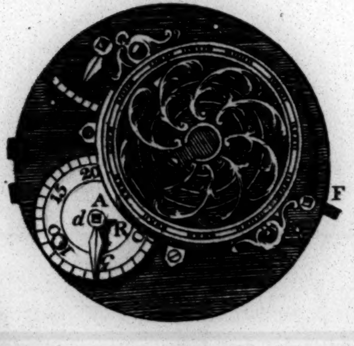


Fig. 8.

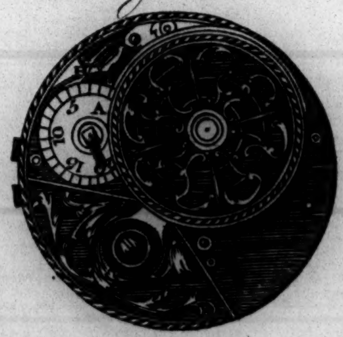


Fig. 9.

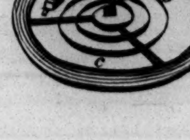


Fig. 10.

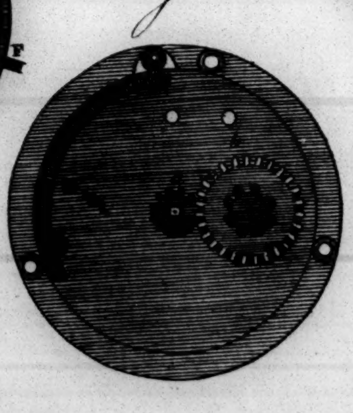
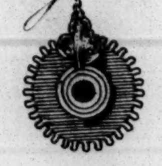


Fig. 11.



T. Clarke Sculpt.

BRITISH MUSEUM

water into air, but cannot help ſaying, that we went along with the bewildered author weary and fatigued. His experiments are very often made at random, almoſt always founded on falſe principles, and ſeldom lead to any thing but to doubt and perplexity. M. Lavoiſier ſent him a copy of his ingenious paper on the compoſition of water; he repeated ſome of the experiments of that illuſtrious chemiſt, but he drew very different concluſions from them. Doctor Prieſtley ſtill appears to retain his doubts on the ſubject, and continues his experiments; the reaſonings and concluſions of Lavoiſier he does not conſider as ſatisfactory; and he has lately publiſhed ſome obſervations on Phlogiſton, inviting farther diſcuſſion. With peculiar pleaſure we mention Dr Black on this occaſion. That gentleman, no leſs conſpicuous for his candour and modeſty than for his ingenuity, had, along with all other chemiſts of the time, believed the doctrine of phlogiſton, and taught it in his public lectures; but, upon examining the Lavoiſierian ſyſtem, he was convinced of its truth, and had the honeſty to confeſs it, though he was thus obliged to acknowledge to his ſtudents, that he had for many years been teaching errors. This acknowledgment does much honour to Dr Black, and proves that he is well entitled to the high character which he has ſo long held.

13 And of M. Lavoiſier. The merit of M. Lavoiſier was great upon the preſent occaſion. From England indeed he received the theory and the firſt experiments on the compoſition of water; but he was the firſt perſon who demonſtrated the theory, and put it beyond doubt. His knowledge of the diſtinction between carbone and hydrogene, as well as the perfect accuracy with which his experiments were made, enabled him to prove, with as much certainty as phyſical ſcience generally admits, that water is compoſed of vital and inflammable air. We will now give ſome account of the proofs of this fact; and, as we have never ſeen them ſtated with more clearneſs and preciſion than by M. Lavoiſier himſelf in his Elements of Chemiſtry, we ſhall take our account of them from him.

Proofs of the Compoſition of Water.

14 Proof of the compoſition of water by analyſis. Plate DXXXVIII. Fig. 1. *Exper.* 1. Take a glaſs tube from 8 to 12 lines diameter, and place it acroſs the furnace EFCD, with a gentle inclination from E to F (A). The higher extremity of the tube is then luted to the glaſs retort A, containing a known quantity of diſtilled water. To the lower extremity F is luted the worm SS, the lower end of which is fixed in the neck of the bottle H, which bottle has the bent tube KK fixed to a ſecond opening. This bent tube is intended to carry off any elaſtic fluids which may eſcape into the bottle H. A fire is then lighted in the furnace EFCD, ſufficient to keep the tube EF red hot, but not to melt it. The water in the retort A is kept boiling by a fire in the furnace VVXX. The water is gradually changed into ſteam by the heat of the two furnaces. It paſſes through the glaſs tube EF into the worm SS, where it is condenſed, and then drops into the bottle H. When the whole water is evaporated, and all the communicating veſſels are emptied into the bottle H, it is found to contain exactly the ſame quantity which was put into the retort. This experiment therefore is a ſimple diſtillation.

Exper. 2. Every thing being diſpoſed as in the laſt experiment, let 28 grains of pure charcoal, broken into ſmall parts, and which has been expoſed to a red heat in a cloſe veſſel, be introduced into the tube EF. The experiment is then performed in the ſame manner as the former. The water is evaporated, and a portion of it is again condenſed in the worm SS, and then falls into the bottle H; but at the ſame time a conſiderable quantity of an elaſtic fluid eſcapes through the tube KK, which is received in veſſels. When the water is entirely evaporated, and the tube examined, the 28 grains of charcoal have wholly diſappeared.

When the water in the bottle H is examined, it is found to have loſt 85.7 grains of its weight; and when the elaſtic fluid which paſſed off by the tube KK is weighed, it is found to weigh 113.7 grains, which is exactly the weight which the water has loſt, added to the 28 grains of charcoal which had diſappeared. The elaſtic fluid, on examination, is diſcovered to be of two kinds; namely, 144 cubical inches of carbonic acid gas weighing 100 grains, and 380 cubical inches of a very light gas weighing only 13.7 grains. Now 100 grains of carbonic acid gas conſiſt of 72 grains of oxygene, combined with 28 grains of carbone. It is therefore evident, that the 28 grains of charcoal muſt have acquired 72 grains of oxygene from the water. It is alſo evident, that 85.7 grains of water are compoſed of 72 grains of oxygene, combined with 13.7 grains of a gas capable of being burned.

Exper. 3. Every thing being put in the ſame order as in the two former experiments, with this difference, that inſtead of the 28 grains of charcoal, 274 grains of ſoft iron, in thin plates rolled up ſpirally, are introduced into the tube EF. The tube is kept red hot while the water is evaporating from the retort. After the water has been diſtilled, it is found to have loſt 100 grains. The gas or elaſtic fluid weighs 15 grains, and the iron has gained 85 grains additional weight, which put together make up 100 grains, the weight which the water has loſt. The iron has all the qualities which it would have received by being burned in oxygene gas. It is a true oxyd (or calx) of iron. We have the ſame reſult as in the laſt experiment, and have therefore another proof for concluding, that 100 grains of water conſiſt of 85 grains of oxygene, and 15 of the baſe of inflammable gas (B).

15 Proof of the compoſition of water by ſyntheſis. We have now exhibited two ſufficient proofs, that water is compoſed of oxygene and hydrogene; but as the compoſition of water is ſo intereſting and important a ſubject, M. Lavoiſier was not ſatiſfied with theſe proofs alone. He juſtly concluded, that if water be a compound of two ſubſtances, it ought to follow, that by reuniting theſe two ſubſtances, water would be produced. He accordingly proved the truth of this concluſion by the following experiment.

(A) The tube EF ſhould be made of glaſs which can bear a ſtrong heat without melting. It ſhould alſo be coated over with a lute compoſed of clay and powdered ſtone-ware; and to prevent it from bending during the experiment, it muſt be ſupported about the middle by an iron bar.

(B) This elementary ſubſtance Mr Lavoiſier has denominated *hydrogene*, which ſignifies "the generative principle of water;" from ὑδωρ "water," and γεινομαι "I produce." When this ſubſtance is combined with caloric, it is called *hydrogenous gas*. It is the lighteſt ſubſtance yet known, being $\frac{1}{13}$th of the weight of an equal bulk of atmoſpheric air. It is very combuſtible, for it has ſo great an attraction for oxygene, that it attracts it from caloric; ſo that its inflammable property is merely its power of decompoſing oxygenous gas, for it will not burn by itſelf. When drawn into the lungs, it produces inſtant death. See Aerology.

Exper. 4. He took a large cryſtal balloon A, fig. 2. containing about 30 pints, and having a large mouth; round which was cemented the plate of copper BC, pierced with four holes, through which four tubes paſs. The firſt tube H*h* is intended to exhauſt the balloon of its air, by adapting it to an air pump. The ſecond tube *gg* communicates with a reſervoir of oxygenous gas placed at MM. The third tube *d* D δ is connected with a reſervoir of hydrogenous gas at NN. The fourth tube contains a metallic wire GL, having a knob at its lower extremity L, from which an electric ſpark is paſſed to δ, in order to ſet fire to the hydrogenous gas. The metallic wire is moveable in the tube, that the knob L may be either turned towards δ, or away from it, as there is occaſion. We muſt alſo add, that the three tubes H *h*, *gg*, *d* D δ are furniſhed with ſtop-cocks.

It is neceſſary that the oxygenous gas, before being put into the reſervoir, ſhould be completely purified from carbonic acid. This may be done by keeping it for a long time in contact with a ſolution of cauſtic potaſh. The hydrogenous gas ought to be purified in the ſame manner. The quantity employed ought to be double the bulk of the oxygenous gas. It is beſt procured from water by means of iron, as was deſcribed in Experiment Third.

Great care muſt alſo be taken to deprive the oxygenous and hydrogenous gas of every particle of water. For this purpoſe they are made to paſs in their way to the balloon A, through ſalts which have a ſtrong attraction for water; as the acetite of potaſh (a compound of vinegar and vegetable alkali), or the muriate or nitrate of lime (the muriatic or nitric acid combined with lime). Theſe ſalts are diſpoſed in the tubes MM and NN of one inch diameter, and are reduced only to a coarſe powder, that they may not unite into lumps, and interrupt the paſſage of the gaſſes.

Every thing being thus prepared for the experiment, the balloon is exhauſted of its air by the tube H *h*, and is filled with oxygenous gas. The hydrogenous gas is alſo preſſed in through the tube *d* D δ by a weight of one or two inches of water. As ſoon as the hydrogenous gas enters the balloon, it is ſet fire to by an electric ſpark. The combuſtion can be kept up as long as we pleaſe, by ſupplying the balloon with freſh quantities of theſe two gaſſes. As the combuſtion advances, a quantity of water is collected on the ſides of the balloon, and trickles down in drops to the bottom of it. By knowing the weight of the gaſſes conſumed, and the weight of the water produced, we ſhall find that they are preciſely equal. M. Lavoiſier and M. Meuſnier found that it required 85 parts by weight of oxygenous gas and 15 parts of hydrogenous gas to produce 100 parts of water.

Thus we have complete proofs, both analytical and ſynthetical, that water is not a ſimple elementary ſubſtance, as it has been long ſuppoſed, but is compounded of two elements, oxygene and hydrogene. We muſt add, that M. Lavoiſier uſed the moſt ſcrupulous accuracy in making the experiments which we have deſcribed; and that he is of opinion that the proportions given above cannot be $\frac{1}{200}$ from the real truth. Such then is the hiſtory and proof of the compoſition of water. We come next to conſider what ſubſtances are chemically united or diſſolved in it.

Analyſis of the different Subſtances contained in Water.

16 Advantages of analyzing water.

SINCE it is made certain by obſervation and experiment, that water contains many different kinds of ſubſtances; and as its qualities, and conſequently its uſes, differ much according to the nature of the ſubſtances combined with it—the knowledge of an eaſy and accurate method of analyſing waters is become a matter of the utmoſt importance. By ſuch an analyſis we ſhall be enabled to ſelect the pureſt water for the purpoſes of life, and to avoid water which might be improper and hurtful; or, when good water cannot be had, to ſeparate thoſe ſubſtances from it which render it impure. By the ſame important art we ſhall find it eaſy to diſtinguiſh thoſe waters which are beſt adapted to the arts and manufactures; we ſhall alſo be able to compare different mineral waters, to explain the cauſes of their effects in medicine, and to imitate thoſe by art which are moſt efficacious.

All natural waters are more or leſs impure; for water has ſo ſtrong an attraction for different ſubſtances, that it imbibes part of them in every ſituation in which it is found, not only when it flows over beds of earth, but when it filters through ſtrata of metals, and even when it is diſſolved in the atmoſphere. Water cannot be procured in a pure ſtate without undergoing the proceſs of diſtillation.

Before we proceed to ſtate the methods by which the different ſubſtances found in water may be detected, it will be proper to point out to the reader ſuch ſenſible qualities of particular waters as may enable him to inſtitute the proceſs by which the analyſis ought to be conducted. In every courſe of experiments, that order ought to be followed which will lead with moſt eaſe and certainty to the end which is in view; but unleſs a man from general knowledge be able to conjecture with ſome degree of accuracy what are the reſults to be expected in particular caſes, he cannot be able to determine what experiments he ought to make.

17 The general circumſtances to be attended to are,

The general circumſtances which are firſt to be attended to in the examination of waters, are their colour, ſmell, taſte, ſpecific gravity, temperature, and local ſituation.

18 The colour,

1. The firſt thing to be attended to in water is its colour. Pure water is tranſparent like cryſtal. Muddineſs or a brown colour is a certain proof that ſome extraneous ſubſtance is diffuſed through the water. A green colour indicates the preſence of iron, and a blue that of copper. If upon agitation airy bubbles appear in the water, we are ſure that it contains carbonic acid or fixed air. The water which is to be examined with reſpect to colour ſhould be put into a deep glaſs, that we may look down into a conſiderable body of it; for we ſhall thus diſcover any muddineſs much better than by viewing the water horizontally through the glaſs.

19 The ſmell,

2. We are next to obſerve whether the water has any ſmell. If it be pure, it will have no ſmell; if it diffuſe a ſubtile penetrating odour, we have reaſon to conclude that it contains carbonic acid; if the ſmell of putrid eggs or of the ſcourings of a gun ariſe from it, we infer that it is impregnated with hepar ſulphuris, or ſulphur combined with an alkali.

21 The taſte,

3. Pure water has no taſte. Water containing carbonic acid has a mild ſouriſh taſte. If it have a bitter taſte, it may contain ſulphate of ſoda or Glauber's ſalt, nitre or the ſulphate, nitrate or muriate of magneſia, or lime combined with the nitric or muriatic acid. If the water has a ſlight auſterity of taſte, we may expect that it contains lime or gypſum; if it be ſaltiſh, it contains common ſalt; if the taſte be lixivious, alkali is preſent; if æruginous, there is copper; if ferruginous or inky, we have reaſon to ſuppoſe that it contains iron.

20 Specific gravity,

4. The ſpecific gravity of water can enable us to diſcover that it contains ſome extraneous matter, but does not point out what ſort of matter it is. We are always ſure that the lighteſt waters are the pureſt. The ſtandard to be employed for comparing the ſpecific gravity of water to be examined is diſtilled water.

22 Temperature,

5. Another circumſtance to be conſidered is the temperature of the water, whether it be hot, cold, or tepid. We muſt determine whether the temperature be the ſame during the whole year, or whether it depends on the weather;

whether it freezes in winter; if hot, whether, when allowed to cool, it depoſits any ſediment, and loſes its taſte and ſmell.

23 Local ſituation. 6. The local ſituation of the water muſt alſo be taken into review. We muſt conſider the ſoil through which it flows, and inquire whether there be mines or veins of metals near, or any kind of ſubſtance which water can diſſolve. We muſt alſo inquire whether the water flows in equal quantity during the whole year, or increaſes with rain, and decreaſes with dry weather: whether it is ſtagnant or flowing; if it flows, whether it flows ſwiftly or ſlowly: whether it depoſits any ſediment; and if it does, of what ſort it is, whether a ſalt, earth, metal, or metallic ochre: whether it petrifies bodies thrown into it: and whether there be any ſulphur to be found near it in a ſublimed ſtate.

It is alſo proper to obſerve whether it be hard or ſoft; whether any animalcules live or vegetables grow in it; and whether it has any reputation for its effects in medicine.

24 General diviſion of water. Water may be divided into two great diviſions, *freſh* and *ſalt water*.—Freſh water may be divided into *atmoſpheric*, *ſtagnant*, and *running*.

25 Salt water, Salt water comprehends moſt of the ſeas on the globe, but eſpecially thoſe of the torrid and the greater part of the temperate zones. It contains common ſalt in great quantity, ſulphate or muriate of magneſia, and ſulphate of lime, beſides a great quantity of putrid matter brought into it by the rivers, or produced by the decompoſition of the numerous tribes of animals which live and die in it. See Sea and *Sea-Water*.

26 Rain and ſnow water; Atmoſpheric water comprehends rain and ſnow water. Rain is the water which is evaporated from the ſea and land, diſſolved in the air, and afterwards diſcharged on the earth; it ought therefore to reſemble diſtilled water in purity; and it would certainly do ſo, if the atmoſphere did not abound with vapours and exhalations capable of being combined with it. It contains a ſmall quantity of ſulphate of lime, together with a very ſmall portion of nitrous acid. The rain that drops from the tops of houſes is always mixed with ſoot. Some ſhowers have contained a quantity of the pollen of flowers, which has given riſe to the ſtories of ſhowers of ſulphur. The rain which falls at a diſtance from towns, or after a long tract of wet weather, is pureſt; for the atmoſphere is then in ſome meaſure waſhed, if we may uſe the expreſſion, from all heterogeneous ſubſtances.—Snow water is contaminated with the ſame ſubſtances as rain water. When newly melted, it is deſtitute both of common air and of fixed air, or the carbonic acid. It is probably from the want of theſe that ſnow water is injurious to health.

27 Water of lakes and marſhes; Stagnant water forms a lake; and when a great quantity of earth is diffuſed through it, it forms a marſh. The water of lakes is generally very pure and tranſparent; for as they are not ſubject to ſo much agitation as ſtreams, the ſubſtances that happen to fall into them are not much diffuſed, but ſoon ſubſide to the bottom. Some lakes are ſalt.—Marſhes are much more impure. They are generally contaminated with the putrid matter produced by the decompoſition of animals and vegetables, and are often of a yellowiſh or browniſh colour.

28 Spring and river water; Running water comprehends ſpring and river water.—Spring water is the rain water, which, after diſcharging itſelf upon the earth, and being imbibed by it, again iſſues out. As it runs below the ſurface through different ſubſtances, it carries along with it ſuch as it can diſſolve, and is therefore not ſo pure as rain water. It often contains ſalts, earths, or metals.—Rivers conſiſt of a collection of ſprings, and generally partake of the ſoil through which they paſs. Rivers which run through great towns are loaded with animal and vegetable ſubſtances. But thoſe which run at a diſtance from towns are purer than moſt ſprings; becauſe, as they run with more rapidity, and to a greater diſtance, a great part of their impurities are thus volatilized. If the ſoil be ſoft through which a river runs, it will be full of earth; but if hard and rocky, the water is very clear and pure.

Water is called *hard* when it does not diſſolve ſoap, or boil vegetables, or make an infuſion of tea. It generally contains ſome acid combined with abſorbent earth, for which it has leſs attraction than for the alkali of the ſoap. When ſoap is put into ſuch water, its alkali is immediately attracted by the acid of the water, the ſoap is decompounded, and the oil of it ſwims on the ſurface of the water. Water is not reckoned hard if it contains leſs than 10 grains of extraneous ſubſtances in the pound weight. 22 Hard water,

If the acid with which the abſorbent earth is united be the carbonic, the water may be purified by boiling. But in order to make it agreeable to the palate after the calcareous earth is depoſited, it ought to be expoſed in the open air in broad ſhallow veſſels. It will thus recover a portion of the air which was expelled by the boiling. But if the earth be ſuſpended by any other acid, the water can be corrected by the addition of ſome fixed alkali, which immediately joins itſelf to the acid, while the earth is depoſited. A ſolution of potaſh, or of any other alkali, may be poured into the water till it ceaſe to produce any turbid appearance, or till no more is precipitated. The water muſt then be decanted from the ſediment, or filtered if neceſſary. 30 How corrected.

Having now mentioned the different kinds of waters, it will be next proper to deſcribe the moſt accurate methods of analyzing them. Theſe are two, by precipitation and evaporation. Precipitants are ſubſtances which, being thrown into any impure water, ſeparate the impurities, and throw them to the bottom of the veſſel. Precipitation is the moſt expeditious method of examining waters; but it does not enable us to form ſo accurate an eſtimate as is often neceſſary of the preciſe quantity of extraneous ſubſtances contained in them. 31 Two methods of analyzing water, by precipitation,

The other method of analyzing water is by evaporation, which conſiſts in ſeparating the water from the impurities, by converting the water into ſteam, and cryſtallizing the ſalts contained in it. Both theſe methods are often neceſſary to be employed, either of them ſeparately being defective. As the precipitants indicate the proper method of conducting the evaporation, it will be proper, before we deſcribe how to analyze water by evaporation, to deſcribe particularly the effects produced on it by applying different precipitants. 32 And by evaporation.

Method of analyzing Water by Precipitation.

The ſubſtances hitherto found in water are, common atmoſpherical air, acids, alkalis, earths, ſulphurs, and metals. 33 Subſtances contained in water.

Acids, when diſengaged, may be diſcovered by turnſol or ſyrup of violets; and when combined with any baſe, they may be detected by the nitrate of ſilver, muriate of barytes, and lime-water. Uncombined alkalis are aſcertained by Brazil wood and turmeric; in combination with acids, they may be detected by ſpirit of wine. Earths are precipitated by the acid of ſugar and the acetous acid. Sulphur is diſcovered by the mineral acids; and metals are precipitated by lime-water and tincture of galls. 34 Teſts for diſcovering them.

Moſt waters contain common atmoſpherical air. Fixed air, now called *carbonic acid*, is alſo found in all waters in quantity from $\frac{1}{100}$th part of the bulk of the water to a bulk equal to the water itſelf. That ſome ſpecies of air is contained in water, is evident from the ſmall bubbles which may 35 Method of analyzing water containing common air and carbonic acid.

may be often ſeen to riſe in it when poured into a glaſs. Theſe bubbles are ſtill more diſtinguiſhable in water placed under the exhauſted receiver of an air-pump; for the weight of the atmoſphere being removed, the water expands; and the air contained in its interſtices is thus let looſe, and riſes to the ſurface. The air may alſo be ſeparated from water by boiling, and may be eaſily collected by a proper apparatus. Experiments may then be made upon it to determine its ſpecies and quantity.

36 Teſts for diſcovering carbonic acid in water,

Carbonic acid is known to be contained in water by the following marks: The taſte is ſomewhat pungent, aceſcent, cooling, and very agreeable. The ſmell is ſubtile and penetrating. When agitated, it emits a number of air-bubbles, which give it the appearance of briſkneſs. Theſe are the ſenſible appearances which aerated water exhibits; but there are teſts which chemiſtry furniſhes much more deciſive.

From a pigment called *litmus* is obtained a tincture called the *tincture of turnſol*. The litmus is wrapped up in a clean linen cloth, and ſteeped in diſtilled water; the water ſoon aſſumes a blue or violet colour, and is then fit for uſe. The tincture enables the chemiſt to diſcover the ſmalleſt particle of diſengaged acid; for a few drops of it poured into water containing an acid immediately communicates a red colour to the whole fluid.

There is a more convenient method of uſing the turnſol: The ſaturated tincture is boiled with a little ſtarch, and then a piece of paper is dipped into it, ſo as to tinge it completely. Paper thus tinged, when dipped into water containing an acid, inſtantly receives a red colour. The tincture is, however, a more delicate and ſenſible teſt than the tinged paper; for water ſaturated with aerial acid does not make any change in the colour of the paper; yet one part of aerated water gives a diſtinct red to 50 parts of the tincture.

37 And of collecting it,

The method of collecting and aſcertaining the elaſtic fluids contained in water was unknown till the preſent age. The eaſieſt method is to fill a veſſel terminating in a narrow neck with aerated water, then tie to the neck a bladder from which all the air has been carefully ſqueezed. Let the aerated water be boiled; the elaſtic fluid is then expelled, and aſcends into the bladder, where it is collected. The bladder may then be removed from the veſſel, and its mouth tied up.

There is another method, which is much more accurate, for determining the quantity contained in any quantity of water: Fill a bottle or retort with aerated water, and let a ſtopper be put into its mouth, with a hole in it. Let one end of a crooked tube be inſerted into the hole of the ſtopper, ſo cloſely that no air may eſcape at the joining; and let the other end of the tube be bent upwards into an inverted veſſel full of mercury. Fire is then applied to the bottle or retort, and continued till the water boil. The heat carries off the air which is conveyed through the crooked tube into the inverted veſſel of mercury. If the water be kept boiling for a ſhort time, the whole or greater part of the elaſtic fluid will be expelled, and its bulk is eſtimated by the bulk of mercury which it has diſplaced. But it muſt be remembered, that the elaſtic fluid above the mercury is in a ſtate of greater dilation than the external air, for it is not preſſed by the whole weight of the atmoſphere; but, as M. Sauſſure obſerves, it is only charged with that weight diminiſhed by the column of mercury.

38 And ſeparate it from common air.

When the aerial fluid is thus collected, if we wiſh to ſeparate the carbonic acid from the common air, the proceſs is eaſy: Let the aerial fluid be ſeparated from the mercury, while the external air is carefully excluded; and let the veſſel containing it be inverted into another veſſel containing lime-water. The lime will immediately abſorb the carbonic acid, and form calcareous earth, while the atmoſpherical air is left behind. The calcareous earth may then be weighed; and the carbonic acid being afterwards expelled, the loſs of weight will give the quantity of carbonic acid.

39 Method of diſcovering the ſulphuric acid,

The only other acids hitherto found in water beſides the carbonic, are the ſulphuric and muriatic acids. The preſence of the ſulphuric acid is moſt accurately aſcertained by the muriate of barytes, which is a compound of the muriatic acid with barytes or ponderous earth. Barytes has ſo ſtrong an attraction for the ſulphuric acid, that it ſeparates it from all other acids, and forms with it a compound called *ponderous ſpar*, which is inſoluble in water. As the carbonate of alkali, or an aerated alkali, may produce a muddineſs and precipitation reſembling the effects of the ſulphuric acid, it is neceſſary to add to it a few drops of the nitric acid, which will diſſolve any portion of barytes precipitated by the aerated alkali.

40 And muriatic acid.

The muriatic acid may be eaſily diſcovered, by throwing into the water impregnated with it a little nitrate of ſilver (a compound of the nitric acid with ſilver). If there be the ſmalleſt portion of muriatic acid, it inſtantly ſeizes the ſilver, and is precipitated along with it in the appearance of a white mucilage. As the muriatic acid conſtitutes about one fourth of the muriate of ſilver, we may eaſily determine its quantity, by ſubtracting one-fourth from the weight of the precipitate. Along with the nitrate of ſilver a little nitric acid ſhould be added, for the reaſon mentioned in the laſt experiment.

41 How alkalis are detected.

Alkalis are known to exiſt in water by the lixivious or ſaltiſh taſte which they communicate, by their efferveſcence with acids, and by ſeveral precipitants.

There are three teſts which may be employed for diſcovering the preſence of alkalis. 1. Paper tinged blue by the tincture of turnſol, and made red by diſtilled vinegar, recovers its blue colour when dipped into water containing an alkali. 2. The watery tincture of Brazil wood alſo ſerves to diſcover alkalis. It may either be uſed in the ſtate of tincture, or a piece of paper may be tinged with it after being boiled with a little ſtarch. In both caſes it receives a blue colour from the alkali. One grain of ſoda diſſolved in 4295 grains of water changes the colour of the tinged paper to a blue, which, though delicate, may be eaſily diſtinguiſhed. 3. Watery tincture of turmeric is changed to a brown colour by alkalis. Paper tinged with this tincture boiled with ſtarch is alſo affected in the ſame way. A ſingle grain of ſoda diſſolved in 859 grains of diſtilled water will obſcure the yellow colour of the tinged paper, and turn it into a browniſh hue.

The tincture of Brazil wood is remarkable for its ſenſibility in diſcovering the preſence of an alkali. The tincture of turmeric is much ſlower in its deciſion; but this circumſtance enables us, with ſome degree of accuracy, to eſtimate the quantity of alkali contained. The turmeric, too, anſwers beſt when there is occaſion to examine an alkaline water by candle light, as the change of colour which it produces is eaſily diſtinguiſhable.—Beſides theſe teſts now mentioned, any of the infuſions of vegetables which are moſt eaſily affected by alkalis may be uſed with ſucceſs, ſuch as flowers of mallows and ſyrup of violets; but they are not on all occaſions ſo deciſive.

42 Method of diſtinguiſhing the alkalis from one another.

After being aſſured of the preſence of an alkali, we muſt next determine what alkali it is. The alkalis moſt commonly found in water are the mineral and volatile, the vegetable ſeldom occurring. The mineral alkali is combined with the carbonic, ſulphuric, or muriatic acid; the volatile is probably communicated by putrid animal or vegetable ſubſtances; and the vegetable is united with the ſulphuric

WEIGHING.

Plate DXXXVIII

Fig. 1.

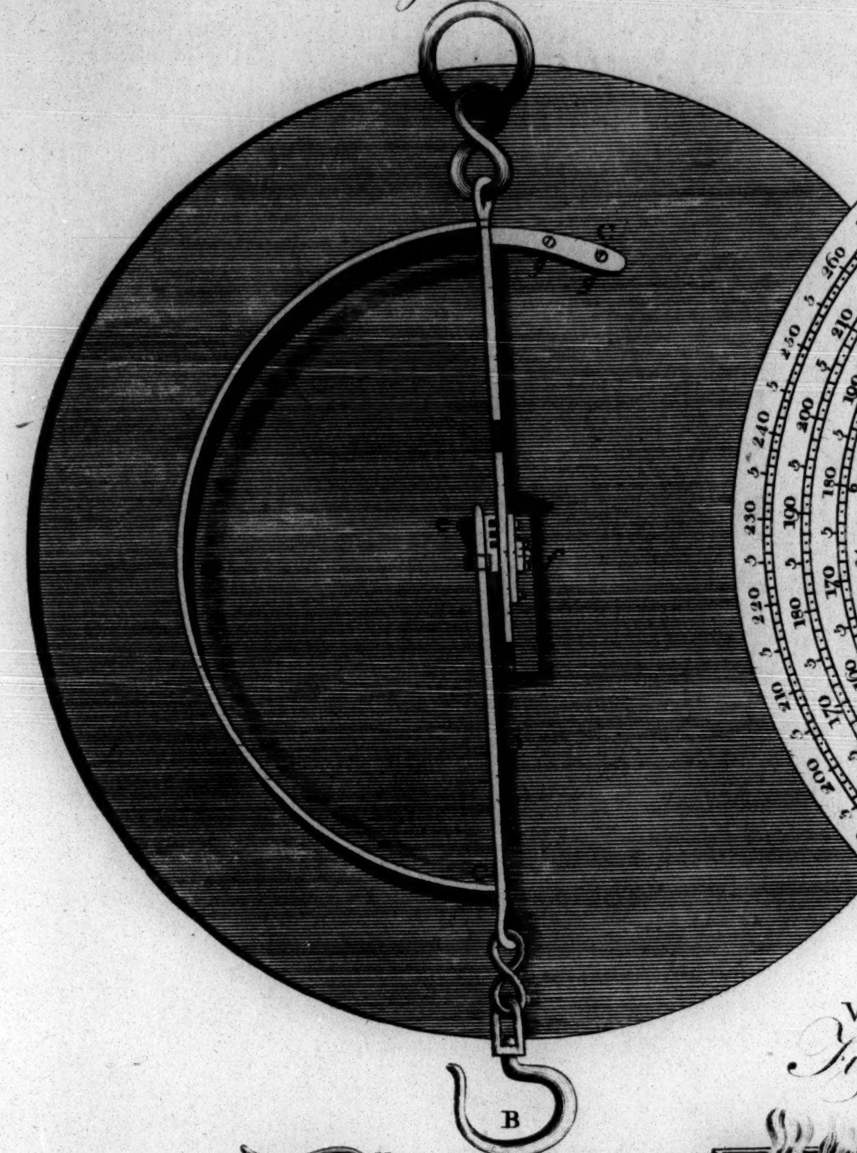
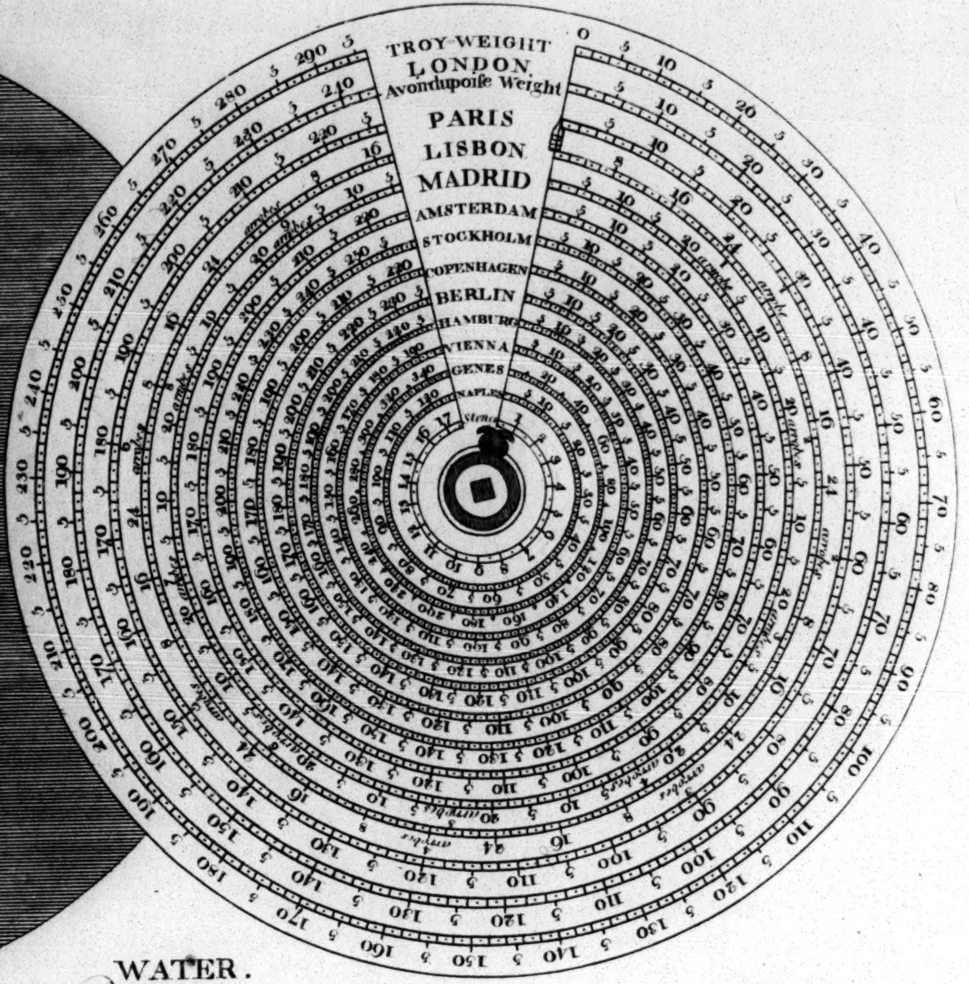


Fig. 2.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Avondupoiſe Weight
PARIS
LISBON
MADRID
AMSTERDAM
STOCKHOLM
COPENHAGEN
BERLIN
HAMBURG
VIENNA
GENES
NAPLES

WATER.

Fig. 1.

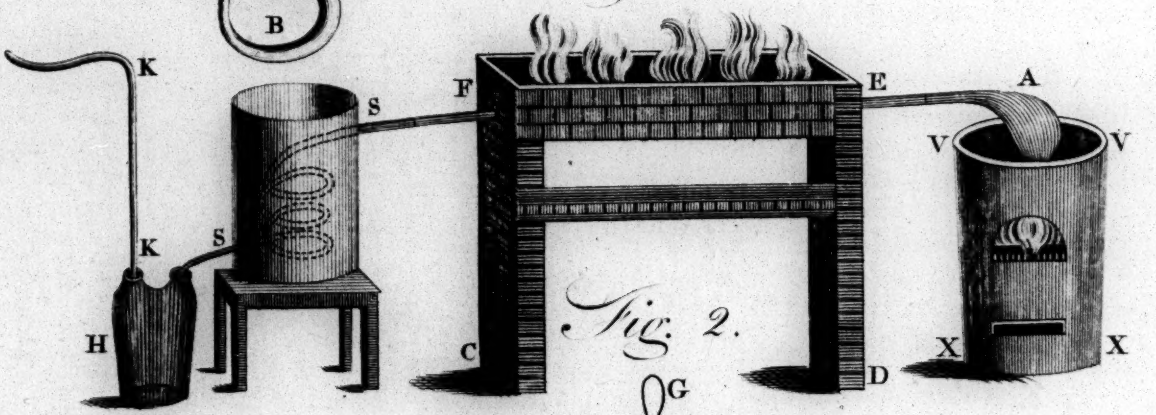
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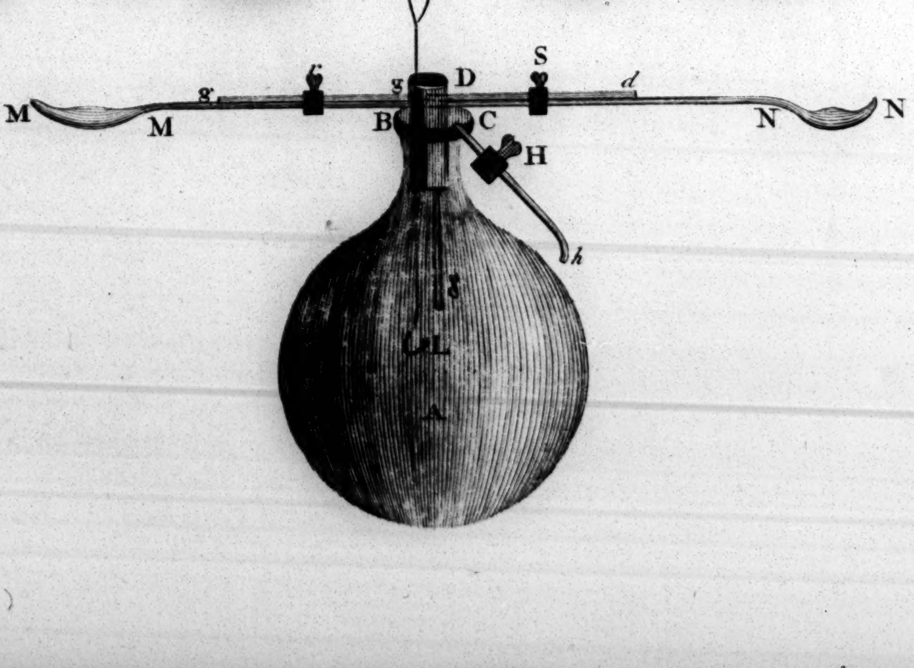
Fig. 2.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or muriatic acid, but more frequently with the nitric acid. Bergman ſays, that mercury, diſſolved in the nitric acid without heat, enables us to diſtinguiſh theſe alkalis. When a little of this ſolution is thrown into water, if a yellowiſh white ſubſtance is precipitated, we may conclude that a cauſtic vegetable alkali is preſent; if the precipitate be white, there is vegetable alkali ſaturated with the carbonic acid. If the precipitate be firſt yellow, and afterwards become white, mineral alkali is preſent; and if it be of a greyiſh black, we know that volatile alkali is preſent.

43 A better method.

The ſpecies of alkali may be more eaſily aſcertained, by pouring into the water a little ſulphuric acid, or, what Morveau recommends as anſwering the purpoſe better, a little diſtilled vinegar, which with potaſh forms a deliqueſcent ſalt, and with ſoda a foliated cryſtallizable ſalt.

44 How the reſence of arths may e diſcover- d.

The earths which are moſtly found in waters are lime and magneſia. If any other earth has been diſcovered, it has been by ſo few chemiſts, and in ſuch ſmall portions, that it has been little attended to (c). Lime and magneſia are always united with the carbonic or ſome of the foſſil acids. The carbonic acid is eaſily expelled by boiling the water, and the earth falls to the bottom, and may then be eaſily examined by applying ſulphuric acid. If the earth be calcareous, with ſulphuric acid it forms gypſum; if it be magneſia, Epſom ſalt is produced; and if it be clay, the product is alum.

Scarcely any water is entirely free from lime; even the pureſt water, after ſtanding 24 hours, depoſits ſome ſaccharated lime. The acid of ſugar is one of the moſt ſenſible teſts for diſcovering it. A ſmall quantity of diſtilled water, in which there is diſſolved a ſingle grain of pure lime, will become muddy if the ſmalleſt quantity of the acid of ſugar be thrown in. The preſence of calcareous earth may alſo be diſcovered by employing the acetite of lead. It precipitates the earth in the form of a white powder. But as ſulphuric acid alſo precipitates the acetite of lead, to make the experiment accurately, it is neceſſary to add a little diſtilled vinegar to the precipitate, and if it conſiſt of calcareous earth, it will be immediately diſſolved; but if it be a ſulphate of lime, the vinegar will have no effect upon it.—When lime or magneſia is diſſolved in any of the mineral acids, it may be detected by adding a little carbonate of potaſh. The nature of the earth may be afterwards eaſily determined.

45 [illegible]w ſul[illegible] is diſ[illegible]red.

Of the inflammable bodies, perhaps none has been found diſſolved in water except ſulphur. Sulphur is combined either with an alkali or with hydrogene, forming a ſulphuret of hydrogene. Sulphuric or hepatic waters are eaſily known by the following marks: 1. A fetid ſmell, which is felt in approaching the ſpring. 2. The taſte is ſtrong, ſomewhat ſweet, not unlike that of putrid eggs, but more diſagreeable. 3. When a piece of ſilver is put into it, it becomes tarniſhed. 4. But the niceſt teſt is a mark made on paper with the tartarite of biſmuth or acetite of lead, which becomes black when expoſed to the vapour of the hepatic water.

When we wiſh to diſcover the quantity of ſulphur which is diſſolved in an alkali, it may be precipitated by the ſulphuric or muriatic acid, but much more plentifully by the nitric acid. To render the experiment ſucceſsful, it is neceſſary that the mixture ſhould be heated. When the nitric acid is dropped in, the ſulphureous ſmell is inſtantly diſſipated, the water grows turbid, and a white ſubtile powder ſlowly ſubſides. When dried, it is found to be genuine ſulphur. When the water contains a fixed alkali, the acid has no effect in decompoſing the ſulphureous water till the alkali be ſaturated; but after the alkali is ſaturated, the hepatic air is then driven off by the acid, and the ſulphur falls down.

46 Method of making ſulphureous water artificially.

Sulphureous water may eaſily be formed artificially: A quantity of hepar ſulphuris, conſiſting of equal parts of ſulphur and potaſh, is to be put into a veſſel which communicates by a crooked tube with an inverted glaſs filled with water. Sulphuric acid is then poured into the veſſel containing hepar ſulphuris, a few drops at a time. The veſſel containing the acid muſt communicate with the veſſel containing the hepar ſulphuris by a tube, that while the acid may be poured in at pleaſure, the elaſtic gas which iſſues from the action of the acid on the hepar ſulphuris may not be diſſipated, but may paſs into the inverted glaſs. This gas, if a candle be applied, will burn, and a reſiduum of ſulphur of a whitiſh colour remains. The water in the inverted veſſel muſt be frequently agitated, that the gas may be abſorbed.

47 How iron is diſcovered.

The metals hitherto found diſſolved in waters are two, iron and copper. The former occurs often, the latter rarely. Iron is united with the carbonic or ſulphuric acid, and may generally be detected by a greeniſh or yellowiſh colour, by its inky taſte, by an ochre which it depoſits, by tincture of galls, and by the Pruſſian alkali. Only the two laſt of theſe methods require any deſcription. Spirit of wine ſaturated with powdered galls precipitates iron ſlowly; the precipitate is purple when the quantity of iron is ſmall; but when the quantity is large, it is black. In ſome caſes indeed iron may be preſent in water without giving a dark colour to the galls. This is owing to a ſuperfluity of acid. But if a ſufficient quantity of alkali be added to ſaturate the acid, the black colour will then appear.—The Pruſſian alkali is prepared from four parts of Pruſſian blue, boiled with one part of alkali in a ſufficient quantity of water. The clear liquor muſt then be ſaturated with an acid, and filtered, that it may be freed from the ſmall portion of Pruſſian blue which is ſeparated. A ſingle drop of this alkali dropped into water containing the ſulphate of iron immediately forms a Pruſſian blue. In making experiments with this alkali, it is proper to add a little muriatic acid.

48 And its quantity aſcertained.

The quantity of iron contained in water may be aſcertained with conſiderable accuracy, by the colour communicated by the tincture of galls: for if the tincture be poured into diſtilled water, then ſmall pieces of iron may be added, till the liquor has acquired the colour of the chalybeate water; and then we may conclude, that the quantity of iron contained in the chalybeate water is equal to the artificial mixture, if the colour be the ſame. There is alſo another way of eſtimating the quantity of iron. When precipitated, let the reſiduum be waſhed in pure water, then dried and weighed. Pour upon it one of the mineral acids, and digeſt them together, and after pouring it off, waſh what remains undiſſolved; then dry and weigh it again, and from the diminution of weight collect that of the iron. In this experiment the acid employed ought not to be very ſtrong nor great in quantity, nor ought the digeſtion to be continued long; for if the reſiduum ſhould contain any ſelenite which is ſoluble by acids, the ſelenite might ſeize upon a conſiderable portion of the acid, and conſequently the experiment be inaccurate.

49 How copper is detected.

Copper is ſometimes united in water with the ſulphuric acid. It is diſcovered by the blue colour which it imparts to the water, by an æruginous taſte, and by the ochre which it depoſits. It may alſo be detected by throwing into the water a piece of poliſhed iron; the copper will be precipitated upon the iron.

(c) A ſmall quantity of ſiliceous earth was found by Bergman in an acidulous ſpring, as alſo by Dr Black in the Geyzer ſpring in Iceland. Clay may alſo be often found in waters; but it is probably only diffuſed, not chemically diſſolved.

Method of analyzing Water by Evaporation.

50 General circumſtances to be attended to.

Having now deſcribed the methods of detecting the various ſubſtances contained in water by *precipitation*, we come next to deſcribe how they are diſcovered by *evaporation*.

The veſſels employed in evaporating the water ought to be broad, for fluids evaporate more quickly in proportion to the extent of the ſurface. If earthen veſſels can be found of ſo cloſe a texture as not to abſorb any ſaline matter, they may be ſafely employed. Iron and copper veſſels are improper, becauſe they are liable to be corroded. The moſt convenient are thin glaſs veſſels, which may without danger be expoſed to a ſtrong heat. The capacity of the veſſels depends on the quantity of water which is neceſſary for the ſeveral experiments. The quantity of water may be ſmall if it contain a large proportion of extraneous matter. The evaporation ſhould be ſlow and gentle. The veſſel employed ought to have a cover to keep out duſt; but muſt have a hole ſeveral inches in diameter, that the vapours may iſſue out. The hole ſhould not be opened till the vapour be ſo much condenſed as to iſſue with ſuch force as to keep the duſt from falling in.

51 Order in which ſubſtances uſually appear while water is evaporating.

Some ſubſtances require more water to diſſolve them than others. As the quantity of water is diminiſhed by evaporation, they appear therefore in an order correſponding to their different degrees of ſolubility; thoſe which are leaſt ſoluble appearing firſt. The following is the order in which they are diſcovered; Firſt carbonate of lime and carbonate of iron, then gypſum, then the ſulphate of potaſh, then the ſulphate of iron, then the nitrate of potaſh, and next in order the ſulphate of copper; afterwards the muriate of potaſh, then ſoda, then the muriate of ſoda, then the ſulphate of magneſia, and laſtly the deliqueſcent ſalts. Aerated magneſia, or carbonate of magneſia, is not ſeparated all at once, but continues to fall during the whole proceſs. This order is often altered by the ſuperabundance of any particular ſubſtance.

52 How the reſiduum ſhould be treated.

The different ſubſtances may be ſeparated as they ſucceſſively appear; but it is better to continue the evaporation to dryneſs. The reſiduum ſhould be carefully collected and well dried. It is then put into a bottle, and alcohol poured on till it riſe an inch above it. The bottle ſhould then be cloſed and ſhaken. After ſtanding for a few hours, the liquor may be filtered. What paſſes through the filter is preſerved for a future analyſis, and what remains behind has eight times its weight of cold diſtilled water poured upon it; the mixture is then ſhaken, allowed to ſtand for ſome time, and again filtered. What was diſſolved by the water is preſerved for future examination, and the reſiduum is then boiled for a quarter of an hour in ſomewhat more than four or five hundred times its weight of diſtilled water, and afterwards filtered.

53 When it ſhows a brown colour, ſhould be expoſed to the air.

Being now purified by alcohol, cold water and hot water, the reſiduum is no longer ſoluble in alcohol or water. If it ſhow a brown colour, this is a mark that iron is contained in it. To aſcertain this point, it may be expoſed for ſome weeks in an open veſſel to the rays of the ſun, care being taken to moiſten it from time to time. By the expoſure to the air, the iron will imbibe oxygene, and is then no longer ſoluble in vinegar. The reſiduum may then be weighed; a quantity of acetous acid or diſtilled vinegar is then to be poured on it, and the mixture to be digeſted. By the digeſtion the acid will diſſolve the carbonate of lime and magneſia, if there be any in the reſiduum. What the acid has not diſſolved may be waſhed, dried, and weighed, and by its loſs of weight it may eaſily be determined what the acid has taken up.

54 The acetous acid is then to be poured on it;

55 Then to be evaporated to dryneſs and examined.

The matter diſſolved by the acetous acid is then to be evaporated to dryneſs. It may be determined whether it contains calcareous earth or magneſia by this circumſtance; if it conſiſt of calcareous earth, it continues dry in a moiſt air; but if it contain magneſia, it is deliqueſcent. The ſame point may alſo be aſcertained by the ſulphuric acid. This acid added to calcareous earth, forms gypſum, or the ſulphate of lime; but when added to magneſia, it diſſolves it, forming the ſulphate of magneſia or Epſom ſalt; or if the reſiduum contain both lime and magneſia, there will be produced both ſulphate of lime and ſulphate of magneſia. The preciſe quantity of the ſimple ſubſtances contained in each may be known by weighing the compound, and remembering that 100 parts of the ſulphate of lime contain about 32 of pure lime, 46 of ſulphuric acid, and 22 of water (D); and 100 parts of the ſulphate of magneſia contain 19 of pure magneſia, 33 of ſulphuric acid, and 48 of water (E).

That matter which was not diſſolved by the acetous acid is either iron or ſilex. The iron is ſoluble by muriatic acid or by an alkali. The portion which reſiſts the action of the muriatic acid is ſiliceous earth, which may be farther examined by the blow-pipe; for ſiliceous earth, when added to ſoda in a ſtate of fuſion, combines with it with a violent efferveſcence, and is thus changed into glaſs.

Having now ſhown how to examine the reſidue which was inſoluble in alcohol and water, it will next be proper to deſcribe how to analyze the ſolutions obtained by alcohol, cold water, and hot water.

56 How to treat the ſolution obtained by alcohol.

1. The ſolution obtained by alcohol contains lime and magneſia, combined with the muriatic acid or with the nitric acid. To enable us to diſcover the nature and quantity of the ingredients, we evaporate them to dryneſs, and then pour ſulphuric acid on the reſidue; the ſulphuric immediately diſplaces the other acids, and unites with the baſe. If the baſe be lime, it forms a ſulphate of lime; if it be magneſia, it produces the ſulphate of magneſia.

57 And the ſolution obtained by cold water.

2. The ſolution obtained by cold water muſt be examined by evaporation. The evaporation ought to be gentle, that the cryſtals may aſſume regular forms. The cryſtals, as they ſucceſſively appear, are then to be placed on bibulous paper and dried; but not ſo much as to expel any of the water of cryſtallization. The ſpecies of the ſalt thus formed may be diſtinguiſhed by the taſte and ſhape of the cryſtals. But that they may be diſtinguiſhed with accuracy, we ſhall mention other methods: The ſolution obtained by cold water may contain alkalis, neutral ſalts, ſalts united with earths, ſalts united with metals, and neutral ſalts combined with earths or metals.

The alkalis can eaſily be diſcovered by the methods men-

(D) The proportions given above are Bergman's; but Dr Kirwan eſtimates them differently. According to him, 100 parts of the ſulphate of lime contain 32 of earth, 29,44 of acid, and 38,56 of water. When well dried, it loſes about 24 of water, and therefore contains 42 of earth, 39 of acid, and 19 of water.

(E) According to Dr Kirwan, 100 grains of the ſulphate of magneſia perfectly dry contain 45,67 of ſulphuric acid, 36,54 of pure earth, and 17,83 of water. In cryſtals they contain 23,75 of acid, 19 of earth, and 57,25 of water.

mentioned above, but the neutral or compound ſalts will occaſion more difficulty. We muſt firſt determine what the acid is, and with what baſe it is united. The ſulphuric acid is detected by the muriate of barytes, as deſcribed above. The nitrous acid, when preſent, is expelled by the ſulphuric acid, and may be eaſily diſtinguiſhed by its ſmell and red fumes. It will be made ſtill more evident by expoſing its fumes to a paper moiſtened with ammonia or volatile alkali. The muriatic acid is eaſily detected by expoſing the fumes of it to a paper moiſtened with water. This acid may alſo be diſcovered by the nitrate of ſilver.

It is more difficult to diſcover the baſes of the neutral ſalts which are always alkalis. We formerly deſcribed the method of detecting them in water when diſengaged, but we have now to ſeparate them from an acid. Potaſh may be ſeparated by barytes, ſoda is expelled by potaſh, and ammonia is expelled either by potaſh or ſoda.

We have mentioned already the method of diſcovering and diſtinguiſhing the earths and metals diſſolved in water; but there is one compound which is extremely difficult to ſeparate, viz. ſoda from common ſalt. The beſt method for effecting this is the proceſs of M. Giaonetti: "It conſiſts (ſays M. Fourcroy,) in waſhing the mixed ſalt with diſtilled vinegar. The acid diſſolves the mild ſoda; the mixture is dried, and waſhed afreſh with ſpirit of wine, which is charged with the terra foliata mineralis, without touching the marine ſalt; the ſpirituous ſolution is evaporated to dryneſs, and the reſiduum calcined; the vinegar is decompoſed and burned; we have then nothing but the mineral alkali, whoſe quantity is exactly found."

§ Fourcroy's Lectures on Chemiſtry vol. ii.

58 How to treat the ſolution obtained by boiling water.

3. The ſolution obtained by boiling water contains only ſelenite or gypſum. This may be ſeparated in chryſtals by evaporation to dryneſs, or it may be decompoſed by an alkali.

59 Fourcroy's general method of analyſis.

We have now ſaid every thing that is neceſſary reſpecting the two modes of analyzing water by precipitation and evaporation; but as a difficulty may occur to the unexperienced chemiſt reſpecting the order in which he ought to proceed in making his experiments, we ſhall lay before our readers the method recommended by M. Fourcroy.

He firſt examines the ſenſible properties of the water, the taſte, colour, weight, &c. and then pours upon four pounds of water the ſame weight of lime-water. If no precipitate falls in 24 hours, he concludes that the water contains no diſengaged carbonic acid, nor mild fixed alkali, nor earthy ſalts with baſe of aluminous earth or magneſia, nor metallic ſalts. If a precipitate be inſtantly formed, he proceeds to filter the liquid, and to examine the chemical qualities of the precipitate. If it has no taſte, if it is inſoluble in water, if it efferveſces with acids, and if it forms with ſulphuric acid an inſipid ſalt almoſt inſoluble in water, he concludes that it is chalk, and that the lime-water attracted only the aerial acid diſſolved in the water. On the contrary, if the precipitate be not copious, if it collects ſlowly, if it excites no efferveſcence, if, with the ſulphuric acid it forms a bitter ſalt, it is magneſia; but if with the ſame acid it forms a ſweetiſh aſtringent ſalt, it is aluminous earth or clay. Sometimes it may be a compound of both.

Being now examined by lime-water, he pours upon it other four pounds of the ſame water, a gros or two (F) of volatile cauſtic alkali, or he paſſes it through ſome alkaline gas diſengaged by means of heat. When the water is ſaturated, he leaves it in a cloſe veſſel for 24 hours; then if a precipitate be formed, as it muſt contain ſalts, with iron, magneſia, or aluminous earth for its baſe, he inveſtigates the nature of it. It muſt be obſerved, that the alkaline gas is not to be depended upon alone, but may be uſed as an auxiliary.

M. Fourcroy next pours into a certain quantity of the water under examination a portion of cauſtic mineral alkali diſſolved. He continues to pour it in till no farther muddineſs is produced, as it diſcompoſes the ſalts with a baſe of aluminous earth, or a baſe of lime. If the precipitate reſembles in form, colour, and quantity, that which is yielded by lime-water, it may be preſumed that the water contains no calcareous earth; but if it be more weighty, copious, and has formed more quickly than the precipitate formed by the lime-water, then it contains lime mixed with magneſia or aluminous earth. If the precipitate contain any iron, it is eaſily detected by its colour and taſte.

Theſe obſervations of M. Fourcroy will be of great uſe to the young chemiſt, in pointing out the order which he may follow with facility and advantage in the analyſis of waters; and after he has formed his opinion concerning the ingredients contained in the water, he may examine the truth of it by applying the particular teſts which have already been deſcribed.

In the account which we have given of the method of analyzing waters, the chemical reader will obſerve, that we have chiefly followed Bergman. We have done ſo, becauſe we reckon him the beſt writer on the ſubject, and becauſe we have been more anxious to ſtudy truth and utility than novelty. We ardently wiſh that ſome able chemiſt would exhibit an accurate and eaſy mode of analyzing earths, which every farmer could practiſe without a deep knowledge of chemiſtry. Farmers would then be enabled to apply the manures proper to particular ſoils, in which they would be much aſſiſted by Dr Kirwan's valuable Treatiſe on Manures.

Under the title of *MINERAL Waters*, we have given an analyſis of the moſt remarkable waters in Europe. (See alſo SPA, SELTZER, PYRMONT, and the names of other celebrated waters). Thoſe who wiſh for more information concerning the mode of analyzing water, may conſult Bergman's Chemical Eſſays, Fourcroy's Lectures on Chemiſtry, and the different books referred to by theſe authors.

Holy WATER, which is made uſe of in the Church of Rome, as alſo by the Greeks, and by the other Chriſtians of the Eaſt of all denominations, is water with a mixture of ſalt, bleſſed by a prieſt according to a ſet form of benediction. It is uſed in the bleſſing of perſons, things, and places; and is likewiſe conſidered as a ceremony to excite pious thoughts in the minds of the faithful.

The prieſt, in bleſſing it, firſt, in the name of God, commands the devils not to hurt the perſons who ſhall be ſprinkled with it, nor to abuſe the things, nor diſquiet the places, which ſhall likewiſe be ſo ſprinkled. He then prays that health, ſafety, and the favour of heaven may be enjoyed by ſuch perſons, and by thoſe who ſhall uſe ſuch things, or dwell in ſuch places. Veſtments, veſſels, and other ſuch things that are ſet apart for divine ſervice, are ſprinkled with it. It is ſometimes ſprinkled on cattle, with an intention to free or preſerve them from diabolical enchantments; and in ſome ritual books there are prayers to be ſaid on ſuch occaſions, by which the ſafety of ſuch animals, as being a temporal bleſſing to the poſſeſſors, is begged of God, whoſe providential care is exended to all his creatures. The hope which Catholics entertain of obtaining ſuch good effects from the devout uſe of holy water, is

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(E) A gros is equal to 59,0703 of Engliſh Troy grains.

grounded on the promiſe made to believers by Chriſt (St Mark xvi. 17.), and on the general efficacy of the prayers of the church, the petition of which prayers God is often pleaſed to grant; though ſometimes in his providence, he ſees it not expedient to do ſo. That ſuch effects have been produced by holy water in a remarkable manner, has been aſſerted by many authors of no ſmall weight; as, namely, by St Epiphanius, Haer. 30th; St Hierom, in the Life of St. Hilarion; Theodoret *Hiſt. Eccl.* lib. v. cap. 21; Palladius, *Hiſt. Lauſ.*; Bede, lib. v. cap. 4.

As a ceremony (ſays the Catholic), water brings to our remembrance our baptiſm; in which by water we were cleanſed from original ſin. It alſo puts us in mind of that purity of conſcience which we ought to endeavour always to have, but eſpecially when we are going to worſhip our God. The ſalt which is put into the water to preſerve it from corrupting, is alſo a figure of divine grace, which preſerves our ſouls from the corruption of ſin; and is likewiſe an emblem of that wiſdom and diſcretion which ought to ſeaſon every action that a Chriſtian does, and every word that he ſays. It is wont to be bleſſed and ſprinkled in churches on Sundays, in the beginning of the ſolemn office. It is kept in veſſels at the doors of the ſame churches, that it may be taken by the faithful as they enter in. It is alſo often kept in private houſes and chambers (A).

Putrid Water, is that which has acquired an offenſive ſmell and taſte by the putreſcence of animal or vegetable ſubſtances contained in it. It is in the higheſt degree pernicious to the human frame, and capable of bringing on mortal diſeaſes even by its ſmell. It is not always from the apparent muddineſs of waters that we can judge of their diſpoſition to putrify; ſome which are ſeemingly very pure being more apt to become putrid than others which appear much more mixed with heterogeneous matters. Under the article ANIMALCULE, n° 33, is mentioned a ſpecies of inſects which have the property of making water ſtink to an incredible degree, though their bulk in proportion to the fluid which ſurrounds them is leſs than that of one to a million. Other ſubſtances no doubt there are, which have the ſame property: and hence almoſt all water which is confined from the air is apt to become offenſive, even though kept in glaſs or ſtone-ware veſſels. Indeed it is a common obſervation, that water keeps much longer ſweet in glaſs-veſſels, or in thoſe of earthen or ſtone-ware, than in thoſe of wood, where it is exceedingly apt to putrify. Hence, as ſhips can only be ſupplied with water kept in wooden caſks, ſailors are extremely liable to thoſe diſeaſes which ariſe from putrid water; and the diſcovery of a method by which water could eaſily be prevented from becoming putrid at ſea would be exceedingly valuable. This may indeed be done by quicklime; for when water is impregnated with it, all putreſcent matters are either totally deſtroyed, or altered in ſuch a manner as never to be capable of undergoing the putrefactive fermentation again. But a continued uſe of lime-water could not fail of being pernicious, and it is therefore neceſſary to throw down the lime; after which the water will have all the purity neceſſary for preſerving it free from putrefaction. This can only be done by means of fixed air; and mere expoſure in broad ſhallow veſſels to the atmoſphere would do it without any thing elſe, only taking care to break the cruſt which formed upon it. Two methods, however, have been thought of for doing this with more expedition. The one, invented by Dr Alſton, is, by throwing into the water impregnated with lime a quantity of magneſia. The lime attracts fixed air more powerfully than magneſia; in conſequence of which the latter parts with it to the lime: and thus becoming inſoluble, falls along with the cauſtic magneſia to the bottom, and thus leaves the water perfectly pure. Another method is that of Mr Henry, who propoſes to throw down the lime by means of an efferveſcing mixture of oil of vitriol or chalk put down to the bottom of the water-caſk. His apparatus for this purpoſe is as ſimple as it can well be made, though it is hardly probable that ſailors will give themſelves the trouble of uſing it; and Dr Alſton's ſcheme would ſeem better calculated for them, were it not for the expence of the magneſia; which indeed is the only objection made to it by Mr Henry. Putrid water may be reſtored and made potable by a proceſs of the ſame kind.

Of late it has been diſcovered that charcoal poſſeſſes many unexpected properties, and among others, that of preſerving water from corruption, and of purifying it after it has been corrupted. Mr Lowitz, whoſe experiments on charcoal have been publiſhed in Crell's Chemical Journal, has turned his attention to this ſubject in a memoir read to the Economical Society of Peterſburg. He found that the effect of charcoal was rendered much more ſpeedy by uſing along with it ſome ſulphuric acid. One ounce and a half of charcoal in powder, and 24 drops of concentrated ſulphuric acid (oil of vitriol), are ſufficient to purify three pints and a half of corrupted water, and do not communicate to it any ſenſible acidity. This ſmall quantity of acid renders it unneceſſary to uſe more than a third part of the charcoal powder which would otherwiſe be wanted: and the leſs of that powder is employed, the leſs is the quantity of water loſt by the operation, which, in ſea-voyages, is an object worthy of conſideration. In proportion to the quantity of acid made uſe of, the quantity of charcoal may be diminiſhed or augmented. All acids produce nearly the ſame effects: neutral ſalts alſo, particularly nitre and ſea-ſalt, may be uſed, but ſulphuric acid is preferable to any of theſe; water which is purified by means of this acid and charcoal will keep a longer time than that which is purified by charcoal alone. When we mean to purify any given quantity of corrupted water, we ſhould begin by adding to it as much powder of charcoal as is neceſſary to deprive it entirely of its bad ſmell. To aſcertain whether that quantity of powdered charcoal was ſufficient to effect the clarification of the ſaid water, a ſmall quantity of it may be paſſed through a linen bag, two or three inches long; if the water, thus filtrated, ſtill has a turbid appearance, a freſh quantity of powdered charcoal muſt be added, till it is become perfectly clear; the whole of the water may then be paſſed through a filtering bag, the ſize of which ſhould be proportioned to the quantity of water. If ſulphuric acid, or any other, can be procured, a ſmall quantity of it ſhould be added to the water, before the charcoal powder.

The cleaning of the caſks in which water is to be kept in ſea-voyages ſhould never be neglected; they ſhould be well waſhed with hot water and ſand, or with any other ſubſtance capable of removing the mucilaginous particles, and afterwards a quantity of charcoal-duſt ſhould be employed, which will entirely deprive them of the muſty or putrid ſmell they may have contracted.—The charcoal uſed for purifying water ſhould be well burnt, and afterwards beat into a fine powder.

Sea-

(A) This article was furniſhed by an eminent divine of the church of Rome, to whom we are indebted for greater favours.

Sea-Water. See *Sea-Water.*

Water-Carts, carriages conſtructed for the purpoſe of watering the roads for ſeveral miles round London; a precaution abſolutely neceſſary near the metropolis, where, from ſuch a vaſt daily influx of carriages and horſes, the duſt would otherwiſe become quite inſufferable in hot dry weather. Pumps are placed at proper diſtances to ſupply theſe carts.

Water-Ordeal. See Ordeal.

Water, among jewellers, is properly the colour or luſtre of diamonds and pearls. The term, though leſs properly, is ſometimes uſed for the hue or colour of other ſtones.

Water-Bellows. See *Machines for blowing Air into Furnaces.*

Water-Colours, in painting, are ſuch colours as are only diluted and mixed up with gum-water, in contradiſtinction to oil colours. See *Colour-Making.*

Water-Gang, a channel cut to drain a place by carrying off a ſtream of water.

Water-Hen. See Parra.

Water-Line of a Ship, certain horizontal lines ſuppoſed to be drawn about the outſide of a ſhip's bottom, cloſe to the ſurface of the water in which ſhe floats. They are accordingly higher or lower upon the bottom, in proportion to the depth of the column of water required to float her.

Water-Lodged, the ſtate of a ſhip when, by receiving a great quantity of water into the hold, by leaking, &c. ſhe has become heavy and inactive upon the ſea, ſo as to yield without reſiſtance to the efforts of every wave ruſhing over her decks. As, in this dangerous ſituation, the centre of gravity is no longer fixed, but fluctuating from place to place, the ſtability of the ſhip is utterly loſt: ſhe is therefore almoſt totally deprived of the uſe of her ſails, which would operate to overſet her, or preſs the head under water. Hence there is no reſource for the crew, except to free her by the pumps, or to abandon her by the boats as ſoon as poſſible.

Water-Sail, a ſmall ſail ſpread occaſionally under the lower ſtudding-ſail, or driver-boom, in a fair wind and ſmooth ſea.

Water-Ouzel. See Turdus.

Water-Spout, an extraordinary meteor conſiſting of a large maſs of water collected into a ſort of column, and moved with rapidity along the ſurface of the ſea.

The beſt account of the water-ſpout which we have met with is in the Phil. Tranſ. Abridged, vol. viii. as obſerved by Mr Joſeph Harris, May 21. 1732, about ſunſet, lat. 32° 30′ N. long. 9° E. from Cape Florida.

"When firſt we ſaw the ſpout (ſays he), it was whole and entire, and much of the ſhape and proportion of a ſpeaking trumpet; the ſmall end being downwards, and reaching to the ſea, and the big end terminated in a black thick cloud. The ſpout itſelf was very black, and the more ſo the higher up. It ſeemed to be exactly perpendicular to the horizon, and its ſides perfectly ſmooth, without the leaſt ruggedneſs. Where it fell the ſpray of the ſea roſe to a conſiderable height, which made ſomewhat the appearance of a great ſmoke. From the firſt time we ſaw it it continued whole about a minute, and till it was quite diſſipated about three minutes. It began to waſte from below, and ſo gradually up, while the upper part remained entire, without any viſible alteration, till at laſt it ended in the black cloud above: upon which there ſeemed to fall a very heavy rain in that neighbourhood.—There was but little wind, and the ſky elſewhere was pretty ſerene."

Water-ſpouts have by ſome been ſuppoſed to be merely electrical in their origin; particularly by Signior Beccaria, who ſupported his opinion by ſome experiments. But if we attend to the ſucceſſive phenomena neceſſary to conſtitute a complete water-ſpout through their various ſtages, we ſhall be convinced, that recourſe muſt be had to ſome other principle in order to obtain a complete ſolution.

Dr Franklin, in his Phyſical and Meteorological Obſervations, ſuppoſes a water-ſpout and a whirlwind to proceed from the ſame cauſe; their only difference being, that the latter paſſes over the land, and the former over the water. This opinion is corroborated by M. de la Pryme, in the Philoſophical Tranſactions, where he deſcribes two ſpouts obſerved at different times in Yorkſhire, whoſe appearances in the air were exactly like thoſe of the ſpouts at ſea, and their effects the ſame as thoſe of real whirlwinds.

A fluid moving from all points horizontally towards a centre, muſt at that centre either mount or deſcend. If a hole be opened in the middle of the bottom of a tub filled with water, the water will flow from all ſides to the centre, and there deſcend in a whirl: but air flowing on or near the ſurface of land or water, from all ſides towards a centre, muſt at that centre aſcend; becauſe the land or water will hinder its deſcent.

The Doctor, in proceeding to explain his conceptions, begs to be allowed two or three poſitions, as a foundation for his hypotheſis. 1. That the lower region of air is often more heated, and ſo more rarefied, than the upper, and by conſequence ſpecifically lighter. The coldneſs of the upper region is manifeſted by the hail, which ſometimes falls from it in warm weather. 2. That heated air may be very moiſt, and yet the moiſture ſo equally diffuſed and rarefied as not to be viſible till colder air mixes with it; at which time it condenſes and becomes viſible. Thus our breath, although inviſible in ſummer, becomes viſible in winter.

Theſe circumſtances being granted, he preſuppoſes a tract of land or ſea, of about 60 miles in extent, unſheltered by clouds and unrefreſhed by the wind, during a ſummer's day, or perhaps for ſeveral days without intermiſſion, till it becomes violently heated, together with the lower region of the air in contact with it; ſo that the latter becomes ſpecifically lighter than the ſuperincumbent higher region of the atmoſphere, wherein the clouds are uſually floated: he ſuppoſes alſo that the air ſurrounding this tract has not been ſo much heated during thoſe days, and therefore remains heavier. The conſequence of this, he conceives, ſhould be, that the heated lighter air ſhould aſcend, and the heavier deſcend; and as this riſing cannot operate throughout the whole tract at once, becauſe that would leave too extenſive a vacuum, the riſing will begin preciſely in that column which happens to be lighteſt or moſt rarefied; and the warm air will flow horizontally from all parts of this column, where the ſeveral currents meeting, and joining to riſe, a whirl is naturally formed, in the ſame manner as a whirl is formed in a tub of water, by the deſcending fluid receding from all ſides of the tub towards the hole in the centre.

And as the ſeveral currents arrive at this central riſing column, with a conſiderable degree of horizontal motion, they cannot ſuddenly change it to a vertical motion; therefore as they gradually, in approaching the whirl, decline from right to curve or circular lines, ſo, having joined the whirl, they aſcend by a ſpiral motion: in the ſame manner as the water deſcends ſpirally through the hole in the tub before-mentioned.

Laſtly, as the lower air neareſt the ſurface is more rarefied by the heat of the ſun, it is more impreſſed by the current of the ſurrounding cold and heavy air which is to aſſume its place, and conſequently its motion towards the whirl is ſwifteſt, and ſo the force of the lower part of the whirl ſtrongeſt, and the centrifugal force of its particles greateſt. Hence the vacuum which incloſes the axis of the whirl ſhould be greateſt near the earth or ſea, and diminiſh gradually as it approaches the region of the clouds, till it ends in a point.

This circle is of various diameters, ſometimes very large.

If the vacuum paſſes over water, the water may riſe in a body or column therein to the height of about 32 feet. This whirl of air may be as inviſible as the air itſelf, though reaching in reality from the water to the region of cool air, in which our low ſummer thunder-clouds commonly float; but it will ſoon become viſible at its extremities. The agitation of the water under the whirling of the circle, and the ſwelling and riſing of the water in the commencement of the vacuum, renders it viſible below. It is perceived above by the warm air being brought up to the cooler region, where its moiſture begins to be condenſed by the cold into thick vapour, and is then firſt diſcovered at the higheſt part, which being now cooled condenſes what riſes behind it, and this latter acts in the ſame manner on the ſucceeding body; where, by the contact of the vapours, the cold operates faſter in a right line downwards, than the vapours themſelves can climb in a ſpiral line upwards: they climb however; and as by continual addition they grow denſer, and by conſequence increaſe their centrifugal force, and being riſen above the concentrating currents that compoſe the whirl, they fly off, and form a cloud.

It ſeems eaſy to conceive, how, by this ſucceſſive condenſation from above, the ſpout appears to drop or deſcend from the cloud, although the materials of which it is compoſed are all the while aſcending. The condenſation of the moiſture contained in ſo great a quantity of warm air as may be ſuppoſed to riſe in a ſhort time in this prodigiouſly rapid whirl, is perhaps ſufficient to form a great extent of cloud; and the friction of the whirling air on the ſides of the column may detach great quantities of its water, diſperſe them into drops, and carry them up in the ſpiral whirl mixed with the air. The heavier drops may indeed fly off, and fall into a ſhower about the ſpout; but much of it will be broken into vapour, and yet remain viſible.

As the whirl weakens, the tube may apparently ſeparate in the middle; the column of water ſubſiding, the ſuperior condenſed part drawing up to the cloud. The tube or whirl of air may nevertheleſs remain entire, the middle only becoming inviſible, as not containing any viſible matter.

Dr Lindſay, however, in ſeveral letters publiſhed in the Gentleman's Magazine, has controverted this theory of Dr Franklin, and endeavoured to prove, that water-ſpouts and whirlwinds are diſtinct phenomena; and that the water which forms the water-ſpout, does not aſcend from the ſea, as Dr Franklin ſuppoſes, but deſcends from the atmoſphere.

Our limits do not permit us to inſert his arguments here, but they may be ſeen in the Gentleman's Magazine, volume li. p. 559, 615; vol. liii. p. 1025; and vol. lv. p. 594. We cannot avoid obſerving, however, that he treats Dr Franklin with a degree of aſperity to which he is by no means intitled, and that his arguments, even if concluſive, prove nothing more than that ſome water-ſpouts certainly do deſcend; which Dr Franklin hardly ever ventured to deny. There are ſome very valuable diſſertations on this ſubject by profeſſor Wilcke of Upſal.

Water-Works. See *Water-Works* (A).

Water-Works for entertainment. See HYDROSTATICS, ſect. 6.

WATERFORD, a city and ſea-port of Ireland, in a county of the ſame name, with a biſhop's ſee. It is the ſecond place in the kingdom, and is a wealthy populous city, enjoying many ample privileges. The ſtreets are narrow, and the air is not very healthy; but it has an excellent harbour, ſeated as well for trade as any in the world, and ſhips of the greateſt burden may ride at the quay. It ſtands on the river Sure, 8 miles north of St George's Channel, 26 ſouth of Kilkenny, and 75 ſouth by weſt of Dublin. W. Long. 6. 54. N. Lat. 52. 18.

WATERFORD, a county of Ireland, 46 miles in length, and 25 in breadth; bounded on the ſouth by St George's Channel; on the weſt by Cork; on the north by the river Sure, which ſeparates it from Tipperary and Kilkenny; and on the eaſt by Waterford Haven, which parts it from Wexford. It contains 71 pariſhes, and ſends 10 members to parliament. It is a fine country, very pleaſant and rich, and the principal place is of the ſame name.

WATERING, in the manufactures, is to give a luſtre to ſtuffs, &c. by wetting them lightly with gum-water, and then paſſing them through the preſs or calender whether hot or cold. The gum-water ought to be pure, thin, and clear, otherwiſe the folds of the ſtuff will all ſtick together: the operation muſt alſo be performed when the water is very hot, that it may penetrate.

Watering Meadows. See MEADOWS.

WATERLAND (Dr Daniel) a learned Engliſh divine who diſtinguiſhed himſelf greatly in theological controverſies, was born in 1683 at Waſely in Lincolnſhire, of which place his father was rector. He had his academical learning at Magdalen college, Cambridge, where he drew up a uſeful tract, which went through ſeveral editions, intitled, *Advice to a Young Student, with a Method of Study for the firſt four years*. In 1713 he became maſter of the college, was ſoon after appointed chaplain to George I. and in 1720 preached the firſt courſe of lectures founded by lady Moyer in defence of our Lord's divinity. He went through ſeveral promotions; and at the time of his death in 1740, was canon of Windſor, archdeacon of Middleſex, and vicar of Twickenham. Beſides his controverſial writings, he publiſhed two volumes of ſermons.

WATLING-STREET. See WAY.

WATSON (Dr Robert), an elegant hiſtorian, was born at St Andrew's, in Scotland, about the year 1730. He was the ſon of an apothecary of that place, who was alſo a brewer. Having gone through the uſual courſe of languages and philoſophy at the ſchool and univerſity of his native place, and alſo entered on the ſtudy of divinity, a deſire of being acquainted with a larger circle of literati, and of improving himſelf in every branch of knowledge, carried him, firſt to the univerſity of Glaſgow, and afterwards to that of Edinburgh. The period of theological ſtudies

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(A) For referring this article from the word WATER to the word WORKS, an apology is due to the Public; and the apology which we have to offer, we are perſuaded, will be ſuſtained. It is this: The gentleman who contributed the articles *Resistance of Fluids* and RIVER, promiſed to furniſh alſo the article *Water Works*; but ſickneſs has hitherto prevented him from fulfilling that promiſe. We truſt, however, that before our preſſes ſhall reach to the word WORKS, he may be able to fill up the ſketch which he has long ago drawn of this very important ſubject. And ſuch of our readers as can eſtimate the merit of his two articles, which we have juſt mentioned, will not blame the Editor for deviating a little from the alphabetical order, to give him a chance of furniſhing a third article, to which theſe two are ſo cloſely related.

ſtudies at the univerſities of Scotland is four years; but during that period, young men of ingenious minds find ſufficient leiſure to carry on and advance the purſuits of general knowledge. Mr Watſon purſued his ſtudies with ardour. Few men ever ſtudied more conſtantly. It was a rule with him to ſtudy eight hours every day; and this law he obſerved during the whole courſe of his life. An acquaintance with the polite writers of England, after the union of the two kingdoms, became general in Scotland; and in Watſon's younger years, an emulation began to prevail of writing pure and elegant Engliſh. Mr Watſon applied himſelf with great induſtry to the principles of philoſophical or univerſal grammar; and by a combination of theſe, with the authority of the beſt Engliſh writers, formed a courſe of lectures on ſtyle or language. He proceeded to the ſtudy of rhetoric or eloquence; the principles of which he endeavoured to trace to the nature of the human mind. He delivered a courſe of lectures in Edinburgh on theſe ſubjects; and met with the countenance, approbation, and friendſhip of Lord Kames, Mr Hume, with other men of genius and learning.

At this time he had become a preacher: and a vacancy having happened in one of the churches of St Andrew's, he offered himſelf a candidate for that living, but was diſappointed. Mr Henry Rymer, who then taught logic in St Salvador's College, was in a very infirm ſtate of health, and entertained thoughts of retiring from the cares and emoluments of his office, to live upon his ſmall ſalary or ſtipend. Mr Watſon underſtanding this, purchaſed, for not a great ſum of money, what, in familiar phraſeology, may be called the good-will of Mr Rymer's place; and, with the conſent of the other maſters of St Salvador's, was appointed profeſſor of logic. He obtained alſo a patent from the crown, conſtituting him profeſſor of rhetoric and belles lettres. The ſtudy of logic, in St Andrew's, as in moſt other places, was at this time confined to ſyllogiſms, modes, and figures. Mr Watſon, whoſe mind had been opened by converſation, and by reading the writings of the wits that had begun to flouriſh in the Scotch capital, prepared and read to his ſtudents a courſe of metaphyſics and logics on the moſt enlightened plan; in which he analyzed the powers of the mind, and entered deeply into the nature of the different ſpecies of evidence of truth or knowledge. By his hiſtory of Philip II. Dr Watſon attained in his lifetime a conſiderable degree of celebrity; and his hiſtory of Philip III. publiſhed after his death, has added to his fame. Of this laſt performance, however, he has only completed the four firſt books; the two laſt were written by the editor of his manuſcript, at the deſire of the guardians of his children.

On the death of principal Tulideph, Dr Watſon, through the earl of Kinnoull, was appointed his ſucceſſor; in which ſtation he lived only a few years. He married a lady of ſingular beauty and virtue, daughter to Mr Shaw, profeſſor of divinity in St Mary's college, St Andrew's. By this lady he had five daughters, who ſurvived him.

WATTS (Dr Iſaac), a learned and eminent diſſenting miniſter, was born at Southampton in 1674, of parents eminent for piety, and conſiderable ſufferers for conſcience-ſake. In 1690 he was ſent up to London for academical education under the tuition of the Rev. Mr Thomas Rowe; and in 1696 was himſelf engaged as tutor to the ſon of Sir John Hartopp, bart. at Stoke Newington. He began to preach in 1698, and met with general acceptance; and after officiating for three years as an aſſiſtant to the Rev. Dr Iſaac Chauncy, he ſucceeded in his paſtoral charge in 1702, and continued to preſide over that church as long as he lived. Though his whole income did not amount to an hundred a-year, he allotted one third of it to the poor. He died in 1748. His numerous works have rendered his name famous among people of every denomination, both in this and other countries, and they have been tranſlated into a variety of languages. His Lyric Poems, his Pſalms and Hymns, and his divine Songs for Children, are a ſufficient proof of his poetical talents, and have had an amazing number of editions. His logic and philoſophy have been much admired. He alſo wrote works upon a variety of other ſubjects, and printed ſeveral volumes of his ſermons. He was admired for the mildneſs and benevolence of his diſpoſition and the ſweetneſs of his manners. After his death, his works were collected, and publiſhed in ſix volumes quarto.

WAVE, in philoſophy, a cavity in the ſurface of water, or other fluids, with an elevation aſide thereof.

The waves of the ſea are of two kinds, natural and accidental. The natural waves are thoſe which are exactly proportioned in ſize to the ſtrength of the wind, whoſe blowing gives origin to them. The accidental waves are thoſe occaſioned by the wind's reacting upon itſelf by repercuſſion from hills and mountains, or high ſhores, and by the waſhing of the waves themſelves; otherwiſe of the natural kind, againſt rocks and ſhoals: all theſe caſes give the waves an elevation, which they can never have in their natural ſtate. For the height of the waves, ſee Sea.

Stilling Waves by means of Oil. See Sea.

WAVED, in heraldry, is ſaid of a bordure, or any ordinary or charge, in a coat of arms, having its outlines indented in manner of the riſing and falling of waves: it is uſed to denote, that the firſt of the family in whoſe arms it ſtands, acquired its honours by ſea-ſervice.

WAVING, in the ſea-language, is the making ſigns to a veſſel to come near or keep off.

WAX, or *Bees Wax*, in natural hiſtory, a firm and ſolid ſubſtance, moderately heavy, and of a fine yellow colour, formed by the bees from the pollen of flowers. See Apis.

The beſt ſort is that of a lively yellow colour, and an agreeable ſmell, ſomewhat like that of honey: when new, it is toughiſh, yet eaſy to break; but by age it becomes harder and more brittle, loſes its fine colour, and in a great meaſure its ſmell.

It appears that wax and the pollen have for their baſis a fat oil, which paſſes to the ſtate of reſin by its combination with oxygene. If the nitric or muriatic acid be digeſted upon fixed oil for ſeveral months, it paſſes to a ſtate reſembling wax. Wax, by repeated diſtillations, affords an oil which poſſeſſes all the properties of volatile oils. It is reduced into water and carbonic acid by combuſtion. The colouring matter of wax is inſoluble in water and in alcohol.

Chaptal's Chemiſtry, vol. iii.

Fixed alkalis diſſolve wax, and render it ſoluble in water. It is this ſaponaceous ſolution which forms the punic wax. It may be uſed as the baſis of ſeveral colours; and may be made into an excellent paſte for waſhing the hands. Ammoniac likewiſe diſſolves it; and as this ſolvent is evaporable, it ought to be preferred when it is propoſed to uſe the wax as a varniſh.

From the common yellow wax, by bleaching, is formed white-wax, ſometimes called, very improperly, *virgin-wax*. The greater the ſurface is in proportion to the quantity, the ſooner and more perfectly this operation is performed. The uſual way is to melt the wax in hot water; when melted, they preſs it through a ſtrainer of tolerable fine linen, and pour it into round and very ſhallow moulds. When hardened by cooling, it is taken out and expoſed to the ſun and air, ſprinkling it now and then with water, and often turning it: by this means it ſoon becomes white.

The beſt ſort is of a clear and almoſt tranſparent whiteneſs, dry, hard, brittle, and of an agreeable ſmell, like that of the yellow wax, but much weaker.

The common yellow wax is of very great uſe both in medicine and in many of the arts and manufactures. It has been ſometimes given internally in dyſenteries and eroſions of the inteſtines; but its great uſe is in the making ointments and plaſters, and the greater part of thoſe of the ſhops owe their conſiſtence to it. The white wax is alſo an ingredient in ſome of the cerates and ointments of the ſhops; and is uſed in making candles, and in many of the nicer arts and manufactures where wax is required.

Sealing-Wax, or *Spaniſh-Wax*, is a compoſition of gum lac, melted and prepared with reſins, and coloured with ſome ſuitable pigment.

There are two kinds of ſealing-wax in uſe; the one hard, intended for ſealing letters, and other ſuch purpoſes; the other ſoft, deſigned for receiving the impreſſions of ſeals of office to charters, patents, and ſuch written inſtruments. The beſt hard red ſealing-wax is made by mixing two parts of ſhell lac, well powdered, and reſin and vermilion, powdered, of each one part, and melting this combined powder over a gentle fire; and when the ingredients ſeem thoroughly incorporated, working the wax into ſticks. Seed-lac may be ſubſtituted for the ſhell-lac; and inſtead of reſin, boiled Venice turpentine may be uſed. A coarſer, hard, red ſealing-wax, may be made, by mixing two parts of reſin, and of ſhell-lac, or vermilion and red-lead, mixed in the proportion of one part of the vermilion to two of the red-lead, of each one part; and proceeding as in the former preparation. For a cheaper kind, the vermilion may be omitted, and the ſhell-lac alſo, for very coarſe uſes. Wax of other colours is made by ſubſtituting other colouring matters for vermilion, as verditer for blue, ivory black for black wax. For uncoloured, ſoft ſealing-wax, take of bees-wax, one pound; of turpentine, three ounces; and of olive-oil, one ounce; place them in a proper veſſel over the fire, and let them boil for ſome time; and the wax will be then fit to be formed into rolls or cakes for uſe. For red, black, green, blue, yellow, and purple ſoft ſealing-wax, add to the preceding compoſition an ounce or more of any ingredients directed above for colouring the hard ſealing-wax, and ſtir the maſs till the colouring ingredients be incorporated with the wax.

Wax-Work, the repreſentation of the faces, &c. of perſons living or dead; made by applying plaſter of Paris in a kind of paſte, and thus forming a mould containing the exact repreſentation of the features. Into this mould melted wax is poured, and thus a kind of maſks are formed; which being painted and ſet with glaſs eyes, and the figures dreſſed in their proper habits, they bear ſuch a reſemblance that it is difficult to diſtinguiſh between the copy and the original.

WAY, a paſſage or road.

The Roman ways are divided into conſular, prætorian, military, and public; and of theſe we have four remarkable ones in England: the firſt, Watling-ſtreet, or Watheling-ſtreet, leading from Dover to London, Dunſtable, Touceſter, Atterſton, and the Severn, extending as far as Angleſea in Wales. The ſecond, called *Hikenild* or *Ikenild-ſtreet*, ſtretches from Southampton over the river Iſis at Newbridge: thence by Camden and Litchfield; then paſſes the Derwent near Derby, and ends at Tinmouth. The third, called *Foſſe-way*, becauſe in ſome places it was never perfected, but lies as a large ditch, leads from Cornwall through Devonſhire, by Tethbury, near Stow in the Wolds; and beſide Coventry to Leiceſter, Newark, and ſo to Lincoln. The fourth, called *Erming* or *Erminage-ſtreet* extends from St David's in Wales, to Southampton.

Way Covert, Gang, Hatch. See *Covert Way*, *Gang*, &c.

Way of a Ship, is ſometimes the ſame as her rake, or run forward or backward: but this term is moſt commonly underſtood of her ſailing.

Way-Leaves, in the coal buſineſs. See Coalery, n° 3.

Right of Ways, in law. This may be grounded on a ſpecial permiſſion; as when the owner of the land grants to another a liberty of paſſing over his grounds, to go to church, to market, or the like: in which caſe the gift or grant is particular, and confined to the grantee alone; it dies with the perſon; and if the grantee leaves the country, he cannot aſſign over his right to any other; nor can he juſtify taking another perſon in his company. A way may be alſo by preſcription; as if all the owners and occupiers of ſuch a farm have immemorially uſed to croſs another's ground; for this immemorial uſage ſuppoſes an original grant, whereby a right of way thus appurtenant to land may clearly be created. A right of way may alſo ariſe by act and operation of law; for if a man grants me a piece of ground in the middle of his field, he at the ſame time tacitly and impliedly gives me a way to come at it; and I may croſs his land for that purpoſe without treſpaſs. For when the law doth give any thing to one, it giveth impliedly whatſoever is neceſſary for enjoying the ſame. By the law of the twelve tables at Rome, where a man had the right of way over another's land, and the road was out of repair, he who had the right of way might go over any part of the land he pleaſed: which was the eſtabliſhed rule in public as well as private ways. And the law of England, in both caſes, ſeems to correſpond with the Roman.

WAYFARING Tree. See Viburnum.

WAYWODE, is properly a title given to the governors of the chief places in the dominions of the czar of Muſcovy. The palatines, or governors of provinces in Poland, alſo bear the quality of *waywodes*, or *waiwodes*. The Poles likewiſe call the princes of Wallachia and Moldavia *waywodes*; as eſteeming them no other than on the foot of governors; pretending that Wallachia and Moldavia are provinces of Poland. Everywhere elſe theſe are called *hoſpodars*. Du Cange ſays, that the name *waywode* is uſed in Dalmatia, Croatia, and Hungary, for a general of an army: and Leunclavius, in his Pandects of Turkey, tells us, it uſually ſignifies *captain* or *commander*.

WEANING, putting a child away from the breaſt, and bringing it to uſe common food.

WEAR, or Weer, a great ſtank or dam in a river, fitted for the taking of fiſh, or for conveying the ſtream to a mill. New wears are not to be made, or others altered, to the nuiſance of the public, under a certain penalty. See River.

WEARING, or Veering, in ſeamanſhip. See Seamanship, Vol. XVII. p. 219.

WEASEL, in zoology. See Mustela.

WEATHER denotes the ſtate of the atmoſphere with regard to heat and cold, wind, rain, and other meteors.

The phenomena of the weather muſt have at all times attracted much of the attention of mankind, becauſe their ſubſiſtence and their comfort in a great meaſure depended upon them. It was not till the ſeventeenth century, however, that any conſiderable progreſs was made in inveſtigating the laws of meteorology. How deſirous ſoever the ancients might have been to acquire an accurate knowledge of this ſcience, their want of proper inſtruments entirely precluded them from cultivating it. By the diſcovery of the barometer and thermometer in the laſt century, and the invention of accurate electrometers and hygrometers in the preſent, this defect is now pretty well ſupplied; and philoſophers are enabled to make meteorogical obſervations with eaſe and accuracy. Accordingly a very great number of ſuch obſervations have been collected, which have been arranged and examined from time to time by ingenious men, and conſequences deduced from them, on which ſeveral different theories of the weather have been built. But meteorology is a ſcience ſo exceedingly difficult, that, notwithſtanding the united exertions of ſome of the firſt philoſophers of the age, the phenomena of the weather are ſtill very far from being completely underſtood; nor can we expect to ſee the veil removed, till accurate tables of obſervations have been obtained from every part of the world, till the atmoſphere has been more completely analyſed, and the chemical changes which take place in it aſcertained. From the meteorological facts, however, which are already known, we ſhall draw up the beſt account of the weather we can. We ſhall treat of the different phenomena in the following order—heat and cold, wind, rain, thunder, alterations in the gravity of the atmoſphere.

1
Of Heat and Cold.

I. Though there is a conſiderable difference in every part of the world between the temperature of the atmoſphere in ſummer and in winter; though in the ſame ſeaſon the temperature of almoſt every day, and even every hour, differs from that which precedes and follows it; though the heat varies continually in the moſt irregular and ſeemingly capricious manner—ſtill there is a certain mean temperature in every climate, which the atmoſphere has always a tendency to obſerve, and which it neither exceeds nor comes ſhort of beyond a certain number of degrees. What this temperature is, may be known by taking the mean of tables of obſervations kept for a number of years; and our knowledge of it muſt be the more accurate the greater the number of obſervations is.

2
Method of diſcovering the mean annual temperature of every place.

The mean annual temperature is greateſt at the equator (or at leaſt a degree or two on the north ſide of it), and it diminiſhes gradually towards the poles, where it is leaſt. This diminution takes place in arithmetical progreſſion, or, to ſpeak more properly, the annual temperature of all the latitudes are arithmetical means between the mean annual temperature of the equator and the pole. This was firſt diſcovered by Mr Mayer; and by means of an equation which he founded on it, but rendered conſiderably plainer and ſimpler, Mr Kirwan has calculated the mean annual temperature of every degree of latitude between the equator and the pole. He proceeded on the following principle. Let the mean annual heat at the equator be m and at the pole $m-n$; put Φ for any other latitude; the mean annual temperature of that latitude will be $m-n \times \text{ſin.}\ \Phi^2$. If therefore the temperature of any two latitudes be known, the value of m and n may be found. Now the temperature of north lat. 40° has been found by the beſt obſervations to be 62,1°, and that of lat. 50°, 52,9°. The ſquare of the ſine of 40° is nearly 0,419, and the ſquare of the ſine of 50° is nearly 0,586. Therefore,

$$m - 0{,}41\ n = 62{,}1 \text{ and}$$
$$m - 0{,}58\ n = 52{,}9 : \text{therefore}$$
$$62{,}1 + 0{,}41\ n = 52{,}9 + 0{,}58\ n,$$

as each of them, from the two firſt equations, is equal to m. From this laſt equation the value of n is found to be 53 nearly; and m is nearly equal to 84. The mean temperature of the equator therefore is 84°, and that of the pole 31°. To find the mean temperature for every other latitude, we have only to find 88 arithmetical means between 84 and 31. In this manner Mr Kirwan calculated the following table.

TABLE of the Mean Annual Temperature of the Standard Situation, in every Latitude.

Lat.	Temper	Lat.	Temper	Lat.	Temper
90	31,	61	43,5	32	69,1
89	31,04	60	44,3	31	69,9
88	31,10	59	45,09	30	70,7
87	31,14	58	45,8	29	71,5
86	31,2	57	46,7	28	72,3
85	31,4	56	47,5	27	72,8
84	31,5	55	48,4	26	73,8
83	31,7	54	49,2	25	74,5
82	32,	53	50,2	24	75,4
81	32,2	52	51,1	23	75,9
80	32,6	51	52,4	22	76,5
79	32,9	50	52,9	21	77,2
78	33,2	49	53,8	20	77,8
77	33,7	48	54,7	19	78,3
76	34,1	47	55,6	18	78,9
75	34,5	46	56,4	17	79,4
74	35,	45	57,5	16	79,9
73	35,5	44	58,4	15	80,4
72	36,	43	59,4	14	80,8
71	36,6	42	60,3	13	81,3
70	37,2	41	61,2	12	81,7
69	37,8	40	62,	11	82,
68	38,4	39	63,	10	82,3
67	39,1	38	63,9	9	82,7
66	39,7	37	64,8	8	82,9
65	40,4	36	65,7	7	83,2
64	41,2	35	66,6	6	83,4
63	41,9	34	67,4	5	83,6
62	42,7	33	68,3	0	84,

3
In the ſtandard ocean.

This table, however, only anſwers for the temperature of the atmoſphere of the ocean. It was calculated for that part of the Atlantic ocean which lies between the 80th degree of northern and the 45th of ſouthern latitude, and extends weſtwards as far as the Gulf-ſtream, and to within a few leagues of the coaſt of America; and for all that part of the Pacific ocean reaching from lat. 45° north to lat 40° ſouth, from the 20th to the 275th degree of longitude eaſt of London. This part of the ocean Mr Kirwan calls *the ſtandard;* the reſt of the ocean is ſubject to anomalies which will be afterwards mentioned.

4
And alſo the mean monthly temperature.

Mr Kirwan has alſo calculated the mean monthly temperature of the ſtandard ocean. The principles on which he went were theſe: The mean temperature of April ſeems to approach very nearly to the mean annual temperature; and as far as heat depends on the action of the ſolar rays, the mean heat of every month is as the mean altitude of the ſun, or rather as the ſine of the ſun's altitude. The mean heat of April, therefore, and the ſine of the ſun's altitude being given, the mean heat of May is found in this manner: As the ſine of the ſun's mean altitude in April is to the mean heat of April, ſo is the ſine of the ſun's mean altitude in May to the mean heat of May. In the ſame manner the mean heats of June, July, and Auguſt, are found; but the rule would give the temperature of the ſucceeding months too low, becauſe it does not take in the heat derived from the earth, which poſſeſſes a degree of heat nearly equal to the mean annual temperature. The real temperature of theſe months therefore muſt be looked upon as an arithmetical mean between the aſtronomical and terreſtrial heats. Thus in latitude 51°, the aſtronomical heat of the month of September is 44.6°, and the mean annual heat is 52.4°; therefore the real heat of this month ſhould be $\frac{44.6+52.4}{2} = 48.5$. Mr Kirwan, however, after going through a tedious calculation, found the reſults to agree ſo ill with obſervations, that he drew up the following table partly from principles and partly by ſtudying a variety of ſea journals.

Table of the Monthly Mean Temperature of the Standard from lat. 80° *to lat.* 10°.

Lat.	80°	79°	78°	77°	76°	75°	74°	73°	72°	71°	70°	69°	68°	67°	66°	65°	64°	63°	62°,	61°	60°	59°	58°	57°
Jan.	22,	22,5	23,	23,5	24,	24,5	25,	25,5	26,	26,5	27,	27,5	27,5	28,	28,	28,	29,	30,	31,	32,	33,	34,	35,	36,
Feb.	23,	23,	23,5	24,	24,5	25,	25,5	26,	26,5	27,	27,5	28,	28,	28,5	29,	30,	31,	32,	33,	34,	35,	36,	37,	38,
Mar.	27,	27,5	28,	28,5	29,	29,5	30,	30,5	31,	31,5	32,	32,5	33,	33,5	34,	35,	36,	37,	38,	39,	40,	41,	42,	43,
Apr.	32,6	32,9	33,2	33,7	34,1	34,5	35,	35,5	36,	36,6	37,2	37,8	38,4	39,1	39,7	40,4	41,2	41,9	42,7	43,5	44,3	45,09	45,8	46,7
May	36,5	36,5	37,	37,5	38,	38,5	39,	39,5	40,	40,5	41,	41,5	42,	42,5	43,	44,	45,	46,	47,	48,	49,	50,	51,	52,
June	51,	51,	51,5	52,	52,	52,	52,5	53,	53,5	54,	54,	54,5	54,5	54,5	55,	55,	55,5	55,5	56,	56,	56,	56,5	57,	57,
July	50,	50,	50,5	51,	51,	51,	51,5	52,	52,5	53,	53,5	53,5	53,5	54,	54,5	54,5	55,	55,	55,5	55,5	56,	56,5	57,	57,5
Aug	39,5	40,	41,	41,5	42,	42,5	43,	43,5	44,	44,5	45,	45,5	46,	47,	48,	48,5	49,	50,	51,	52,	53,	54,	55,	56,
Sept.	33,5	34,	34,5	35,	35,5	36,	36,5	37,	38,	38,5	39,	39,5	40,	41,	42,	43,	44,	45,	46,	47,	48,	49,	50,	51,
Oct.	28,5	29,	29,5	30,	30,5	31,	31,5	32,	32,5	33,	33,5	34,	34,	35,	36,	37,	37,5	38,	39,	40,	41,	42,	43,	44,
Nov.	23,	23,5	24,	24,5	25,	25,5	26,	26,5	27,	27,5	28,	28,5	29,	30,	31,	32,	32,5	33,	34,	35,	36,	37,	38,	39,
Dec.	22,5	23,	23,5	24,	24,5	25,	25,5	26,	26,5	27,	27,5	28,	28,	29,	30,	30,5	31,	31,	32,	33,	34,	35,	36,	37,

Lat.	56°	55°	54°	53°	52°	51°	50°	49°	48°	47°	46°	45°	44°	43°	42°	41°	40°	39°	38°	37°	36°	35°	34°	33°
Jan.	37,	38,	39,	40,	41,	42,	42,5	42,5	43,	43,5	44,	44,5	45,	45,5	46,	46,5	49,5	51,	52,	53,5	55,	56,5	59,5	63,
Feb.	39,	40,	41,	42,	43,	44,	44,5	44,5	45,	45,5	46,	46,5	47,	48,	49,	50,	53,	56,5	58,	60,	61,	62,	63,	64,5
Mar.	44,	45,	46,	48,	49,	50,	50,5	51,	52,5	53,	53,5	54,5	55,5	56,5	58,5	59,5	60,	60,5	61,	62,	63,	64,	65,	66,5
Apr	47,5	48,4	49,2	50,2	51,1	52,4	52,9	53,8	54,7	55,6	56,4	57,5	58,4	59,4	60,3	61,2	62,1	63,	63,9	64,8	65,7	66,6	67,4	68,3
May	53,	54,	55,	56,	57,	58,	58,5	59,	60,	61,	62,	63,	64,	65,	66,	67,	68,	69,	70,	70,5	71,	71,5	72,	72,5
June	57,5	58,	58,5	59,	59,	60,	61,	62,	63,	64,	65,	66,	67,	68,	69,	70,	70,5	71,	71,	71,	71,5	71,5	72,	72,5
July	58,	59,	60,	61,	62,	63,	63,5	64,	65,	66,	67,	68,	69,	69,5	70,	70,	71,	71,	72,	72,	72,5	72,5	72,5	72,5
Aug.	57,	58,	59,	60,	61,	62,	63,5	64,	65,	66,	67,	68,	69,	69,5	70,	70,	71,	71,	72,	72,	72,5	72,5	72,5	72,5
Sept.	52,	53,	54,	55,	56,	57,	58,5	59,	60,	61,	62,	63,	64,	66,	68,	69,5	70,5	71,	71,5	72,	72,5	72,5	72,5	72,5
Oct.	45,	46,	47,	48,	49,	50,	50,5	51,	52,	53,	54,	55,	56,	57,	58,	59,	60,	61,	62,	63,	64,	65,	66,	67,5
Nov.	40,	41,	42,	43,	44,5	46,	46,5	47,	48,	49,	50,	51,	52,	53,	54,	55,	56,	57,	58,	59,	60,	61,	62,	63,
Dec.	38,	39,	40,	41,	42,	44,	44,5	45,	46,	47,	48,	49,	50,	51,	52,	53,	54,	55,	56,	57,	58,	39,	60,	61,

Lat.

Lat.	32°	31°	30°	29°	28°	27°	26°	25°	24°	23°	22°	21°	20°	19°	18°	17°	16°	15°	14°	13°	12°	11°	10°
Jan.	63,	63,	63,5	63,5	63,5	64,	64,5	65,5	67,	68,	69,	71,	72,	72,5	73,	73,5	74,	74,5	75,	76,	76,5	77,	77,5
Feb.	66,	67,	68,5	68,5	69,5	69,5	70,5	71,	72,	72,	72,5	74,	75,	76,	76,5	77,	77,5	78,	78,5	79,	79,5	79,8	80,
Mar.	67,5	68,5	69,5	71,	72,	72,5	73,	73,5	74,5	75,	75,5	76,	77,	77,5	78,	78,5	79,	79,5	80,	80,8	81,	81,5	81,8
Apr.	69,1	69,9	70,7	71,5	72,3	72,8	73,8	74,5	75,4	75,9	76,5	77,2	77,8	78,3	78,9	79,4	79,9	80,4	80,8	81,3	81,7	82,	82,3
May	73,	73,	73,5	74,5	75,5	76,	76,5	77,5	78,	78,5	79,5	80,	80,5	81,	81,5	82,	82,5	83,	83,	83,5	84,	84,	84,3
June	73,	73,	73,5	74,5	75,5	76,	76,5	78,	78,5	79,	79,5	80,	80,5	81,5	82,	82,5	83,	83,5	83,8	84,	84,3	84,6	84,8
July	73,	73,	73,5	74,5	75,5	76,	76,5	78,	78,5	79,	79,5	80,	80,5	81,5	82,	82,5	83,	83,5	83,8	84,	84,3	84,6	84,8
Aug	73,	73,	73,5	74,5	75,5	76,	76,5	78,	78,5	79,	79,5	80,	80,5	81,5	82,	82,5	83,	83,5	83,8	84,	84,3	84,6	84,8
Sept.	73,	73,	73,5	74,	75,5	76,	76,5	77,5	78,	78,5	79,	79,5	80,	81,	81,5	82,	82,5	83,	83,	83,5	84,	84,3	84,6
Oct.	68,5	69,5	70,5	71,	72,5	72,5	73,	73,5	74,5	75,	75,5	77,	78,	79,	80,	81,	81,5	82,	82,5	83,	83,5	83,8	84,
Nov.	64,5	65,5	66,5	68,	69,	69,5	71,5	72,	73,5	74,	74,5	75,	75,5	76,	77,	78,	78,5	79,	79,5	80,	80,5	80,8	81,
Dec.	62,5	63,5	64,5	66,	67,	67,5	68,5	69,5	70,5	71,	71,5	72,	72,5	73,	74,	75,	75,5	76,	76,5	77,	77,5	78,	78,5

From this table it appears, that January is the coldeſt month in every latitude, and that July is the warmeſt month in all latitudes above 48°. In lower latitudes Auguſt is generally warmeſt. The difference between the hotteſt and coldeſt months increaſes in proportion to the diſtance from the equator. Every habitable latitude enjoys a mean heat of 60° for at leaſt two months; this heat ſeems neceſſary for the production of corn. Within ten degrees of the poles the temperatures differ very little, neither do they differ much within ten degrees of the equator; the temperature of different years differ very little near the equator, but they differ more and more as the latitudes approach the poles.

5 The mean temperature of land varies with the height of the place.

The temperature of the earth at the level of the ſea is the ſame with that of the ſtandard ocean; but this temperature gradually diminiſhes as we aſcend above that level till, at a certain height, we arrive at the region of perpetual congelation. This region varies in height according to the latitude of the place; it is higheſt at the equator, and deſcends gradually nearer the earth as we approach the poles. It varies alſo according to the ſeaſon, being higheſt in ſummer and loweſt in winter. M. Bouguer found the cold on the top of Pinchinca, one of the Andes, to extend from ſeven to nine degrees below the freezing point every morning immediately before ſun-riſe. He concluded, therefore, that the mean height of the *term of congelation* (the place where it firſt freezes during ſome part of the day all the year round) between the tropics was 15,677 feet above the level of the ſea; but in lat. 28° he placed it in ſummer at the height of 13,440 feet. Now, if we take the difference between the temperature of the equator and the freezing point, it is evident that it will bear the ſame proportion to the term of congelation at the equator that the difference between the mean temperature of any other degree of latitude and the freezing point bears to the term of congelation in that latitude. Thus the mean heat of the equator being 84°, the difference between it and 32 is 52; the mean heat of lat. 28° is 72.3, the difference between which and 32 is 40.3: Then 52 : 15577 : : 40.3 : 12072. In this manner Mr Kirwan calculated the following table,

Mean height of the Term of Congelation.		Mean height of the Term of Congelation.	
Lat.	Feet.	Lat.	Feet.
0	15577	45	7658
5	15457	50	6260
10	15067	55	4912
15	14498	60	3684
20	13719	65	2516
25	13030	70	1557
30	11592	75	748
35	10664	80	120
40	9016		

6 Methods of finding it.

If the elevation of a country above the level of the ſea proceeds at a greater rate than ſix feet *per* mile, we muſt, according to Mr Kirwan*, for every 200 feet of elevation diminiſh the annual temperature of the ſtandard in that latitude as follows. If the elevation be at the rate of

6 feet *per* mile $\frac{1}{4}$ of a degree
7 feet - $\frac{1}{3}$
13 feet - $\frac{4}{10}$
15 or upwards $\frac{1}{2}$

According to him ‡ alſo, for every 50 miles diſtance from the ſtandard ocean, the mean annual temperature in different latitudes is to be depreſſed or raiſed nearly at the following rate:

From lat. 70° to lat. 35° cooled $\frac{1}{3}$ of a degree
35 - $\frac{1}{8}$
30 - 0
25 warmed $\frac{1}{5}$
20 - $\frac{1}{2}$
10 - 1°

7 Cauſe of the heat of the atmoſphere.

The cauſe of the heat of the atmoſphere is evidently the ſun's rays; this has been obſerved and acknowledged in all ages. The heat which they produce is leſs according as they fall more obliquely; hence the temperature conſtantly diminiſhes from the equator to the pole, becauſe their obliquity conſtantly increaſes with the latitude. But if the heat depended on the ſolar rays alone, it would diſappear in the polar regions during winter when the ſun ceaſes to riſe. This, however, is by no means the caſe; the mean temperature, even at the pole, is 31°; and we find within the arctic circle as hot weather as under the equator. The reaſon of this is, that the ſun's rays heat the earth conſiderably during ſummer: this heat it retains and gives out ſlowly during winter, and thus moderates the violence of the cold; and ſummer returns before the earth has time to be cooled down beyond a certain degree. This is the reaſon that the coldeſt weather does not take place at the winter ſolſtice, but ſome time after when the temperature of the earth is loweſt; and that the greateſt heat takes place alſo ſome conſiderable time after the ſummer ſolſtice, becauſe then the temperature of the earth is higheſt. For pure air is not heated by the ſolar rays which paſs through it, but acquires ſlowly the temperature of the earth with which it is in contact. This is the reaſon why the temperature decreaſes according to the elevation above the level of the ſea (A).

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* Temperature of Latitudes, page 45.

† Ibid. page 43.

8 And of the difference between the temperature on land and ſea.

Since the atmoſphere is heated by contact with the ſuperficies of the earth, its temperature muſt depend upon the capacity of that ſuperficies for receiving and tranſmitting heat. Now this capacity differs very much in land and water. Land, eſpecially when dry, receives heat with great readineſs, but tranſmits it through its own ſubſtance very ſlowly. Dr Hailes found, that in 1724, when the air and ſurface of the earth were both at 88°, a thermometer placed only two inches below the ſurface ſtood at 85; another 16 inches below the ſurface, at 70°; and another 24 inches deep, at 68°. The two laſt mentioned thermometers retained the ſame temperature till the end of the month, though the temperature of the air frequently varied, and then fell only to 63° or 61°. The earth, at about 80 or 90 feet below its ſurface, conſtantly retains the ſame temperature: and this is nearly equal to the mean annual heat of the country. Hence the mean annual temperature of any country may be found out pretty accurately, by examining the heat of deep wells or ſprings. Water, on the contrary, receives heat ſlowly, on account of its tranſparency; but what it does receive, is very quickly tranſfuſed through the whole maſs.

Land is often heated and cooled to a much greater degree than ſea is. Dr Raymond often found the earth in the neighbourhood of Marſeilles heated to 170°, but he never found the ſea above 77°; in winter the earth was often cooled down to 14°, but the ſea never lower than 45°. The ſea atmoſphere, therefore, ought to preſerve a much more uniform temperature than the land atmoſphere; and we find this in fact to be the caſe. The cauſe of the greater equability of water than land is evident. In ſummer the ſurface of the ſea is conſtantly cooled down by evaporation; and in winter, whenever the ſurface is cooled, it deſcends to the bottom from its increaſed gravity, and its place is ſupplied by warmer water. This proceſs goes on continually, and the winter is over before the atmoſphere has been able to cool down the water beyond a certain degree. It muſt be remembered alſo, that water has a greater capacity for heat than land has, and therefore is longer either in heating or cooling.

Theſe obſervations will enable us to explain the difference which takes place between the annual temperature of the atmoſphere above the ocean and that of places at ſome conſiderable diſtance from it. As the ſea is never heated ſo highly as the land, the mean ſummer temperature at ſea may be conſidered, all over the world, as lower than on land. During winter, when the power of the ſun's rays in a great meaſure ceaſes, the ſea gives out heat to the air much more readily than the earth; the mean winter temperature, therefore, at ſea is higher than on land; and in cold countries the difference is ſo great, that it more than counterbalances the difference which takes place in ſummer; ſo that in high latitudes the mean annual temperature ought to be greater at ſea than on land. Accordingly from lat. 70° to 35°, to find the temperature of a place, the ſtandard temperature for the ſame latitude ought, according to Dr Kirwan, to be depreſſed ⅓d of a degree for every 50 miles diſtance; for the cold which takes place in winter always increaſes in proportion to the diſtance from the ſtandard. At a leſs diſtance than 50 miles the temperatures of land and ſea are ſo blended together by ſea and land winds, that there is little difference in the annual mean. In lower latitudes than 30°, the rays of the ſun, even in winter, retain conſiderable power: the ſurface of the earth is never cooled very low, conſequently the difference between the annual temperatures of the ſea and land becomes leſs. As we approach nearer to the equator, the power of the ſolar rays during winter increaſes ſo that the mean winter temperature of the land atmoſphere approaches nearer and nearer to that of the ſea, till at laſt at the equator it equals it. After we paſs lat. 30°, therefore, the mean annual land temperature gradually exceeds that of the ſea more and more till at the equator it exceeds it a degree for every 50 miles diſtance.

Such then, in general, is the method of finding the mean annual temperature over the globe. There are, however, ſeveral exceptions to theſe general rules, which come now to be mentioned.

9 Temperature of the northern Pacific Ocean.

That part of the Pacific ocean which lies between north lat. 52° and 66° is no broader at its northern extremity than 42 miles, and at its ſouthern extremity than 1300 miles; it is reaſonable to ſuppoſe, therefore, that its temperature will be conſiderably influenced by the ſurrounding land, which conſiſts of ranges of mountains covered, a great part of the year, with ſnow: and there are beſides a great many high, and conſequently cold, iſlands ſcattered through it. For theſe reaſons Mr Kirwan concludes, that its temperature is at leaſt 4 or 5 degrees below the ſtandard. But we are not yet furniſhed with a ſufficient number of obſervations to determine this with accuracy.

10 Of the ſouthern hemiſphere.

It is the general opinion, that the ſouthern hemiſphere, beyond the 40th degree of latitude, is conſiderably colder than the correſponding parts of the northern hemiſphere. The cauſe of this we ſhall endeavour to aſſign in the article WIND.

11 Of ſmall ſeas.

Small ſeas ſurrounded with land, at leaſt in temperate and cold climates, are generally warmer in ſummer and colder in winter than the ſtandard ocean, becauſe they are a good deal influenced by the temperature of the land. The Gulph of Bothnia, for inſtance, is for the moſt part frozen in winter; but in ſummer it is ſometimes heated to 70°, a degree of heat never to be found in the oppoſite part of the Atlantic*. The German ſea is above three degrees colder in winter, and five degrees warmer in ſummer, than the Atlantic ‡. The Mediterranean Sea is, for the greater part of its extent, warmer both in ſummer and winter than the

* Mem. Stock. 1776.

‡ Kirwan's Temperature of Lat. p. 53.

(A) It was ſome time ago the favourite opinion of philoſophers, that the heat of the earth was derived from a maſs of fire in its centre. But there does not ſeem any probability in the opinion, as the heat of the earth does not increaſe the deeper we go, but remains conſtant nearly at the mean heat of the place. In the mine of Joachimſtahd in Bohemia, one of the deepeſt exiſting, Mr Monnet found the temperature at the depth of 1700 feet to be 50°. The temperature of the earth has even been found to diminiſh the deeper we go, though never lower than 36°.

the Atlantic, which therefore flows into it. The Black Sea is colder than the Mediterranean, and flows into it ‡.

12 Temperature of North America. The eaſtern parts of North America are much colder than the oppoſite coaſt of Europe, and fall ſhort of the *ſtandard* by about 10° or 12°, as appears from American Meteorological Tables. The cauſes of this remarkable difference are many. The higheſt part of North America lies between the 40th and 50th degree of north latitude, and the 100th and 110th degree of longitude weſt from London; for there the greateſt rivers originate. The very height, therefore, makes this ſpot colder than it otherwiſe would be. It is covered with immenſe foreſts, and abounds with large ſwamps and moraſſes, which render it incapable of receiving any great degree of heat; ſo that the rigour of winter is much leſs tempered by the heat of the earth than in the old continent. To the eaſt lie a number of very large lakes; and farther north Hudſon's Bay; about 50 miles on the ſouth of which there is a range of mountains which prevent its receiving any heat from that quarter. This bay is bounded on the eaſt by the mountainous country of Labrador and by a number of iſlands. Hence the coldneſs of the north-weſt winds and the lowneſs of the temperature. But as the cultivated parts of North America are now much warmer than formerly, there is reaſon to expect that the climate will become ſtill milder when the country is better cleared of woods, though perhaps it will never equal the temperature of the old continent.

13 Of iſlands and ſtony countries. Iſlands are warmer than continents in the ſame degree of latitude; and countries lying to the windward of extenſive mountains or foreſts are warmer than thoſe lying to the leeward. Stones or ſand have a leſs capacity for heat than earth has, which is always ſomewhat moiſt; they heat or cool, therefore, more rapidly and to a greater degree. Hence the violent heat of Arabia and Africa, and the intenſe cold of Terra del Fuego. Living vegetables alter their temperature very ſlowly, but their evaporation is great; and if they be tall and cloſe, as in foreſts, they exclude the ſun's rays from the earth, and ſhelter the winter ſnow from the wind and the ſun. Woody countries, therefore, are much colder than thoſe which are cultivated.

Thus we have endeavoured to aſcertain the mean temperature of every climate, and to aſſign the cauſes by which that temperature is governed. Mr Kirwan, in his admirable Treatiſe on the Temperature of Different Latitudes, has done much to reduce this part of meteorology to regularity, and to ſubject it to calculation; and he has in ſome meaſure ſucceeded. To enable our readers to judge how far his rules agree with facts, we ſhall ſubjoin a table of the mean temperature of a variety of places drawn up from actual obſervations.

Table of the Mean Temperature of different Places.

Latitude.		Years of Obſervation.	Places.	Mean Heat of the Ther.
11°	20	10	Chandernagor*	92°
11	56	4	Pondicherry*	85
13	5	2	Madras*	82,4
20	10	10	Iſle of France*	80,6
39	54	6	Pekin*	54,7
41	54	6	Rome ‡	60
42	36	7	Baſtia*	68,4
42	44	12	Perpignan*	59,6
43	16	8	Rieux*	56,9
43	18	13	Marſeilles*	58,5
43	37	11	Montpellier*	59,4
43°	50	36	Lucca†	60,8
43	51	5	Niſmes*	60,3
44	50	16	Bourdeaux*	56,3
45	22	7	Padua*	53,8
		6	St Gothard*	30
45	28	16	Milan §	54,9
46	31	10	Lauſanne ‖	48,5
46	35	15	Poitiers*	52,7
47	12	13	Chinon*	53,6
47	14	11	Beſançon*	51,3
48	27	12	Chartres*	50,7
48	31	12	St Brieux*	52,47
48	50	28	Paris*	52,47
48	56	6	Ratiſbon*	49,1
48	59	22	Montmorenci*	50,9
49	26	6	Manheim*	51,5
49	46	24	Neufchatel*	50,9
50	17	14	Arras*	48,2
50	51	5	Breda*	51,1
51	31	19	London ¶	50,6
51	41	7	Copenhagen*	51,1
52	4	8	Hague*	51,8
52	30	15	Lynden § §	48,3
52	32	11	Berlin*	49,1
53	11	13	Franeker*	52,25
55	45	4	Moſcow*	40,1
57		3	Nain*	27,5
59	20	15	Stockholm*	44,37
59	56	18	Peterſburg ‡ ‡	39,5
60	27	10	Abo*	41,9
			AMERICA.	
			Peru*	77
6°	16′	2	Surinam*	77,9
16	20		Guadaloupe*	83
		20	Leogane, St Domingo*	79
37	10	3	Williamſburgh*	58
39	57		Philadelphia † †	52,5
42	25	3	Cambridge*	48
46	55	4	Quebec*	41,9

14 Cauſes of the daily variations of temperature. As to the daily variations of the temperature of the atmoſphere, they are owing to a variety of cauſes; many of which are probably unknown. Some of them, however, are the following: 1. Wind. It is evident that winds flowing from cold countries muſt produce cold, and from hot countries heat and that whatever has a tendency to produce ſuch winds muſt be the cauſe of unuſual cold or heat.—2. Evaporation. Water always abſorbs a quantity of heat when it aſſumes the ſtate of vapour. Hence the coldneſs of marſhy countries, and the cold which we often experience during and after violent rains. Hence alſo we may expect a cold winter after a rainy ſummer, becauſe the unuſual evaporation carries off the heat of the earth.—3. Vapour, when condenſed, gives out a quantity of heat; a country, therefore, may be heated by the condenſation over it of vapour brought from a diſtance. Hence the ſultrineſs often felt before rain.—4. Vapours, when they remain long over any country, may produce cold by obſtructing the paſſage of the ſun's rays to the earth. To this cauſe Dr Franklin aſcribed the very ſevere winter which followed 1783; a year remarkable for the thick fog which overſpread Europe and

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‡ Ibid.

* P. Cotte Journal de Phyſique, July 1791.

‡ Abbé de Condrilli.

† M. Steſano Conti.

§ The Aſtronomers.

‖ Dr Verdeil.

¶ Phil. Tranſ.

§ § Mr Barker.

‡ ‡ Edin. Tranſ. vol. ii. p. 229.

† † Mem. Stock. 1771

America during ſeveral months.—5. When, from any of theſe cauſes, the winter has been ſeverer than uſual, prodigious quantities of ice may accumulate about the pole, which may contribute ſomething perhaps towards lowering the temperature of ſeveral ſucceeding years.

15
Of WINDS

II. The winds evidently have a very great influence on the weather; the cauſes which produce them, therefore, ought to be examined with the greateſt attention. Were we able to regulate their motions, we might, in a great meaſure, mould the climate of any country according to our pleaſure; were able to foreſee them, it would be of the greateſt importance to navigation and agriculture. In the torrid zone, where they are regular, the mean annual temperature remains almoſt always the ſame; their irregularity increaſes as we approach the pole, and in the ſame manner the difference between the mean annual temperature increaſes with the latitude.

Wind is produced chiefly by the action of the ſun on the atmoſphere; there are many other cauſes, however, and ſome perhaps of which we are yet ignorant. But we ſhall reſerve this part of our ſubject, on account of its importance and extent, for a ſeparate article.

16
Of RAIN.

III. We come now to the moſt difficult part of our ſubject, the phenomena and cauſes of rain. It has been long known, that water is conſtantly riſing from the whole ſurface of the globe, in the form of vapour, and mixing with the atmoſphere. Evaporation has been aſcribed to various cauſes; but the greater number of philoſophers have for ſome time paſt acquieſced in the theory firſt advanced by Dr Halley, that it was produced by a real ſolution of water in air, juſt as ſugar or ſalt is diſſolved in water. This theory is ſupported by a great many very plauſible arguments, which at the firſt view ſeem to eſtabliſh its truth.—Theſe arguments, however, are not all of them ſo concluſive as they appear. Thus it was thought, that becauſe evaporation was promoted by heat, and retarded by cold, it bore an exact reſemblance to the ſolution of ſalts in liquids: but it is now known that evaporation is not ſo much retarded by cold as was at firſt ſuppoſed; that in ſome circumſtances it is even promoted by it; and that it does not depend ſo much upon the abſolute degree of heat or cold, as upon the difference of temperature between the atmoſphere and the evaporating ſurface. Beſides, water evaporates much more rapidly in a vacuum than in the open air, which could not poſſibly be the caſe if evaporation were owing to the ſolution of water in air.

17
Cauſes of evaporation.

Evaporation, then, cannot be owing to ſolution of water in air; it is produced by the combination of a certain quantity of caloric with the particles of water, by which it is converted into an elaſtic fluid lighter than air, which therefore immediately aſcends and mixes with the atmoſphere. This was long ago ſhown by Dr Black to be the way in which ſteam or the vapour ariſing from boiling water is produced. The ſame principles were afterwards applied by Mr De Luc to ſpontaneous evaporation; and the proofs upon which this theory reſts are quite convincing. But though evaporation is not produced by air, vapour would very ſoon condenſe and return to its former ſtate by contact with colder bodies, unleſs it were attracted and ſupported by air.

18
Qualities of vapour.

We are indebted to the experiments of Sauſſure and De Luc for much of our knowledge of the qualities of vapour. It is an elaſtic inviſible fluid like common air, but lighter; being to common air, according to Sauſſure, as 10 to 14, or, according to Kirwan, as 10 to 12: it cannot paſs beyond a certain maximum of denſity, otherwiſe the particles of water which compoſe it unite together, and form ſmall, hollow, viſible veſicles, called *veſicular vapour*; which is of the ſame ſpecific gravity with atmoſpherical air. It is of this vapour that clouds and fogs are compoſed. This maximum increaſes with the temperature; and at the heat of boiling water is ſo great, that ſteam can reſiſt the whole preſſure of the air, and exiſt in the atmoſphere in any quantity. See METEOROLOGY, n° 7—23.

19
Quantity of vapour raiſed annually.

Evaporation, at leaſt in our climate, is about four times greater during the ſummer than the winter half-year, other things being equal, it is ſo much the more abundant the greater the difference is between the temperature of the air and of the evaporating ſurface; ſo much the leſs, the nearer they approach to the ſame temperature; and leaſt of all when they actually arrive at it. Whenever the atmoſphere is more than 15 degrees colder than the evaporating ſurface, little evaporation takes place at all. Evaporation is powerfully promoted by winds, eſpecially cold winds blowing into warm countries, or warm winds blowing into cold countries*. Tracts of land covered with trees or vegetables emit more vapour than the ſame ſpace covered with water. From the experiments of Mr Williams, the quantity appears to be one-third more ‡. But the method in which theſe experiments were made (the ſame objection lies againſt ſeveral of Dr Hailes's experiments, the original diſcoverer of the fact) prevented him from aſcertaining exactly the quantity of vapour emitted by plants. He made the plants grow in a box well cloſed up from the air, meaſured the quantity of water with which he ſupplied them, and at the end of the experiment weighed the box and the plants themſelves. By this means he knew pretty accurately the quantity of water which the plants had abſorbed, and which had afterwards diſappeared; and all this he concluded had been emitted by the plants in the ſtate of vapour. But it is well known that plants have the power of decompounding water, of retaining the hydrogen, and throwing off the oxygen. A part of the water then was decompounded and changed into air; and the quantity of this ought to have been aſcertained and ſubtracted. Still, however. the quantity of vapour emitted by vegetables is very great. Evaporation is promoted by heat, and is therefore much greater in the torrid zone than in our latitudes. There, too, the difference between the quantities in ſummer and winter is much leſs than in our climate, becauſe the difference between the temperature of the two ſeaſons is leſs. Animals alſo are continually throwing off vapour by inſenſible perſpiration; the quantity of which is exceedingly different, according to the climate, ſeaſon, and temperament, and cannot therefore be calculated exactly. According to Keil, a ſingle man perſpires 31 ounces of vapour in 24 hours, and conſequently 707 pounds of water in a year. The quantity of vapour then which is emitted by animals alone muſt be very great.

From an experiment made by Dr Watſon in England, during ſummer, when the earth had been burnt up by a month's drought without rain, it appears that 1600 gallons of water were evaporated from a ſingle acre in 12 hours.—If we were to ſuppoſe that this repreſented the mean daily evaporation all over the globe, it would be eaſy to calculate the quantity of water annually evaporated from the whole of its ſurface. And if we conſider the ſtate of the earth when the experiment was made, the ſituation of England nearer the pole than the equator, and the evaporation conſtantly going on from animals and vegetables, which is not taken in, we will ſurely not think the mean aſſumed too great. 1600 gallons in 12 hours is 3200 in 24 hours. Let us call it only 3000, which is equal to 693,000 cubic inches. An acre contains 272,640 ſquare inches; ſo that the daily evaporation from every ſquare inch will be about .11 of a cubic inch. This in a year will amount to ſomewhat more than 40 cubic inches for every ſquare inch. From the experiments of Mr Williams *, it appears, that in Bradford in New England, the evaporation during 1772 amounted to 42,65 inches; but from the way that his experiments were conducted, the amount was probably too great. Theſe experiments, however, ſerve to ſhow, that our calculation is not perhaps very remote from the truth. 40 inches from every ſquare inch on the ſuperficies of the globe makes 107,942 cubic miles, equal to the water annually evaporated over the whole globe.

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* Temperat. of Latitudes, p. 12.

‡ Tranſ. Philad. vol. ii. p. 121.

* Tranſ. Philad. vol. ii. p. 135.

20
Quantity contained in the atmoſphere at once.

Were this prodigious maſs of water all to ſubſiſt in the atmoſphere at once, it would increaſe its maſs by about a twelfth, and raiſe the barometer nearly three inches. But this never happens, no day paſſes without rain in ſome part of the earth; ſo that part of the evaporated water is conſtantly precipitated again. Indeed it would be impoſſible for the whole of the evaporated water to ſubſiſt in the atmoſphere at once, at leaſt in the ſtate of vapour.

M. De Sauſſure has ſhown, that when the thermometer is at 66°, a cubic foot of air cannot contain more vapour than what is equivalent to 8 grains of water. If more than this be added, it will paſs its maximum, be converted into veſicular vapour, and at laſt fall down in drops of rain. At the temperature of 32° a cubic foot of air can contain only 4 grains, and the quantity it can contain is increaſed .1109 of a grain by every additional degree of heat. Suppoſing then that the whole atmoſphere was ſaturated with water, it would not amount to the hundredth part of the quantity of water evaporated annually.

21
Never amounts to its maximum.

The quantity of vapour exiſting in the atmoſphere is indicated by the hygrometer. Water has the property of arriving at a ſtate of equilibrium in hygroſcopic ſubſtances: that is, ſuppoſing a certain quantity of water attached to a hygroſcopic ſubſtance, if another hygroſcopic ſubſtance be brought into contact with it containing leſs water, ſome of the water attached to the firſt ſubſtance will leave it, and attach itſelf to the other, till both contain the ſame proportion of water. Air is a hygroſcopic ſubſtance, and ſo is every thing of which hygrometers are made. Now the hygrometer never points at extreme moiſture while the air continues tranſparent, and conſequently contains nothing but inviſible vapour; the atmoſphere therefore, while tranſparent, never contains the greateſt poſſible quantity of vapour.

The higher regions of the atmoſphere contain leſs vapour than the ſtrata near the ſurface of the earth. This was obſerved both by M. De Sauſſure and M. De Luc, who mentions ſeveral ſtriking proofs of it. See METEOROLOGY, n° 10, &c.

At ſome height above the tops of mountains the atmoſphere is probably ſtill drier; for it was obſerved both by Sauſſure and De Luc, that on the tops of mountains the moiſture of the air was rather leſs during the night than the day. And there can be little doubt that every ſtratum of air deſcends a little lower during the night than it was during the day, owing to the cooling and condenſing of the ſtratum neareſt the earth. Vapours, however, muſt aſcend very high, for we ſee clouds forming far above the tops of the higheſt mountains.

22
Formation of clouds

Rain never begins to fall while the air is tranſparent: the inviſible vapours firſt paſs their maximum, and are changed into veſicular vapours; clouds are formed, and theſe clouds gradually diſſolve in rain. Clouds, however, are not formed in all parts of the horizon at once; the formation begins in one particular ſpot, while the reſt of the air remains clear as before: this cloud rapidly increaſes till it overſpreads the whole horizon, and then the rain begins.

It is remarkable, that though the greateſt quantity of vapours exiſt in the lower ſtrata of the atmoſphere, clouds never begin to form there, but always at ſome conſiderable height. It is remarkable, too, that the part of the atmoſphere at which they form has not arrived at the point of extreme moiſture, nor near that point even a moment before their formation. They are not formed then, becauſe a greater quantity of vapour had got into the atmoſphere than could remain there without paſſing its maximum. It is ſtill more remarkable, that when clouds are formed, the temperature of the ſpot in which they are formed is not always lowered, though this may ſometimes be the caſe. On the contrary, the heat of the clouds themſelves is ſometimes greater than that of the ſurrounding air §. Neither then is the formation of clouds owing to the capacity of air for combining with moiſture being leſſened by cold: ſo far from that, we often ſee clouds, which had remained in the atmoſphere during the heat of the day, diſappear in the night, after the heat of the air was diminiſhed.

§ De Luc ſur la Meteorol. vol. ii. p. 100.

23
And rain cannot be accounted for.

The formation of clouds and rain, then, cannot be accounted for by a ſingle principle with which we are acquainted. It is neither owing to the ſaturation of the atmoſphere, nor the diminution of heat, nor the mixture of airs of different temperatures, as Dr Hutton ſuppoſes; for clouds are often formed without any wind at all either above or below them; and even if this mixture conſtantly took place, the precipitation, inſtead of accounting for rain, would be almoſt imperceptible.

It is a very remarkable fact, that evaporation often goes on for a month together in hot weather without any rain. This ſometimes happens in this country; it happens every year in the torrid zone. Thus at Calcutta, during January 1785, it never rained at all *: the mean of the thermometer for the whole month was 66½ degrees; there was no high wind, and indeed during great part of the month little wind at all.

* Aſiat. Reſearches, vol. ii. Appendix.

24
Vapour diſappears,

The quantity of water evaporated during ſuch a drought muſt be very great; yet the moiſture of the air, inſtead of being increaſed, is conſtantly diminiſhing, and at laſt diſappears almoſt entirely. For the dew, which is at firſt copious, diminiſhes every night; and if Dr Watſon's experiment formerly mentioned be attended to, it will not be objected that the quantity of evaporation is alſo very much diminiſhed. Of the very dry ſtate to which the atmoſphere is reduced during long droughts, the violent thunder-ſtorms with which they often conclude is a proof, and a very deciſive one. Now what becomes of all this moiſture? It is not accumulated in the atmoſphere above the country from which it was evaporated, otherwiſe the whole atmoſphere would in a much leſs period than a month be perfectly ſaturated with moiſture. If it be carried up daily through the different ſtrata of the atmoſphere, and wafted to other regions by ſuperior currents of air, how is it poſſible to account for the different electrical ſtate of the clouds ſituated between different ſtrata, which often produces the moſt violent thunder-ſtorms? Are not vapours conductors of the electric fluid; and would they not have daily reſtored the equilibrium of the whole atmoſphere through which they paſſed? Had they traverſed the atmoſphere in this manner, there would have been no negative and poſitive clouds, and conſequently no thunder-ſtorms. They could not have remained in the lower ſtrata of the atmoſphere, and been daily carried off by winds to other countries; for there are often no winds at all during ſeveral days to perform this office: nor in that caſe would the dews diminiſh, nor could their preſence fail to be indicated by the hygrometer.

25
And aſſumes a new form in the atmoſphere.

It is impoſſible for us to account for this remarkable fact upon any principle with which we are acquainted. The water can neither remain in the atmoſphere, nor paſs thro' it in the ſtate of vapour. It muſt therefore aſſume ſome other form; but what that form is, or how it aſſumes it, we know not.

26
Its converſion into oxygen and hydrogen improbable.

It will immediately occur to every body, that vapour is decompoſed in the atmoſphere, and changed into oxygen and hydrogen gas. But is it true that a greater quantity of oxygen exiſts in the atmoſphere after a long drought than immediately after rain? Have ſuch prodigious quantities of hydrogen been found in the atmoſphere as muſt always exiſt in it if this hypotheſis were true? Has any hydrogen ever been found in analyzing atmoſpheric air? Or if hydrogen, from its lightneſs, aſcends to the higher regions of the atmoſphere, what cauſes it to deſcend at particular times, contrary to that lightneſs, in order to come into contact with oxygen? Do not clouds often form on mountains round the habitations of men? Yet has the preſence of hydrogen been ever aſcertained by any phenomena? Would it not produce dangerous conflagrations when it came into contact with fire? But has this been the caſe in a ſingle inſtance? If this hypotheſis were true, could rain take place at all without a conflagration in the atmoſphere? Yet has any ſuch conflagration been ever obſerved? The hypotheſis, then, that vapour is changed into oxygen and hydrogen in the atmoſphere, and that rain is produced by the reunion of theſe elements, cannot be admitted, though it is not improbable that ſome ſmall part of it actually undergoes this change. See WIND.

We do not take notice of M. De Luc's conjecture about the compoſition of the atmoſphere, becauſe it is not ſupported by a ſingle proof, and becauſe he refuſes to believe the analyſis of the atmoſphere reſulting from the very deciſive experiments of Scheele, Lavoiſier, and Prieſtley, though he has ſeen them often performed, and has nothing to urge againſt their force. There is no philoſopher to whom meteorology lies under greater obligations than to M. De Luc. His diſcoveries have been many and important, his experiments ingenious, and his application unwearied; but his conjectures are like thoſe of every other man who attempts to fathom the wiſdom of the Almighty. Were we poſſeſſed of an underſtanding equal to that of the Author of Nature, we might expect, with reaſon, to dive by our conjectures into the myſteries of his operations; but in our preſent ſtate they are vain.

Evaporation goes on longeſt without producing rain in the torrid zone, where the heat is greateſt; it goes on longeſt alſo in every place in ſummer, when the heat is alſo greateſt: heat therefore ſeems to be an agent.

27
Theory of rain imperfect.

There are then two ſteps of the proceſs between evaporation and rain, of which at preſent we are completely ignorant: 1. What becomes of the vapour after it enters into the atmoſphere? 2. What makes it lay aſide the new form which it muſt have aſſumed, and return again to its ſtate of vapour, and fall down in rain? And till theſe two ſteps be diſcovered by experiments and obſervations, it will be impoſſible for us to give a rational or a uſeful theory of rain.

28
Whether owing to electricity.

It has for ſome time paſt been the opinion of philoſophers, that electricity is the principal agent in producing rain; and M. Bertholon aſſures us, that by raiſing proper conductors to draw off the electrical matter from the atmoſphere, the quantity of rain may be diminiſhed at pleaſure. That the electric fluid acts a very important part in nature, cannot be doubted, and it is not improbable that it may be the agent in producing rain. This ſuppoſition indeed is ſupported by many facts. Dew at leaſt exhibits a great many electrical phenomena; it is attracted by points, and attaches itſelf to ſome ſubſtances, while it avoids others. Whenever there are no clouds, the electricity of the atmoſphere is always poſitive; but the formation of clouds produces conſiderable changes in the ſtate of its electricity. The atmoſphere alſo gives ſigns of electricity conſtantly during rain; and clouds are evidently attracted by mountains. In what manner, however, the electrical fluid produces rain (if it is the agent at all) is ſtill unknown. Some philoſophers aſſure us, that clouds are induced to diſſolve in rain by becoming negative, others by becoming ſtrongly poſitive, and both ſupport their opinion by experiments. We do not ſee the analogy, however, between clouds and plates of metal covered with drops of water. And even if their opinion were well founded, the production of the clouds themſelves would remain to be accounted for.

29
Quantity of rain different according to the latitude,

The mean annual quantity of rain is greateſt at the equator, and decreaſes gradually as we approach the poles.

Thus at	* Granada, Antilles,	12° N. lat.		it is 126 inches.
	* Cape François, St Domingo	19°	46′	120
	‡ Calcutta -	22	23	81
	* Rome -	41	54	39
	‖ England -	33		32
	¶ Peterſburgh	59	16	16

On the contrary, the number of rainy days is ſmalleſt at the equator, and increaſes in proportion to the diſtance from it. From north latitude 12° to 43° the mean number of rainy days is 78; from 43° to 46° the mean number is 103; from 46° to 50° it is 134; from 51° to 60°, 161 †.

30
Seaſon,

The number of rainy days is often greater in winter than in ſummer; but the quantity of rain is greater in ſummer than in winter ‡. At Peterſburgh, the number of rainy or ſnowy days during winter is 84, and the quantity which falls is only about five inches; during ſummer the number of rainy days is nearly the ſame, but the quantity which falls is about 11 inches ‖.

31
And ſituation.

More rain falls in mountainous countries than in plains. Among the Andes it is ſaid to rain almoſt perpetually, while in Egypt it hardly ever rains at all. If a rain-gauge be placed on the ground, and another at ſome height perpendicularly above it, more rain will be collected into the lower than into the higher; a proof that the quantity of rain increaſes as it deſcends, owing perhaps to the drops attracting vapour during their paſſage through the lower ſtrata of the atmoſphere where the greateſt quantity reſides. This, however, is not always the caſe, as Mr Copland of Dumfries diſcovered in the courſe of his experiments *. He obſerved alſo, that when the quantity of rain collected in the lower gauge was greateſt, the rain commonly continued for ſome time; and that the greateſt quantity was collected in the higher gauge only either at the end of great rains, or during rains which did not laſt long. Theſe obſervations are important, and may, if followed out, give us new knowledge of the cauſes of rain. They ſeem to ſhow, that during rain the atmoſphere is ſomehow or other brought into a ſtate which induces it to part with its moiſture; and that the rain continues as long as this ſtate continues. Were a ſufficient number of obſervations made on this ſubject in different places, and were the atmoſphere carefully analyſed during dry weather, during rain, and immediately after rain, we might ſoon perhaps diſcover the true theory of rain.

Rain falls in all ſeaſons of the year, at all times of the day, and during the night as well as the day; though, according to M. Toaldo, a greater quantity falls during the day than the night. The cauſe of rain, then, whatever it may be, muſt be ſomething which operates at all times and ſeaſons. Rain falls alſo during the continuance of every wind, but ofteneſt when the wind blows from the ſouth. Falls of rain often happen likewiſe during perfect calms.

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* Cotte Journal de Phyſique, Oct. 1791, p. 264.

‡ Aſiatic Reſearches, vol. i. & ii. Appendix.

‖ Phil. Tranſ.

¶ Edin. Tranſ. vol. ii. p. 244.

† P. Cotte ibid.

‡ Ibid.

‖ Edin. Tranſ. vol. ii. p. 244.

*Mancheſt. Tranſ. vol. iv. p. 619.

32
Mean annual quantity of rain.

It appears from a paper publiſhed by M. Cotte in the *Journal de Phyſique* for October 1791, containing the mean quantity of rain falling at 147 places, ſituated between north latitude 11° and 60°, deduced from tables kept at theſe places, that the mean annual quantity of rain falling in all theſe places is 34.7 inches. Let us ſuppoſe then (which cannot be very far from the truth) that the mean annual quantity of rain for the whole globe is 34 inches. The ſuperficies of the globe conſiſts of 170,981,012 ſquare miles, or 686,401,498,471,475,200 ſquare inches. The quantity of rain therefore falling annually will amount to 23,337,650,812,030,156,800 cubic inches, or ſomewhat more than 21,751 cubic miles of water. This is 16,191 cubic miles of water leſs than the quantity of water evaporated. It ſeems probable therefore, if the imperfection of our data warrant any concluſion, that ſome of the vapour is actually decompoſed in the atmoſphere, and converted into oxygen and hydrogen gas.

The dry land amounts to 52,745,253 ſquare miles (ſee the article Sea, n° 1.); the quantity of rain falling on it annually therefore will amount to 30,960 cubic miles. The quantity of water running annually into the ſea (ſee Sea, n° 3.) is 13,140 cubic miles; a quantity of water equal to which muſt be ſupplied by evaporation from the ſea, otherwiſe the land would ſoon be completely drained of its moiſture.

The quantity of rain falling annually in Great Britain may be ſeen from the following table:

Years of obſervation.	Places.	Rain in inches.
3	Dover § - - -	37,52
5	Ware, Hertfordſhire §	23,6
8	London † - -	17,5
8	Kimbolton ‡ -	23,9
45	Lyndon ‖ - -	22,210
5	Chatſworth, Derbyſhire §	27,865
8	Mancheſter § -	43,1
18	Liverpool § - -	34,41
7	Lancaſter § - -	40,3
5	Kendal § - -	61,223
14	Dumfries § - -	36,127
10	Branxholm, 44 miles ſouth-weſt of Berwick ¶ -	31,26
5	Langholm ¶ -	36,73
5	Dalkeith ¶ -	25,124
20	Glaſgow * -	31,
8	Hawkhill * * - -	28,966
	Mean	32,532

§ Mancheſt. Tranſ. vol. iv.

† Phil. Tranſ. Tables of Obſervations.

‡ Ibid. vol. lxxix. part 1.

‖ Mr Barker, Ibid.

¶ Edin. Tranſ. vol. i. p. 208.

* Statiſt. Account of Scotland, vol. v. p. 245.

* * Edin. Tranſ. vol. i. p. 333.

In this country it generally rains leſs in March than in November, in the proportion at a medium of 7 to 12. It generally rains leſs in April than in October in the proportion of 1 to 2 nearly at a medium. It generally rains leſs in May than September, the chances that it does ſo are at leaſt as 4 to 3; but when it rains plentifully in May (as 1.8 inches or more), it generally rains but little in September; and when it rains one inch or leſs in May, it rains plentifully in September.*

33
Of Thunder.

IV. Thunder has been explained at ſuch great length in the article Electricity, that we ſhall content ourſelves at preſent with a few remarks.

Thunder is exceedingly frequent in the torrid zone, and it ſeems to decreaſe gradually till we approach latitude 60°, or perhaps farther north. During the year 1785, for inſtance, there were 90 thunder-ſtorms at Calcutta. According to Profeſſor Muſchenbroek, it thunders at Utrecht at a medium 15 times annually: in this country the medium is conſiderably below that number. Thunder, too, ſeems to be very common in ſome polar regions. The Abbé Chappe informs us, that he obſerved thunder much more frequently at Tobolſki and in other parts of Siberia than in any other country. Muſchenbroek, however, affirms, we know not upon what authority, that it never thunders at all in Greenland and at Hudſon's Bay. Thunder-ſtorms happen almoſt always during the ſummer, and very ſeldom in winter. During the year 1785, above mentioned, it never thundered at Calcutta in January, November, nor December. In this country a thunder-ſtorm during winter is exceedingly rare.

The phenomena of thunder are now no longer a ſecret, ſince the great Franklin diſcovered the identity of lightning and electricity; a diſcovery inferior to none in the annals of philoſophy. But though we can explain the nature of thunder in general, and the manner in which it is produced, there are ſeveral difficulties ſtill remaining, which future experiments and obſervations only can remove. Air is an electric *per ſe*, and cannot therefore when dry conduct electrical matter from one part to another. We know from the experiments of Dr Franklin and others, that the atmoſphere conſtantly contains in it a quantity of electric matter. If a ſtratum of dry air were electrified poſitively, it would occaſion a negative electricity in the neighbouring ſtratum. Suppoſe now, that an imperfect conductor were to come into contact with each of theſe ſtrata, we know from the principles of electricity that the equilibrium would be reſtored, and that this would be attended with a loud noiſe, and with a flaſh of light. Clouds which conſiſt of veſicular vapours mixed with particles of air, are imperfect conductors; if a cloud therefore come into contact with two ſuch ſtrata, a thunder clap would follow. If a poſitive ſtratum be ſituated near the earth, the intervention of a cloud will, by ſerving as a ſtepping-ſtone, bring the ſtratum within the ſtriking diſtance, and a thunder clap will be heard while the electrical fluid is diſcharging itſelf into the earth. If the ſtratum be negative, the contrary effects will take place. It does not appear, however, that thunder is often occaſioned by a diſcharge of electric matter from the earth into the atmoſphere. The accidents, moſt of them at leaſt, which were formerly aſcribed to this cauſe, are now much more ſatisfactorily accounted for by Lord Stanhope's Theory of the Returning Stroke. Neither does it appear that electricity is often diſcharged into the earth, as the effects of few thunder-ſtorms are viſible upon the earth; that it is ſo ſometimes, however, is certain. The experiments of Mr Sauſſure have demonſtrated, that electrical matter is carried into the atmoſphere by ſimple evaporation; ſo that there is no difficulty in underſtanding how particular ſtrata of air may be ſupplied with a ſufficient quantity of electrical fluid to be charged poſitively; and we know that in that caſe a negative ſtate muſt be produced in the neighbouring ſtratum. In what particular manner, however, this electrical matter is accumulated in particular ſtrata of air, and how it comes to be ſeparated from the vapour to which it was united, remain ſtill ſecrets. They are intimately connected with the cauſes of evaporation and rain, whatever they may be, and probably the diſcovery of the cauſes of either would lead to that of the others.

34
Of the changes in the Gravity of the Atmoſphere.

V. The gravity of the atmoſphere was firſt demonſtrated by Torricelli, the diſciple of Galileo (ſee Pneumatics, n° 25). A column of air, the baſis of which is a ſquare inch, weighs at a medium 15 pounds. The weight of the atmoſphere is meaſured by the barometer. It is greateſt

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* Kirwan, Iriſh Tranſ. vol. v. p. 21.

35 Indicated by the barometer.

at the level of the ſea, becauſe there the column of air is longeſt: there the mean height of the barometer is 30 inches. This Sir George Shuckburg found to be the caſe in the Mediterranean and the Channel, in the temperature of 55° and 60°; Mr Bouguer, on the coaſt of Peru, in the temperature of 84°; and Lord Mulgrave, in latitude 80°. The mean height of the barometer is leſs the higher any place is ſituated above the level of the ſea, becauſe the column of air which ſupports the mercury is the ſhorter. The barometer has accordingly been uſed for meaſuring heights. It indicates, too, with a great deal of accuracy, all the variations in the gravity of the atmoſphere; falling when the atmoſphere is lighter, and riſing when it is heavier, than uſual. Theſe changes have attracted the attention of philoſophers ever ſince the diſcovery of the barometer; and many attempts have been made to explain them, ſome of which have been mentioned under the word BAROMETER. Theſe variations come naturally to be examined here, becauſe the cauſes which produce them, whatever they are, muſt have a great deal of influence on the weather.

Between the tropics the variations of the barometer are exceedingly ſmall; and it is remarkable, that in that part of the world it does not deſcend above half as much for every 200 feet of elevation as it does beyond the tropics*.—In the torrid zone, too, the barometer is elevated about two-thirds of a line twice every day; and this elevation happens at the ſame time with the tides of the ſea§.

36 Range of the barometer.

As the latitude advances towards the poles, the range of the barometer gradually increaſes, till at laſt it amounts to two or three inches. This gradual increaſe will appear from the following table:

TABLE of the Range of the Barometer.

Latitude.	Places.	Range of the Barometer,	
		Greateſt.	Annual.
0°	Peru	0,20 *	—
22 23	Calcutta	c,77 †	—
40 55	Naples	1.00 *	—
51 8	Dover	2,47 §	1,80
53 13	Middlewick	3,00 §	1,94
53 23	Liverpool	2,89 §	1,96
59 56	Peterſburg	3,45 ‡	2,77

In North America, however, the range of the barometer is a great deal leſs than the correſponding European latitudes. In Virginia, for inſtance, it never exceeds 1.1 ¶.

The range of the barometer is greater at the level of the ſea than on mountains, and in the ſame degree of latitude the extent of the range is in the inverſe ratio of the height of the place above the level of the ſea.

37 Phenomena of the variations of the barometer.

From a table publiſhed by Mr Cotte in the *Journal de Phyſique* †, it ſeems exceedingly probable that the barometer has always a tendency to riſe from the morning to the evening; and that this tendency is greateſt between two o'clock in the afternoon, and nine at night, at which hour the greateſt elevation takes place; that the elevation of nine o'clock differs from that of two by $\frac{4}{12}$ths, while that at two differs from the morning elevation only by $\frac{1}{12}$th; and that in certain climates the greateſt elevation takes place at two o'clock. We ſhall inſert a part of the table on which theſe obſervations are founded, which we have reduced to the Engliſh ſtandard.

Places.	Years of obſervation.	Mean height of Barometer.			
		Morning.	Noon.	Evening.	Year.
Arles	6	29,9347	29,9347	29,9413	29,9347
Arras	6	29,6683	26,6683	29,6832	29,6758
Bourdeaux	11	29,7212	29,8385	29,8385	29,8385
Cambray	13	29,8756	29,8682	29,8756	29,8756
Chinon	12	29,7719	29,7795	29,8001	29,7869
Dunkirk	8	29.9199	29,9347	29,9347	29,9273
Hagenau	10	29,5648	29,5648	29,5741	29,5648
Laon	7	29,3354	29,3206	29,3429	29,3354
Liſle	6	29,9165	29,9274	29,9347	29,9077
Mayenne	7	29,7172	29,7056	29,7127	29,7127
Manheim	5	29,6167	29,6018	29,6167	29,6093
Montmorenci	22	29,6536	29,6536	29,6610	29,6536
Mulhauſen	7	29,1873	29,1800	29,1873	29,1873
Obernheim	12	29,4834	29,4665	29,4764	29,4764
Paris	67	29,8902	29,8607	29,8756	29,8756
Poitiers	12	29,7276	29,7276	29,7276	29,7276
Rouen	11	29,8607	29,8535	29,8535	29,8535
Rome	3	29,8607	29,8460	29,8756	29,8607
St Maurice le Gerard	10	29,8016	29.8016	29,8090	29,8016
Troyes	10	29,6885	29.6979	29,6885	29 6885

The range of the barometer is greater in winter than in ſummer. Thus at Kendal the mean range of the barometer for five years, during October, November, December, January, February, March, was 7.982; and for the ſix ſummer months 5.447*.

In ſerene and ſettled weather it is generally high; and low in calm weather, when the air is inclined to rain; it ſinks on high winds, riſes higheſt on eaſterly and northerly winds, and ſinks when the wind blows from the ſouth †.—At Calcutta§, however, it is always higheſt when the wind blows from the north-weſt and north, and loweſt when it blows from the ſouth-eaſt.

The barometer falls ſuddenly before tempeſts, and undergoes great oſcillations during their continuance.—Mr Copeland‖ of Dumfries has remarked, that a high barometer is attended with a temperature above, and a low barometer with one below, the monthly mean. Such are the variations of the barometer as far as they have yet been obſerved. Let us now endeavour to account for them as well as we can.

38 Accounted for.

It is evident that the denſity of the atmoſphere is leaſt at the equator, and greateſt at the poles; for at the equator the centrifugal force, the diſtance from the centre of the earth, and the heat, all of which tend to diminiſh the denſity of the air, are at their maximum, while at the pole they are at their minimum. The mean height of the barometer at the level of the ſea, all over the globe, is 30 inches; the weight of the atmoſphere, therefore, is the ſame all over the globe. The weight of the atmoſphere depends on its denſity and height: where the denſity of the atmoſphere is greateſt, its height muſt be leaſt; and, on the contrary, where its denſity is leaſt, its height muſt be greateſt. The height of the atmoſphere, therefore, muſt be greateſt at the equator, and leaſt at the poles; and it muſt decreaſe gradually between the equator and the poles, ſo that its upper ſurface will reſemble two inclined planes, meeting above the equator their higheſt part*.

During ſummer, when the ſun is in our hemiſphere, the mean

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* M. Caſan Journal de Phyſique, April 1790, p. 268.

§ Ibid.

* Kirwan, Iriſh Tranſ. vol. iii. p. 47.

† Aſiatic Reſearches, vol. ii. Appendix.

§ Mancheſt. Tranſ. vol. iv.

‡ Edin. Tranſ. vol. ii. p.

¶ Tranſ. Philadel. vol. ii. p. 142.

† Aug. 1790, p. 110.

*Mancheſt. Tranſ. vol. iv. p. 547.

† Dr Halley.

§ Aſiatic Reſearches, vol. ii. Appendix.

‖ Mancheſt. Tranſ. vol. iv.

* Kirwan, Iriſh Tranſ. vol. ii. p. 43, &c.

39
By variations in the denſity of the atmoſphere.

mean heat between the equator and the pole does not differ ſo much as in winter. Indeed the heat of northern countries at that time equals the heat of the torrid zone: thus in Ruſſia, during July and Auguſt, the thermometer riſes to 85° †. Hence the rarity of the atmoſphere at the pole, and conſequently its height, will be increaſed. The upper ſurface of the atmoſphere, therefore, in the northern hemiſphere will be leſs inclined; while that of the ſouthern hemiſphere, from contrary cauſes, will be much more inclined. The very reverſe will take place during our winter.

The denſity of the atmoſphere depends in a great meaſure on the preſſure of the ſuperincumbent column, and therefore decreaſes, according to the height, as the preſſure of the ſuperincumbent column conſtantly decreaſes. But the denſity of the atmoſphere in the torrid zone will not decreaſe ſo faſt as in the temperate and frigid zones; becauſe its column is longer, and becauſe there is a greater proportion of air in the higher part of this column. This accounts for the obſervation of Mr Caſſan, that the barometer only ſinks half as much for every 200 feet of elevation in the torrid as in the temperate zones (B). The denſity of the atmoſphere at the equator, therefore, though at the ſurface of the earth it is leſs, muſt at a certain height equal, and at a ſtill greater ſurpaſs, the denſity of the atmoſphere in the temperate zones and at the poles.

In the article **Wind** we ſhall endeavour to prove, that a quantity of air is conſtantly aſcending at the equator, and that part of it at leaſt reaches and continues in the higher parts of the atmoſphere. From the fluidity of air, it is evident that it cannot accumulate above the equator, but muſt roll down the inclined plane (C) which the upper ſurface of the atmoſphere aſſumes towards the poles. As the ſurface of the atmoſphere of the northern hemiſphere is more inclined during our winter than that of the ſouthern hemiſphere, a greater quantity of the equatorial current of air muſt flow over upon the northern than upon the ſouthern atmoſphere; ſo that the quantity of our atmoſphere will be greater during winter than that of the ſouthern hemiſphere; but during ſummer the very reverſe will take place. Hence the greateſt mercurial heights take place during winter, and the range of the barometer is leſs in ſummer than in winter.

The denſity of the atmoſphere is in a great meaſure regulated by the heat of the place: wherever the cold is greateſt, there the denſity of the atmoſphere will be greateſt, and its column ſhorteſt. High countries, and ranges of lofty mountains, the tops of which are covered with ſnow the greateſt part of the year, muſt be much colder than other places ſituated in the ſame degree of latitude, and conſequently the column of air over them much ſhorter. The current of ſuperior air will linger and accumulate over theſe places in its paſſage towards the poles, and thus occaſion an irregularity in its motion, which will produce a ſimilar irregularity in the barometer. Such accumulations will be formed over the north-weſtern parts of Aſia, and over North America: hence the barometer uſually ſtands higher, and varies leſs there, than in Europe. Accumulations are alſo formed upon the Pyrenees, the Alps, the mountains of Africa, Turkey in Europe, Tartary, and Tibet. When theſe accumulations have gone on for ſome time, the denſity of the air becomes too great to be balanced by the ſurrounding atmoſphere; it ruſhes down on the neighbouring countries, and produces cold winds which raiſe the barometer. Hence the riſe of the barometer which generally attends north-eaſt winds in Europe, as they proceed from accumulations in the north-weſt of Aſia, or about the pole; hence, too, the north-weſt wind from the mountains of Tibet raiſes the barometer at Calcutta.

We ſhall endeavour to prove in the article **Wind**, that conſiderable quantities of air are, occaſionally deſtroyed in the polar regions. When this happens, the atmoſphere to the ſouth ruſhes in to fill up the void. Hence ſouth-weſt winds take place, and the barometer falls.

As the mean heat of our hemiſphere differs in different years, the denſity of the atmoſphere, and conſequently the quantity of equatorial air which flows towards the poles, muſt alſo be variable. Hence the range of the barometer is different in different years. Does this range correſpond to the mean annual heat; that is to ſay, is the range greateſt when the heat is leaſt, and leaſt when the heat is greateſt? In ſome years greater accumulations than uſual take place in the mountainous parts in the ſouth of Europe and Aſia, owing, perhaps, to earlier falls of ſnow, or to the rays of the ſun having been excluded by long continued fogs. When this takes place, the atmoſphere in the polar regions, will be proportionably lighter. Hence the prevalence of ſoutherly winds during ſome winters more than others.

As the heat in the torrid zone never differs much, the denſity, and conſequently the height of the atmoſphere, will not vary much. Hence the range of the barometer within the tropics is comparatively ſmall; and it increaſes gradually as we approach the poles, becauſe the difference of the temperature, and conſequently of the denſity, of the atmoſphere increaſes with the latitude.

The diurnal elevation of the barometer in the torrid zone correſponding to the tides, obſerved by Mr Caſſan and others, muſt be owing to the influence of the moon on the atmoſphere. This influence, notwithſtanding the ingenious attempts of D'Alembert and ſeveral other philoſophers, ſeems altogether inadequate to account for the various phenomena of the winds. It is not ſo eaſy to account for the tendency which the barometer has to riſe as the day advances, which ſeems to be eſtabliſhed by Mr Cotte's table. Perhaps it may be accounted for by the additional quantity of vapour added to the atmoſphere, which, by increaſing the quantity of the atmoſphere, may poſſibly be adequate to produce the effect.

The falls of the barometer which preceed, and the oſcillations which acompany, violent ſtorms and hurricanes, ſhow us that theſe phenomena are produced by very great rarefactions, or perhaps deſtruction of air, in particular parts of the atmoſphere. The falls of the barometer, too, that accompany winds proceed from the ſame cauſe. The obſervation made by Mr Copland, that a high barometer is accompanied by a temperature above the mean, will be eaſily accounted for by every one acquainted with Dr Black's theory of latent heat. The higher the mercury ſtands, the denſer the atmoſphere muſt be; and the denſer it becomes, the more latent heat it muſt give out. It is well known that air evolves heat when condenſed artificially.

The

† Dr Guthrie, Edin. Tranſ. vol. ii. p. 229.

(B) Should it not be examined whether the number of parts which the mercury ſinks for every 200 feet of elevation be not proportioned to the latitude of the place?

(C) It is of no conſequence whether the ſurface of the atmoſphere actually forms an inclined plan, or, becoming rarer in a very ſlow ratio (as is probably the caſe), aſcends much higher than the place at which the equatorial currents begin to flow towards the poles; for ſtill the different heights of air of the ſame denſity in different parts of the atmoſphere will in fact form an inclined plane, over which theſe currents will roll, notwithſtanding the very rare air which they may diſplace.

The falling of the barometer which generally precedes rain remains ſtill to be accounted for; but we know too little about the cauſes by which rain is produced to be able to account for it in a ſatisfactory manner. Probably a rarefied ſtate of the atmoſphere is favourable to the production of rain; we know, at leaſt, that it is favourable to evaporation. Suppoſing the obſervations which we made upon the changes which vapour undergoes in the atmoſphere well founded, may not the vapour in its new form accumulate at a conſiderable height in the atmoſphere? and is not the height at which clouds are always formed a proof of this? May not this ſubſtance, whatever it is, when by ſome means or other it returns to the ſtate of vapour, paſſes its maximum, and begins to fall in drops of rain, and conſequently is no longer ſupported by the atmoſphere, cauſe the barometer to fall ſuddenly, at leaſt till new air ruſhes in to ſupply its place?

40
OF PROGNOSTICATING THE WEATHER.

THUS we have endeavoured to deſcribe the various phenomena of the weather, and to account for them as far as the preſent ſtate of our meteorological knowledge enables us to go.

It will be expected that we ſhould not paſs by unnoticed that branch of meteorology which has in all ages attracted the attention of mankind, and in which, indeed, every other part of the ſcience, as far as utility is concerned, evidently centres; we mean the method of prognoſticating the weather. All philoſophers who have dedicated their attention to meteorology, have built upon the hope of being able to diſcover, by repeated obſervations, ſome rules concerning the periods of the ſeaſons and the changes of the weather, convinced that ſuch diſcoveries would be of the higheſt utility, eſpecially in agriculture; for by foreſeeing, even in part, the circumſtances of the ſeaſons, we would have it in our power to prevent at leaſt a part of the loſſes ariſing from them, as by ſowing, for inſtance, the kind of corn beſt adapted for the rain or the drought which is to enſue.

41
Moon ſuppoſed to influence the weather;

The influence of the moon on the weather has in all ages been believed by the common people; the ancient philoſophers embraced the ſame opinion, and engrafted upon it their pretended ſcience of aſtrology. Several modern philoſophers have thought the opinion worthy of notice; among whom Meſſrs Lambert, Cotte, and Toaldo, deſervedly take the lead. Theſe philoſophers, after examining the ſubject with the greateſt attention, have embraced the opinion of the common people, though not in its full extent. To this they have been induced both by the certainty that the moon actually has an influence on the atmoſphere as it has on the ſea, and by obſerving that certain ſituations of the moon in her orbit have almoſt conſtantly been attended with changes of the weather either to wind, to calm, to rain, or to drought.

42
Eſpecially in ten ſituations,

There are ten ſituations in every revolution of the moon in her orbit, when ſhe muſt particularly exert her influence on the atmoſphere, and when conſequently changes of the weather muſt readily take place. Theſe are (1) the new and (2) full moon, when ſhe exerts her influence in conjunction with or oppoſition to the ſun; (3 and 4) the quadratures: (5) the perigee and (6) apogee (for the difference in the moon's diſtance from the earth is about 27,000 miles), the two paſſages of the moon over the equator, one of which, Mr Toaldo calls (7) the *moon's aſcending*, and (8) the other the *moon's deſcending equinox*, the two luniſtices as M. de la Lande has called them, (9) the *boreal luniſtice*, when the moon approaches as near as ſhe can in each lunation to our zenith, (10) the *auſtral*, when ſhe is at the greateſt diſtance from it, for the action of the moon varies greatly according to her obliquity. With theſe ten points Mr Toaldo compared a table of 48 years obſervations for Lombardy, and found the reſult as follows:

Lunar Points.	Attended with a change of weather.	Attended with no change.	Proportion reduced to the loweſt terms.
New moons -	522	82	6 : 1
Full moons - -	506	92	5 : 1
Firſt quarters	424	189	2½ : 1
Laſt quarters -	429	182	2½ : 1
Perigees -	546	99	7 : 1
Apogees - -	517	130	4 : 1
Aſcending equinoxes	465	142	3¼ : 1
Deſcending equinoxes	446	152	2¾ : 1
Southern luniſtices	446	154	3 : 1
Northern luniſtices	448	162	2¾ : 1

And after examining a number of other tables of obſervations, and combining them with his own, he found the proportions between thoſe lunar points on which changes of the weather took place, and thoſe which paſſed without any change when reduced to the loweſt terms, to be as in the laſt column of the above table: ſo that we may wager ſix to one, that this or that new moon will bring a change of weather, and five to one that a full moon will be attended by a change, and ſo on. Several of theſe lunar points often coincide with one another, occaſioned by the inequality of the moon's periodical, anomaliſtical, and ſynodical revolutions, and by the progreſſive motion of the apſes. Thus the new and full moon ſometimes coincide with the apogees, the perigees, &c. Theſe coincidences are the moſt efficacious. Their changing power, according to Mr Toaldo, is as follows:

New moon coinciding with the perigee	33 : 1
———————with the apogee	7 : 1
Full moon coinciding with the perigee	10 : 1
——————— —with the apogee	8 : 1

It ought to be remarked, that theſe changes of the weather ſeldom or never take place exactly when the moon is in theſe lunar points, but ſometime before or after; juſt as the tide, ſay the philoſophers who contend for the influence of the moon, is not at its height till after the moon has paſſed the meridian.

43
And to occaſion a period of ten years,

The power of the moon over the ocean and the atmoſphere is diſplayed in a particular manner during the apſes, in conſequence of her different diſtances from the earth during theſe two ſituations. Now the apſes advance about 40° in the zodiac every year, and complete a revolution in about eight years and ten months. It is probable that the ſeaſons and the conſtitutions of years have a period nearly equal to this revolution, and that therefore nearly the ſame ſeaſons return every ten years. This periodical return of the ſeaſons, as Pliny (D) ſeems to inform us, was obſerved by the ancients. Mr Toaldo found, that in Lombardy the quantities of rain which fell during periods of nine ſucceſſive years were nearly equal; but that this was not true of other periods, for inſtance, of ſix, eight, or ten years. By comparing in like manner the quantities of rain publiſhed by the Royal Academy of Sciences at Paris, from 1699 to 1752, he found,

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(D) "Tempeſtates ardores ſuos habere quadrinis annis.—Octonis vero augeri eaſdem centeſima revolventi ſe luna." *Lib.* 18. *c.* 25.

that of ſix ſeries of nine years, three were greater and three ſmaller, but on both ſides almoſt equal to one another.

During the revolution of the apſes, there are four remarkable points, the two equinoctial and two ſolſtitial points; in which, when the moon is in perigee, her effect will be moſt powerful on the weather. The moon paſſes from one equinoctial point to another in about four years; in them its power is greateſt: it is probable, therefore, that when an ordinary year happens, a return of another may be expected in about four years. As the apſes after their revolution return again in the ſame order as before, it is probable that the return of the ſeaſons will be nearly the ſame in every ſeries of nine years.

44
And of 19 years.

Such, according to Mr Toaldo, is the period at the end of which we are to expect a return of the ſeaſons. Mr Cotte, however, though he does not deny the influence of the revolution of the apſes, places greater confidence in the *lunar period* of 19 years; at the end of which, the new and full moons return to the ſame day in the Julian year. He ſuppoſes, that in like manner the ſeaſons correſpond with one another every 19 years. The ſimilarity, he informs us, is ſtriking between the temperatures of the years 1701, 1720, 1739, 1758, and 1777. That of 1758, upon which we have obſervations much detailed by M. du Hamel, has a remarkable coincidence with 1777: there was ſcarcely any difference in the temperatures of the correſponding months. The years 1778, 1779, and 1780, have been hot and dry, and they correſpond with years which have had the ſame character. The years correſponding with 1782, eſpecially 1725 and 1763, have been ſingularly cold, humid, and late, as was the caſe with 1782 †.

45
Maxims for prognoſticating the weather from the moon.

Such is an imperfect view of the opinions of thoſe philoſophers who have endeavoured to eſtabliſh the influence of the moon over the weather. The moſt important of their maxims for prognoſticating the weather are the following:

1. When the moon is in any of the ten lunar points above mentioned, a change of the weather may be expected. The moſt efficacious of theſe points are the conjunctions and apſes.

2. The coincidence of the conjunctions with the apſes is extremely efficacious: that of the new moon with the perigee gives a moral certainty of a great perturbation.

3. The new and full moons, which ſometimes produce no change on the weather, are ſuch as are at a diſtance from the apſes.

4. A lunar point commonly changes the ſtate into which the weather was brought by the preceding point. For the moſt part the weather never changes but with ſome lunar point.

5. The apogees, quadratures, and ſouthern luniſtices, commonly bring fair weather, for the barometer then riſes; the other points tend to make the air lighter, and thereby to produce bad weather.

6. The moſt efficacious lunar points become ſtormy about the equinoxes and ſolſtices.

7. A change of weather ſeldom happens on the ſame day with a lunar point, but ſometimes before and ſometimes after it.

8. At the new and full moons about the equinoxes, and even the ſolſtices, eſpecially the winter ſolſtice, the weather is commonly determined to good or bad for three, or even ſix months.

9. The ſeaſons and years have a period of eight or nine years correſponding with the revolution of the lunar apſes, and another of 19 correſponding to the *lunar period*.

Would it not be worth while to publiſh a meteorological kalendar yearly, marking the time, to which the lunar points correſpond, at which changes of the weather may be expected, eſpecially when any of theſe points coincide; and marking the probability of a change at any particular time? and might not this be attended by a diary of the weather for the 9 or 19 correſponding years? By this means, if there is any probability in the opinion that the moon has influence over the weather, men would be enabled to foreſee changes with a conſiderable degree of probability; and at any rate, we would be able, by the united obſervations of a whole nation, to determine whether there be any truth in the opinion; and if there be, as its univerſality would lead one to ſuppoſe, ſucceeding obſervations would gradually correct the imperfection of our preſent rules, and enable us to bring our prognoſtics of the weather to the greateſt exactneſs.

46
Remarks on the lunar influence.

We are not ſo ſanguine, however, as Mr Toaldo and P. Cotte on this ſubject. Even allowing the influence of the moon on the weather to be as great as they could deſire, and ſuppoſing, which is very far from being the caſe, that it is not influenced by any other cauſe, we do not ſee how the ſeaſons could return in the ſame order every 9th or 19th year. The motions of the heavenly bodies (eſpecially the moon) are, ſtrictly ſpeaking, incommenſurable. The lunar apogee returns to the ſame ſituation in eight years ten months (without reckoning hours and minutes): at its firſt return it will be two months or ſigns removed from the ſame ſituation with the ſun; at the end of the ſecond period, four months; and at the end of the third, ſix months; ſo that if the ſeaſon was winter at the beginning, after three revolutions it will be the middle of ſummer. Now, how in this caſe can the ſame ſeaſons return? Suppoſing the equinoctial points to produce conſtantly great changes on the weather, if one of them during the firſt revolution happened in winter, in the ſecond it would happen in ſpring, and the third in ſummer; ſo that what would during the firſt revolution produce a particular winter, would in the ſecond act upon the ſpring, and in the third on the ſummer. Would it in theſe caſes produce ſimilar changes on the weather? Surely not. And whether it did or not, would the ſame ſeaſons return in every revolution? In ſix complete revolutions, indeed, or 53 years, the lunar perigee returns to the ſame ſituation as at firſt, very nearly, in the ſame ſeaſon: it might be expected then that the ſeaſons would perform a complete revolution every 53 years, and that the 54th would exactly reſemble the firſt, and ſo on. This may poſſibly be the caſe, but it is by no means probable; for when Mr Toaldo compared the quantity of rain which fell at Paris during 1699, 1700, 1701, 1702, &c. with what fell in 1752, 1753, 1754, &c. though the firſt years in each ſeries correſponded pretty exactly, the difference being only eight lines, there was no ſuch reſemblance between any of the following years.

Neither are we convinced that the influence of the moon can have ſuch an effect on the weather as the above mentioned philoſophers ſuppoſe. The moon only acts, as far as we know at leaſt, by producing tides in the atmoſphere; for the refined ſpeculations of Mr Toaldo about its electrical influence we cannot admit, as the electricity of the atmoſphere is leſs during the night, when the moon's influence ſhould be greateſt, than during the day. Now we do not ſee how theſe tides, ſuppoſing them greater than they are, can be adequate to the effects aſcribed to them.

47
Mr Kirwan's method of prognoſticating the weather.

Mr Kirwan † has lately endeavoured to diſcover probable rules for prognoſticating the different ſeaſons, as far as regards Britain and Ireland, from tables of obſervations alone. On peruſing a number of obſervations, taken in England from 1677 to 1789, he found,

1. That when there has been no ſtorm before or after the vernal equinox, the enſuing ſummer is generally *dry* at leaſt five times in ſix.

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† P. Cotte, Memoires ſur la Meteorologie, vol. i. p. 123.

† Iriſh Tranſ. vol. v. p. 19.

2. That when a ſtorm happens from an eaſterly point, either on the 19th, 20th, or 21ſt of May, the ſucceeding ſummer is generally *dry* four times in five.

3. That when a ſtorm ariſes on the 25th, 26th, or 27th of March (and not before), in any point, the ſucceeding ſummer is generally *dry* four times in five.

4. If there be a ſtorm at ſouth-weſt or weſt-ſouth-weſt on the 19th, 20th, 21ſt, or 22d of March the ſucceeding ſummer is generally *wet* five times in ſix.

In this country winters and ſprings, if dry, are moſt commonly cold; if moiſt, warm: on the contrary, dry ſummers and autumns are uſually hot, and moiſt ſummers cold. So that if we know the moiſtneſs or dryneſs of a ſeaſon, we can judge pretty accurately of its temperature.

From a table of the weather kept by Dr Rutty, in Dublin, for 41 years, Mr Kirwan endeavoured to calculate the probabilities of particular ſeaſons being followed by others. Though his rules relate chiefly to the climate of Ireland, yet as probably there is not much difference between that iſland and Britain in the general appearance of the ſeaſons, we ſhall mention his concluſions here.

In 41 years there were 6 wet ſprings, 22 dry, and 13 variable; 20 wet ſummers, 16 dry, and 5 variable; 11 wet autumns, 11 dry, and 19 variable. A ſeaſon, according to Mr Kirwan, is counted *wet* when it contains two wet months. In general the quantity of rain which falls in dry ſeaſons is leſs than five inches, in wet ſeaſons more: variable ſeaſons are thoſe in which there falls between 30lb. and 36lb. a lb. being equal to .157639 of an inch.

The order in which the different ſeaſons followed each other was as in the following table:

				Times.	Proba-bility.
A dry ſpring -	Has been followed by a	dry	Summer.	11	$\frac{11}{22}$
		wet		8	$\frac{8}{22}$
		variable		3	$\frac{3}{22}$
A wet ſpring -		dry		0	0
		wet		5	$\frac{5}{6}$
		variable		1	$\frac{1}{6}$
A variable ſpring -		dry		5	$\frac{5}{13}$
		wet		7	$\frac{7}{13}$
		variable		1	$\frac{1}{13}$
A dry ſummer -		dry	Autumn.	5	$\frac{5}{16}$
		wet		5	$\frac{5}{16}$
		variable		6	$\frac{6}{16}$
A wet ſummer -		dry		5	$\frac{5}{20}$
		wet		3	$\frac{3}{20}$
		variable		12	$\frac{12}{20}$
A variable ſummer -		dry		1	$\frac{1}{5}$
		wet		3	$\frac{3}{5}$
		variable		1	$\frac{1}{5}$
A dry ſpring and dry ſummer - -		dry		3	$\frac{3}{11}$
		wet		4	$\frac{4}{11}$
		variable		4	$\frac{4}{11}$
A dry ſpring and wet ſummer - -		dry		2	$\frac{2}{8}$
		wet		0	0
		variable		6	$\frac{6}{8}$
A wet ſpring and dry ſummer - -		dry		0	0
		wet		0	0
		variable		0	0
A wet ſpring and wet ſummer - -		dry		2	$\frac{2}{5}$
		wet		1	$\frac{1}{5}$
		variable		2	$\frac{2}{5}$
A wet ſpring and variable ſummer -		dry		1	$\frac{1}{41}$
		wet		0	0
		variable		0	0
A dry ſpring and variable ſummer -		dry		0	0
		wet		2	$\frac{2}{3}$
		variable		1	$\frac{1}{3}$
A variable ſpring and dry ſummer -	Has been followed by a	dry	Autumn.	2	$\frac{2}{4}$
		wet		0	0
		variable		2	$\frac{2}{4}$
A variable ſpring and wet ſummer -		dry		1	$\frac{1}{7}$
		wet		1	$\frac{1}{7}$
		variable		5	$\frac{5}{7}$
A variable ſpring and variable ſummer		dry		0	0
		wet		1	$\frac{1}{41}$
		variable		0	0

Hence Mr Kirwan deduced the probabilitiy of the kind of ſeaſons which would follow others. This probability is expreſſed in the laſt column of the table, and is to be underſtood in this manner: The probability that a dry ſummer will follow a dry ſpring is $\frac{11}{22}$; that a wet ſummer will follow a dry ſpring $\frac{8}{22}$; that a variable ſummer will follow a dry ſpring $\frac{3}{22}$; and ſo on.

This method of Mr Kirwan, if there is ſuch a connection between the different ſeaſons that a particular kind of weather in one has a tendency to produce a particular kind of weather in the next, as it is reaſonable to expect from theory, may in time, by multiplying obſervations, come to a great degree of accuracy, and may at laſt, perhaps, lead to that great deſideratum, a rational theory of the weather. As we wiſh to throw as much light as poſſible on this important ſubject, we ſhall add to theſe a few maxims, the truth of which have either been confirmed by long obſervation, or which the knowledge we have already acquired of the cauſes of the weather has eſtabliſhed on tolerably good grounds.

48
Maxims for prognoſticating the weather.

1. A moiſt autumn with a mild winter is generally followed by a cold and dry ſpring, which greatly retards vegetation.---Such was the year 1741*.

2. If the ſummer be remarkably rainy, it is probable that the enſuing winter will be ſevere; for the unuſual evaporation will have carried off the heat of the earth. Wet ſummers are generally attended with an unuſual quantity of ſeed on the white thorn and dog-roſe buſhes. Hence the unuſual fruitfulneſs of theſe ſhrubs is a ſign of a ſevere winter.

3. The appearance of cranes and birds of paſſage early in autumn announces a very ſevere winter; for it is a ſign that it has already begun in the northern countries.

4. When it rains plentifully in May, it will rain but little in September, and *vice verſa*.

5. When the wind is ſouth-weſt during ſummer or autumn, and the temperature of the air unuſually cold for the ſeaſon, both to the feeling and the thermometer, with a low barometer, much rain is to be expected †.

6. Violent temperatures, as ſtorms or great rains, produce a ſort of criſis in the atmoſphere, which produces a conſtant temperature, good or bad, for ſome months ‖.

7. A rainy winter predicts a ſteril year.----A ſevere autumn announces a windy winter ‡.

Thus we have endeavoured to deſcribe the various phenomena of the weather, and to explain them as far as the infant ſtate of our knowledge of the atmoſphere furniſhed us with principles.

Notwithſtanding the imperfection of our preſent knowledge of this ſubject, the numbers and the abilities of the philoſophers who are at preſent engaged in the ſtudy cannot fail at laſt of being crowned with ſucceſs; and perhaps a rational and ſatisfactory theory of the weather is not ſo far diſtant as we at preſent ſuppoſe. It is a pity, however, that in a ſcience attended with ſo much difficulty as meteorology is, various artificial difficulties ſhould have been thrown in the way, which contribute very much to obſtruct its progreſs. There are no fewer than four thermometers uſed at preſent in different parts of Europe; and the obſervations made by each of them muſt be reduced to one common ſtandard before it is poſſible to compare them with one another. This is a tedious enough buſineſs, but it is nothing at all to the reduction of obſervations of rain and of the barometer to one common ſtandard. Every nation has its own peculiar meaſure; and the French, to add to the difficulty, have reckoned by lines, and twelfths of lines, inſtead of by decimal parts of an inch. Whether, however, this be the caſe at preſent or not, we know not, as we have ſeen no meteorological tables drawn up in France later than 1792. Philoſophers ought certainly to fix upon ſome common ſtandard of weights and meaſures, otherwiſe the labour in meteorology, and even in chemiſtry, muſt ſoon become intolerable. The only other poſſible way to remedy this evil would be, to conſtruct accurate tables, in which the various weights and meaſures uſed by philoſophers are reduced to one common ſtandard. This has already been done in part; but no table of this kind which we have ſeen is ſufficient to remedy the evil: few of them deſcend to decimal parts of ſmall weights or meaſures; yet without this they ſeldom can ſave the trouble of calculation.

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* Du Hamel.

† Mancheſter Tranſ. vol. iv. p. 633.

‖ P. Cotte.

‡ Toaldo.

WEATHER, in ſea-language, is uſed as an adjective, and applied by mariners to every thing lying to windward of a particular ſituation: thus, a ſhip is ſaid to have the weather-gage of another, when ſhe is farther to windward. Thus alſo, when a ſhip under ſail preſents either of her ſides to the wind, it is then called the *weather-ſide* or *weather-board;* and all the rigging and furniture ſituated thereon are diſtinguiſhed by the ſame epithet, as the *weather-ſhrouds*, the *weather-lifts*, the *weather-braces*, &c.

To WEATHER, in ſea-language, is to ſail to windward of ſome ſhip, bank, or head-land.

Weather-Cock, a moveable vane, in form of a cock, or other ſhape, placed on high, to be turned round according to the direction of the wind, and point out the quarter from whence it blows.

Weather-Glaſs. See BAROMETER.

WEATHERING, among ſailors, ſignifies the doubling or ſailing by a head-land or other place.

WEAVING, the art of working a web of cloth, ſilk, or other ſtuff, in a loom with a ſhuttle. For an idea of the manner in which this is performed, ſee CLOTH.

Weaving-Loom, a machine for weaving cloth, ſilk, &c. by raiſing the threads of the warp in order to throw in the ſhoot, and ſtrike it cloſe. Of theſe there are various kinds, diſtinguiſhed by the different ſorts of cloths, ſtuffs, ſilks, &c. in which they are employed; and which are chiefly diſtinguiſhed by the number and variety of the threads they raiſe in order to work the warp, either plain or in figures, by making more or leſs of the woof or ſhoot appear through the warp. In order to give a general idea of weaving, we ſhall here deſcribe the parts of the common weaver's loom. See Plate DXXXIX. fig. 1. in which *e f*, *e f* are the front poſts, and *g*, *g* the back poſts of the loom; *l l l*, *m m*, *m m* are the *lams* in their place at Q, or, as they are called in ſome parts of Scotland, the *hiddles*, and in others the *ſlaves*. They are compoſed of ſtrong threads, ſtretched between two horizontal bars, an upper and a lower. The threads of one lam are ſo diſpoſed as to paſs between the upper threads of the warp, while they admit the lower threads to paſs through loops or ſmall holes in them, and the diſpoſition of the threads of the other lam is ſuch, that while they paſs between the lower threads of the warp, they admit the upper threads to paſs through the ſmall holes juſt mentioned. The lams are ſuſpended from the croſs bar or *lam-bearer* HH, by means of ropes *n*, *n* paſſing from the upper bars of the *lams* over the pulleys at EE, and balanced by weights at the other ends. From the lower bar of each *lam* or *hiddle* a rope paſſes to the *treadles* or moveable bars at O O: ſo that when a foot preſſes a treadle, the lam faſtened to it ſinks, while the other riſes by means of the balancing weight ſuſpended from the pulley at E. The workman then throws in the woof by means of the ſhuttle, and cloſes it by one or two ſtrokes of the *lay* or *batten*, of which WB, WB are called the *ſwords*, CC the *cap*, or in Scotland the upper *ſhell*, DD the *block* or under *ſhell*, and PP the *reed* or *comb* contained between theſe ſhells. LL is the bench on which the workmen ſit; for the loom which our figure repreſents is conſtructed for weaving cloth of ſuch a breadth as to require two workmen, who have their quills in a box *d* on the middle of the bench on which they ſit. Between the workmens bench and the *batten* or *lay* is the *breaſt-bar* I, I, a ſmooth ſquare beam, in which there is an opening to let the web through as it is wove. From this opening the web S S paſſes to the *knee roll* or *web beam* GG, round which it is rolled by means of the ſpokes, viſible in the figure, and kept from being unrolled by a wheel with teeth and clench, viſible likewiſe in the figure. In ſome looms the web paſſes from the knee-roll to the wooden frame X, to be dried as it is wove. Oppoſite to the breaſt bar, and on the other ſide of the *batten* or *lay*, is the *cane-roll* or *yarn-beam*, on which the warp is rolled when put into the loom, and from which it is gradually unrolled as the work proceeds. TT are bobbins filled with yarn of the warp to mend ſuch threads of it as may be broke in the weaving; and B *b*, B *b* are clues of the ſame kind of yarn with the borders of the warp, to mend ſuch threads as may there be broken.

Fig. 2. repreſents the common ſhuttle with the vacuity in the middle, in which the quill with the woof is placed on a ſpindle or axis. As this ſhuttle is thrown with one hand in at one ſide of the warp, and received with the other hand at the other ſide, it is obvious, that when the web is of a breadth too great for a man to reach from one ſide of it to the other, two workmen muſt be employed and much time loſt. To remedy this inconveniency, a new ſhuttle has, in Great Britain, been lately brought into very general uſe, and called the *flying ſhuttle*, becauſe it flies through the warp with wonderful rapidity on two ſteel rollers RR (fig. 3.) This ſhuttle is not thrown with the hand, but moved backwards and forwards by a very ſimple piece of machinery, of which fig. 4. will give the reader a ſufficiently accurate conception. To each end of the *batten* or *lay* L is faſtened a kind of open box B, *b*, with the bottom or horizontal ſide exactly on a level with the threads of the warp of the intended web. In each of theſe boxes is a vertical piece of wood D, *d*, of conſiderable thickneſs, called a *driver*. This driver is moved eaſily on an iron ſpindle or axis from one end of the box to the other by means of a ſlender rope CCCD, and a handle H is ſeen in the figure. When the weaver is to begin his work, he lays the ſhuttle on its rollers in the box B with the iron tip T (fig. 3.) touching, or almoſt touching, the driver D (fig. 4.). Then moving the handle H, with a ſudden jerk, towards the box *b*, the driver D forces the ſhuttle with a rapid motion thro' the warp till it ſtrikes *d*, which is impelled by the ſtroke to the further end of the box *b*. The two drivers D and *d* have now changed their poſitions in their reſpective boxes; ſo that the driver which was at the front of its box before, is now at the farther end of it, and *vice verſa*. Then by a ſudden jerk of the hand towards B the ſhuttle is driven back till it ſtrike D; and thus is the work continued without the weaver having occaſion ever to ſtretch his arms from one margin of the web to the other. That the ſhuttle may not, by the unſteadineſs of the workman's hand, be driven *zig-zag* through the warp or out of the place in which it ought to move, the guiding or driving rope CCCD is made to paſs through ſmooth holes or loops C, C, at the ends of the ropes EC, EC, ſuſpended either from the croſs bar on the top of the loom or from the ſwords of the batten.

This ſhuttle, we ſhould think, a great improvement in every kind of weaving loom, though ſome of the older tradeſmen, with whom we have converſed on the ſubject, contend, that it is valuable only in what they call light-work, ſuch as cotton or linen cloth, or when the web, if woollen, is very broad.

WEB, a ſort of tiſſue or texture formed of threads interwoven with each other; ſome whereof are extended in length, and called the *warp;* others are drawn acroſs, and called the *woof.*

WEDGE, one of the mechanical powers. See MECHANICS.

WEDNESDAY, the fourth day of the week, ſo called from a Saxon idol named *Woden*, ſuppoſed to be Mars, worſhipped on this day

Aſh-WEDNESDAY, the firſt day of Lent, ſo called from the cuſtom obſerved in the ancient Chriſtian church of penitents expreſſing their humiliation at this time, by appearing in ſack-cloth and aſhes.

WEED, a common name for all rank and wild herbs, that grow of themſelves, to the detriment of other uſeful herbs they grow among.

WEED, in the miners language, denotes the degeneracy of a load or vein of fine metal into an uſeleſs marcaſite.

WEEDS, alſo denote a peculiar habit, worn by the relicts of perſons deceaſed, by way of mourning.

WEEK, in chronology, a diviſion of time compriſing ſeven days. See *PLANETARY Days* and SABBATH.

Paſſion-WEEK, or the *Holy WEEK*, is the laſt week in Lent, wherein the church celebrates the myſtery of our Saviour's death and paſſion.

WEEK or WYCK, in geography, a parliament and port-town of Scotland, in the ſhire of Caithneſs. W. Lon. 3. 2. N. Lat. 58. 30.

WEEKS Ember. See EMBER.

Feaſt of WEEKS. See PENTECOST.

WEEVEL, *Method of deſtroying.* See GRANARY.

WEEVER, in ichthyology. See TRACHINUS.

WEEVIL, in zoology, a ſpecies of curculio. See CURCULIO.

WEIGH, a weight of cheeſe, wool, &c. containing 256 pounds avoirdupois. Of corn, the weigh contains 40 buſhels; of barley or malt, ſix quarters. In ſome places, as Eſſex, the weigh of cheeſe is 300 pounds.

WEIGHING, the act of examining a body in the balance to find its weight.

WEIGHING Anchor, is the drawing it out of the ground it had been caſt into, in order to ſet ſail, or quit a port, road, or the like.

WEIGHT, in phyſics, a quality in natural bodies, whereby they tend downwards towards the centre of the earth. Or, weight may be defined in a leſs limited manner, to be a power inherent in all bodies whereby they tend to ſome common point, called the *centre of gravity*, or to ſpeak more accurately, to one another: and that with a greater or leſs velocity, as they are more or leſs denſe, or as the medium they paſs through is more or leſs rare. See MECHANICS.

WEIGHT, in commerce, denotes a body of a known weight appointed to be put in the balance againſt other bodies whoſe weight is required.

The ſecurity of commerce depending, in a good meaſure, on the juſtneſs of weights, which are uſually of lead, iron, or braſs, moſt nations have taken care to prevent the falſification thereof, by ſtamping or marking them by proper officers, after being adjuſted by ſome original ſtandard. Thus, in England, the ſtandard of weights is kept in the exchequer by a particular officer, called the *clerk of the market.*

Weights may be diſtinguiſhed into ancient and modern.

I. ANCIENT WEIGHTS.

1. Thoſe of the ancient Jews, reduced to the Engliſh troy weight, will ſtand as in the following table:

			lb.	oz.	dwt.	gr.
		Shekel - -	0	0	9	$2\frac{4}{7}$
60		Maneh - -	2	3	6	$10\frac{2}{7}$
3000	50	Talent - -	113	10	1	$10\frac{2}{7}$

2. Roman weights, reduced to Engliſh troy weight, will ſtand as in the following table:

										oz.	dwt.	gr.
									Lentes - -	0	0	$0\frac{85}{112}$
4									Siliquæ - -	0	0	$3\frac{1}{28}$
12	3								Obolus - -	0	0	$9\frac{3}{28}$
24	6	2							Scriptulum -	0	0	$18\frac{3}{14}$
72	18	6	3						Drachma -	0	2	$6\frac{9}{14}$
96	24	8	4	$1\frac{1}{3}$					Sextula	0	3	$0\frac{6}{7}$
144	36	12	6	2	$1\frac{1}{2}$				Sicilicus	0	4	$13\frac{2}{7}$
192	48	16	8	$2\frac{2}{3}$	2	$1\frac{1}{3}$			Duella	0	6	$1\frac{5}{7}$
576	144	48	24	8	6	4	3		Uncia	0	18	$5\frac{1}{7}$
6912	1728	576	288	96	72	48	36	12	Libra	10	18	$13\frac{5}{7}$

The Roman ounce is the Engliſh avoirdupois ounce, which they divided into 7 denarii, as well as 8 drachmas.

3. *Attic Weights*

			English Troy Weight.			
			lb.	oz.	dwt.	gr.
		Drachma - -	0	0	2	16.9
100		Mina - -	1	1	10	10
6000	60	Talent - -	67	7	5	0

II. MODERN WEIGHTS.

1. *Engliſh Weights.*—Mr Renardſon, in a paper publiſhed in the Philoſophical Tranſactions, has proved, that at firſt there was but one weight in England, and that this was the avoirdupois. Troy weight was introduced in the time of Henry VII: At preſent, both the troy and avoirdupois weights are uſed in England. Troy weight ſeems to have derived its name from *Troyes*, a town in France, where a celebrated fair was kept. It is uſed for weighing gold, ſilver, jewels, ſilk, and all liquors. The avoirdupois is uſed for weighing other things.

WEAVING

Plate DXXXIX

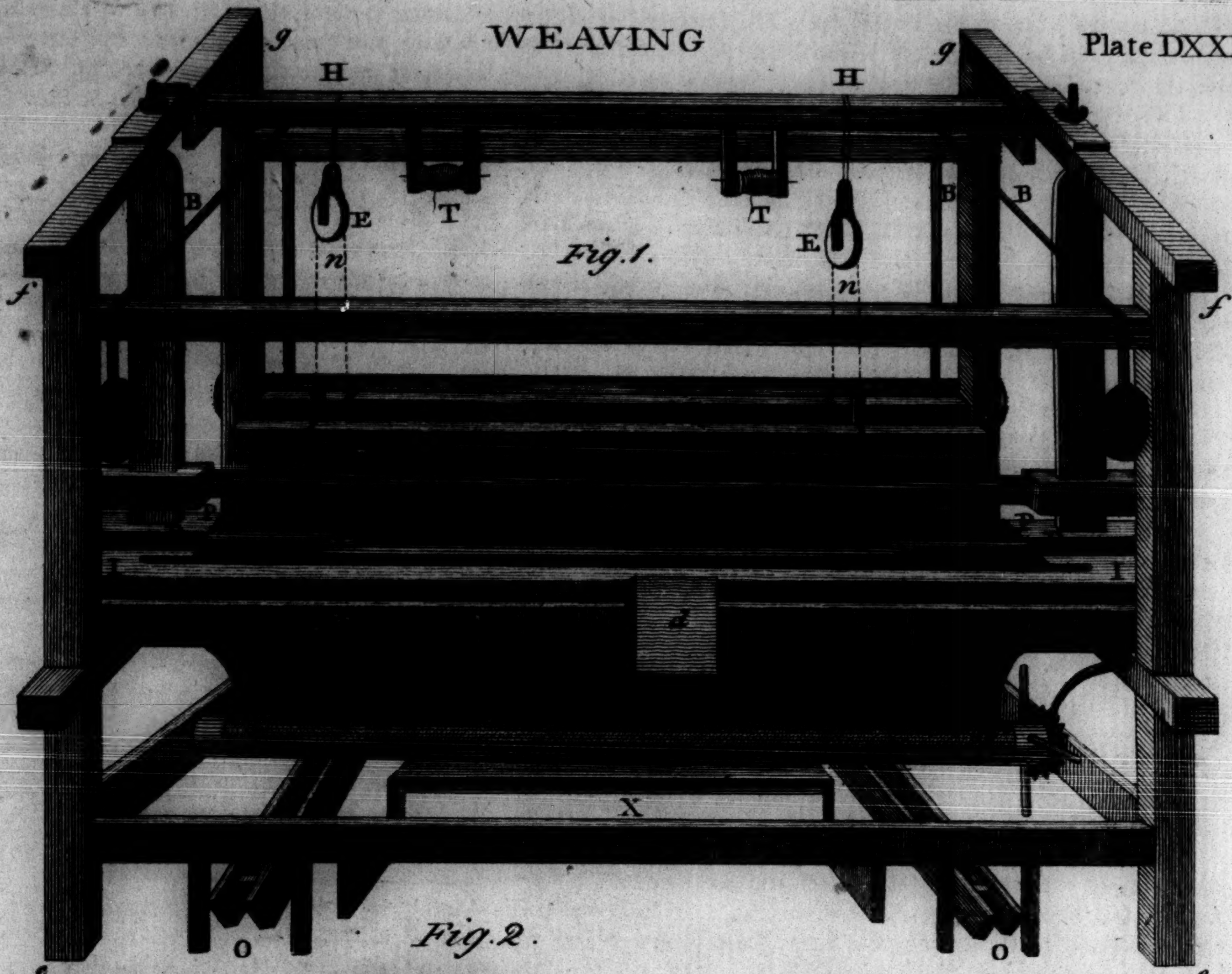
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Fig. 1.

Fig. 2.

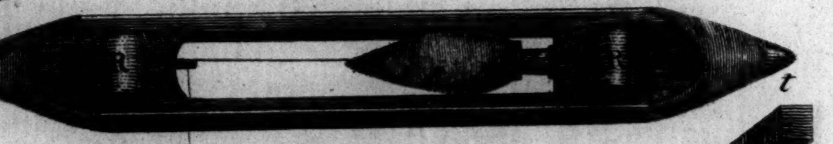

Fig. 3.

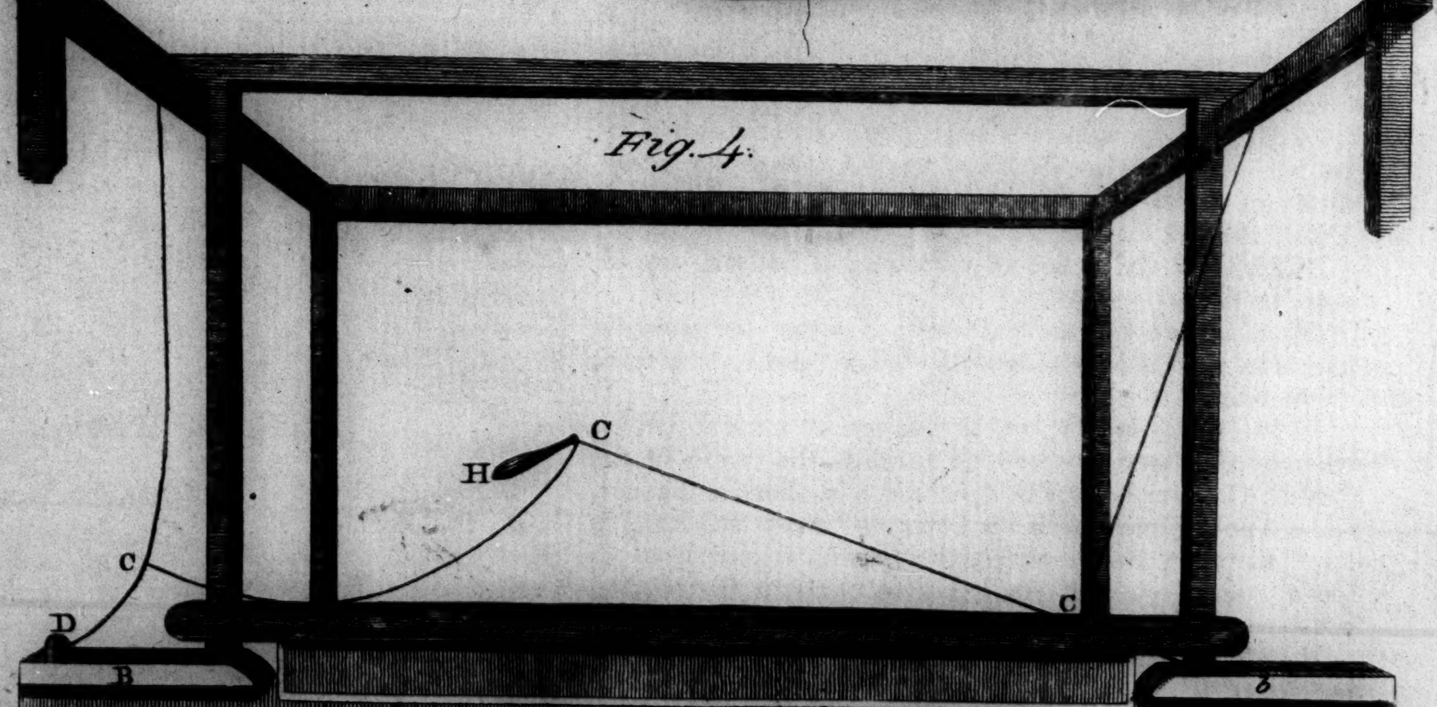

Fig. 4.

Lawson sc.

BRITISH MUSEUM

Table of Troy Weight, as uſed by the Goldſmiths, &c.

Grains			
24	Penny-weight.		
480	20	Ounce.	
5760	240	12	Pound.

Apothecaries.

Grains				
20	Scruple. ℈			
60	3	Dram. ʒ		
480	24	8	Ounce. ℥	
5760	288	96	12	Pound.

The troy pound in Scotland, which by ſtatute is to be the ſame as the French pound is commonly ſuppoſed equal to 15 ounces and three quarters troy Engliſh weight, or 7560 grains. But by a mean of the ſtandards kept by the dean-of-guild of Edinburgh, it weighs 7599$\frac{2}{32}$ or 7600 grains.

Table of Avoirdupois Weight.

Drams.					
16	An ounce.				
256	16	A pound.			
7168	448	28	A quarter.		
28672	1792	112	4	A hundred.	
573440	35840	2240	80	20	A ton

The avoirdupois pound is equal to 7004 troy grains, the avoirdupois ounce to 437.75 grains; and it follows of conſequence, that the troy pound is to the avoirdupois pound as 88 to 107 nearly; for as 88 to 107, ſo is 5760 to 7003.636: that the troy ounce is to the avoirdupois ounce as 80 to 73 nearly; for as 80 to 73, ſo is 480 to 438. An avoirdupois pound is equal to 1lb. 2 oz. 11 dwts. 20 gr. troy: a troy ounce is equal to 1 oz. 1.55dr. avoirdupois; an avoirdupois dram contains 27.34375 grains; 175 troy pounds are equal to 144 avoirdupois pounds.

The moneyers have a peculiar ſubdiviſion of the grain troy: thus,

$$\text{The}\left\{\begin{array}{l}\text{Grain}\\ \text{Mite}\\ \text{Droit}\\ \text{Periot}\end{array}\right\}\text{into}\left\{\begin{array}{l}\text{20 Mites.}\\ \text{24 Droits.}\\ \text{20 Periots.}\\ \text{24 Blanks.}\end{array}\right.$$

The Engliſh weights are uſed in the United States of America.

2. *French Weights*---Different weights were formerly uſed in moſt of the different provinces of France: we believe that they have lately undergone ſeveral alterations; a project of this kind is given in the article Revolution of France. Be that as it may, a knowledge of the ancient weights of that country is of importance on account of the books in which they are uſed. The Paris pound contains 16 ounces, and is divided two ways.

Grains					
24	Penny-weight.				
72	3	Gros.			
576	24	8	Ounce.		
4608	192	64	8	Marc.	
9216	384	128	16	2	Pound

Half-ounce.						
2	Ounce.					
4	2	Half-quarter pound.				
8	4	2	Quarter pound.			
16	8	4	2	Half-pound.		
32	16	8	4	2	Pound.	
3200	1600	800	400	200	100	Quintal.

The weights of the firſt diviſion are uſed to weigh gold, ſilver, and the richer commodities; and the weights of the ſecond diviſion for commodities of leſs value.

The Paris 2 marc, or pound weight, is equal to 7560 grains troy, and the Paris ounce equal to 472.5 grains troy.

	lb.	oz.	dwt.	gr.	
The Paris pound =	1	3	15	0	troy
The Paris ounce =	0	0	19	16.5	troy.

A grain troy = 1.2186507 of a Paris grain.

But the pound was not the ſame throughout France. At Lyons, *e. gr.* the city pound made only 14 ounces: ſo that 100 Lyons pounds was only 86 Paris pounds. But beſide the city pound, they had another at Lyons for ſilk, containing 15 ounces. At Thoulouſe, and throughout the Upper Languedoc, the pound was 13 ounces and a half of Paris weight. At Marſeilles, and throughout Provence, the pound was 13$\frac{1}{4}$ ounces of Paris weight. At Rouen, beſide the common Paris pound and marc, they had the weight of the vicomte; which was 16 ounces, a half, and five-ſixths of the Paris weight. The weights enumerated under the two articles of Engliſh and French weights are the ſame that are uſed throughout the greateſt part of Europe; only under ſomewhat different names, diviſions, and proportions.

French weights are uſed in all the French American ſettlements.

3. *Dutch Weights.*—The weight uſed in Amſterdam and all over Holland is called *Troy Weight*, and is exactly the ſame with that uſed at Bruſſels. The Dutch weights are as follows:

Duſkens.						
2	Troyken.					
4	2	Vierling.				
16	8	4	As.			
512	256	128	32	Angle.		
10240	5120	2560	640	20	Ounce.	
81920	40960	20480	5120	160	8	Marc.

The marc is equal, according to M. Tillet, to 4620 French grains.

The Amſterdam pound uſed in commerce is divided into 16 ounces, 32 loots, or 128 drachms. This pound contains 2 marcs troy, and ought therefore to weigh only 10240 *as*: but it weighs 10280; ſo that it is a little heavier than the troy pound of Amſterdam: 256 lb. of commerce are equal to 257 lb. troy of Holland. Two different pounds are uſed by apothecaries; the one containing 2 marcs, the other only 1$\frac{1}{2}$. The firſt is called *arſenic* pound weight;

weight: it contains 16 ounces, the ounce 8 drachms, the drachm 8 ſcruples, the ſcruple 20 grains. The ſecond is called the *apothecary's* pound; it is divided into 12 ounces, or 24 loots. Three arſenic pounds are equal to 4 apothecary's pounds.

The Dutch ſtone - = 8 commercial lb.
The Liſpundt, or Ll. = 15
The hundred weight = 100
The Schippondt, or Sch. lb. = 300

4. *Spaniſh Weights.*----The marc of Caſtile, uſed for weighing gold and ſilver, is divided as follows,

Grains (gold weight).	Grain (ſilver weight).	Tomine (gold weight).	Tomine (ſilver weight).	Adarme.	Ochava.	Caſtellano.	Ounce.	Marc.
$1\frac{1}{24}$								
12	$11\frac{12}{25}$							
$12\frac{1}{2}$	12	$1\frac{1}{24}$						
$37\frac{1}{2}$	36	$3\frac{1}{8}$	3					
75	72	$6\frac{1}{4}$	6	2				
96	$92\frac{4}{25}$	8	$7\frac{17}{25}$	$2\frac{14}{25}$	$1\frac{7}{25}$			
600	576	50	48	16	8	$6\frac{1}{4}$		
4800	4608	400	384	128	64	50	8	

The marc, according to Tillet, is equal to 7 oz. 4 gros, 8 grains French, which is equal to 4785 *as* of Holland. One hundred marcs of Caſtile = about $93\frac{1}{2}$ marcs of Holland; 100 marcs of Holland = 107 marcs of Caſtile. Medicines are ſold by the ſame marc; but it is divided differently, containing 8 ounces, 64 drachms, 192 ſcruples, 384 obolos, 1152 caracteras, 4608 grains.

The Spaniſh commercial pound is divided into two marcs, called *marcs of Tejo*, each of which is equal to the marc of Caſtile. This pound is divided into 16 ounces, 256 adarmes, 9,216 grains.

5. *Weights of Portugal.*—The Liſbon marc for eſſaying ſilver conſiſts of 12 deniers, and the denier of 24 grains. The marc of Portugal for weighing gold and ſilver is equal, according to Tillet, to 7 ounces, $3\frac{1}{2}$ gros, and 34 grains French, which makes 4776 *as* of Holland; ſo that it is exactly the ſame with the Liſbon pound. It is divided into 8 ounces, 64 outavas, 192 ſcruples, 4608 grains.

The pound conſiſts of 2 marcs, 16 ounces, or 96 outavas. The arroba of 32 lb. the quintal of 4 arrobas, or 128 lb. 100 Oporto pounds make $87\frac{1}{8}$th pounds of commerce of Amſterdam.

6. *Weights of Italy.—Genoa.* Two kinds of weights are uſed at Genoa, the *peſo groſſo* (heavy weight), and the *peſo ſottile* (light weight): the latter is uſed for weighing gold and ſilver, the former for other things. The pound of the peſo ſottile is equal, according to Tillet, to 1 marc, 2 ounces, $2\frac{1}{2}$ gros, 30 grains French. It is divided into 8 ounces, the ounce into 24 deniers, and the denier into 24 grains. The pound of the peſo groſſo is equal to 1 marc, 2 ounces, 3 gros, 5 grains, French. It is divided into 12 ounces:

The cantaro = 100 lbs. peſo groſſo.
The rubbo = 25 lbs.
The rotolo = $1\frac{1}{2}$ lb.
100 lbs. peſo groſſo = $64\frac{1}{3}$ lb. of commerce of Amſterdam.
100 lbs. peſo ſottile = 129 marcs troy of Holland.

Rome. The Roman pound conſiſts of 12 ounces, the ounce of 24 deniers, the denier of 24 grains. The Roman pound, according to Tillet, is equal to 1 marc, 3 ounces, $\frac{1}{2}$ gros, 14 grains, French.

Venice. The marc for weighing gold and ſilver contains 8 ounces, 32 quarti, 1152 carati, or 4608 grani. An hundred marcs of Venice = $97\frac{1}{5}$ marcs troy of Holland, 100 marcs of Holland = 103 of Venice. In Venice they alſo uſe a *peſo groſſo* and *peſſo ſottile.* 100 lbs. peſo groſſo = $94\frac{4}{5}$ commerical lbs. of Amſterdam. 100 lbs. peſo ſottile = $61\frac{2}{7}$ ditto.

7. *Swediſh Weights.*—The marc for weighing gold and ſilver is equal to 16 lods, 64 quentins, or 4384 as. The pound of 32 lods, uſed for weighing food, is equal, according to Tillet, to 1 marc, 5 ounces, 7 gros, 8 grains French, which makes $8848\frac{1}{2}$ as troy of Holland. This anſwers exactly to the weight of the different pounds, as fixed in Sweden, viz. 8848 as = the pound for weighing articles of food; $7821\frac{79}{125}$ as = marc uſed in the mines; $7450\frac{2}{125}$ as = marc uſed in towns and in the country; $7078\frac{2}{5}$ as = marc uſed for weighing iron; 7416 as = pound uſed in medicine.

The ſkippund = 400 lbs. for weighing food.
The centner = 120 lbs.
The waag = 165 lbs.
The ſten = 32 lbs.
The Swediſh as = 1 as of Holland troy.

8. *German Weights.—Vienna.* The marc of Vienna for weighing gold and ſilver is divided into 16 loths, 64 quintals, or 256 deniers or pfenings; the loth into 4 quintals, or 16 pfenings. This marc, according to Tillet, is equal to 1 marc, 1 ounce, 1 gros, 16 grains, French, = 5831 as troy Holland. The pound of Vienna is divided into 2 marcs, or 4 viertings; the marc into 8 ounces, 16 loths, 64 quintals, or 266 pfenings.

Hamburgh. The marc for eſſaying gold is divided into 24 carats; the carat into 12 grains. The marc for ſilver is divided into 16 loths, and the loth into 18 grains. Theſe marcs conſiſt each of 288 grains, and are therefore equal. This marc, uſed in Hamburgh for gold and ſilver, is the marc of Cologne, which is equal, according to Tillet, to 7 ounces, 5 gros, $7\frac{3}{4}$ grains, French, = 4866 as troy of Holland. It is divided into 8 ounces, 16 loths, 64 quentins, 256 pfenings, 4352 eſches, or 65536 richt pfenings theile. The apothecary pound uſed in Hamburgh, and almoſt all Germany, is divided into 12 ounces, 96 drachms, 288 ſcruples, or 5760 grains; an ounce is equal to 621 as of Holland. The pound of commerce is equal, according to Tillet, to 10085 as of Holland; for half a pound is equal to 7 ounces, 7 gros, 23 grains, French. This pound is divided into 16 ounces, 32 loths, 128 quentins, or 512 pfenings.

9. *Ruſſian Weights.*—The berckowitz = 400 lbs.
The pound - - - - = 40 lbs.

The pound is divided into 32 loths, or 96 ſolotnuks. One hundred Ruſſian lbs. = $166\frac{1}{2}$ marcs, or $82\frac{4}{5}$ lbs. of Amſterdam. One hundred lbs. of commerce of Amſterdam = $120\frac{3}{4}$th lbs. of Ruſſia.

10. *Weights uſed in the ſeveral parts of Aſia, the Eaſt Indies, China, Perſia,* &c.----In Turkey, at Smyrna, &c. they uſe the batman, or battemant, containing $7\frac{1}{2}$ occos; the occo contains 4 chekys or pounds, each of which, according to Tillet, is equal to 1 marc 2 oz. 3 gros. 28 gr. French. The Turkiſh weights are divided as follows:

Cantaras.	Batmans.	Occos.	Rotolos.	Chekis.	Meſcals.	Drachms.
1 =	$7\frac{1}{2}$ =	44 =	100 =	176 =	$11733\frac{1}{3}$ =	17600
	1 =	6 =	$13\frac{1}{21}$ =	24 =	1600 =	2400
		1 =	$2\frac{3}{11}$ =	4 =	$266\frac{2}{3}$ =	400
			1 =	$1\frac{19}{28}$ =	$117\frac{1}{3}$ =	176
				1 =	$66\frac{1}{3}$ =	100
					1 =	$1\frac{1}{2}$

At Aleppo there are three ſorts of rottos; the firſt 720 drachms, making about 7 pounds Engliſh, and ſerving to weigh cottons, galls, and other large commodities; the ſecond is 680 drachms, uſed for all ſilks but white ones, which are weighed by the third rotto of 700 drachms. At Seyda the rotto is 600 drachms.

The other ports of the Levant not named here, uſe ſome of theſe weights; particularly the occa, or ocqua, the rottoli, and rotto.

The Chineſe weights are the piece for large commodities; it is divided into 100 catis, or cattis; though ſome ſay into 125; the cati into 16 taels, or tales; each tael equivalent to $1\frac{1}{3}$ of an ounce Engliſh, or the weight of 1 rial and $\frac{1}{12}$, and containing 12 mas, or maſſes, and each mas 10 condrins. So that the Chineſe piece amounts to 137 pounds Engliſh avoirdupois, and the cadi to 1 pound 8 ounces. The picol for ſilk containing 66 catis and $\frac{3}{4}$; the bahar, bakaire, or bar, containing 300 catis.

Tonquin has alſo the ſame weights, meaſures, &c. as China. Japan has only one weight, viz. the cati; which, however, is different from that of China, as containing 20 taels. At Surat, Agra, and throughout the ſtates of the Great Mogul, they uſe the man, or maund, whereof they have two kinds; the king's man, or king's weight; and the man ſimply; the firſt uſed for the weighing of common proviſions, containing 40 ſeers, or ſerres; and each ſeer a juſt Paris pound. The common man, uſed in the weighing of merchandiſe, conſiſts likewiſe of 40 ſeers, but each ſeer is only eſtimated at 12 Paris ounces, or $\frac{3}{4}$ of the other ſeer.

The man may be looked upon as the common weight of the Eaſt Indies, though under ſome difference of name, or rather of pronunciation; it being called *mao* at Cambaya, and in other places *mein*, and *maun*. The ſeer is properly the Indian pound, and of univerſal uſe; the like may be ſaid of the bahar, tael and catti, above mentioned.

The weights of Siam are the piece, containing two ſhans or cattis; but the Siameſe catti is only half the Japaneſe, the latter containing 20 taels, and the former only 10; though ſome make the Chineſe catti only 16 taels, and the Siameſe 8. The tael contains 4 baats or ticals, each about a Paris ounce; the baat 4 ſelings or mayons: the mayon 2 fouangs; the fouang 4 payes; the paye 2 clams; the ſompaye half a fouang.

It is to be obſerved that theſe are the names of their coins as well as weights; ſilver and gold being commodities there ſold, as other things, by their weights.

In the iſle of Java, and particularly at Bantam, they uſe the gantan, which amounts to near three Dutch pounds. In Golconda, at Viſapour, and Goa, they have the furatelle, containing 1 pound 14 ounces Engliſh; the mangalis, or mangelin, for weighing diamonds and precious ſtones, weighing at Goa 5 grains, at Golconda, &c. $5\frac{1}{2}$ grains. They have alſo the rotolo, containing $14\frac{1}{4}$ ounces Engliſh; the metricol, containing the ſixth part of an ounce; the wall for piaſtres and ducats, containing the 73d part of a rial.

In Perſia they uſe two kinds of batmans or mans; the one called *cabi* or *cheray* which is the king's weight, and the other *batman of Tauris*. The firſt weighs 13 pounds 10 ounces Engliſh; the ſecond $6\frac{1}{2}$ pounds. Its diviſions are the ratel, or a 16th; the Derhem, or drachm, which is the 50th; the meſchal, which is half the derhem; the dung, which is the 6th part of the meſchal, being equivalent to 6 caret grains; and, laſtly, the grain, which is the fourth part of the dung. They have alſo the vakie, which exceeds, a little, our ounce; the ſah-cheray, equal to the 1170th part of the derhem; and the toman, uſed to weigh out large payments of money without telling; its weight is that of 50 abaſſis.

11. *Weights at Cairo in Egypt.*—Almoſt every kind of goods has its own weight; theſe are regulated by the cantaren or principal weight.

		Rotels.
The ordinary cantaren, or hundred weight, weighs		100
The cantaren of	quickſilver and tin	102
	coffee, wine, and iron -	105
	ivory - -	100
	almonds and other fruits -	115
	woods for dying -	120
	arſenic and other drugs -	125
	minium and cinnabar -	130
	gum-arabic, aloes, and other aromatics - -	133

The rotel or rotoli is nearly equal to the pound of Marſeilles; 108 lbs. of Marſeilles are eqnal to 110 rotels. The Marſeilles pound conſiſts of 13 ounces of Paris; ſo that 100 lbs. of Marſeilles are equal to 81. lbs. Paris, and 100 lbs. Paris = 123 lbs. of Marſeilles.

We ſhall here ſubjoin Mr Ferguſon's table for comparing the Engliſh avoirdupois pound with foreign pounds:

Ferguſon's Tables and Tracts.

London pound	1.0000	Hamburgh	1.06865
Antwerp	1.04	Liſbon	1.135
Amſterdam	1.1111	Leghorn	0.75
Abeville	1.0989	Norimberg	1.1363
Ancona	0.78	Naples	0.71
Avignon	0.8928	Paris	1.1235
Bourdeaux	1.0989	Prague	1.2048
Bologna	0.8	Placentia	0.72
Bruges	1.0204	Rochelle	0.8928
Calabria	0.73	Rome	0.7874
Calais	0.9345	Rouen	1.1089
Dieppe	1.0989	Seville	0.9259
Dantzic	0.862	Thouloufe	0.8928
Ferrara	0.75	Turin	0.82
Flanders	0.9433	Venice	1.06
Geneva	1.07	Vienna	1.23
Genoa, groſs	0.7		

In order to ſhow the proportion of the ſeveral weights uſed throughout Europe, we ſhall add a reduction of them to one ſtandard, viz. the London pound.

The 100 lb. of England, Scotland, and Ireland, are equal to

lb.	oz.	
91	8	of Amſterdam, Paris, &c.
96	8	of Antwerp or Brabant.
88	0	of Rouen, the viſcounty weight.
106	0	of Lyons, the city weight.
90	9	of Rochelle,
107	11	of Tholouſe and Upper Languedoc.
113	0	of Marſeilles or Provence.
81	7	of Geneva.
93	5	of Hamburgh.
89	7	of Francfort, &c.
96	1	of Leipſic, &c.
137	4	of Genoa.
132	11	of Leghorn.
153	11	of Milan.
152	0	of Venice.
154	10	of Naples.
97	0	of Seville, Cadiz, &c.
104	13	of Portugal.
96	5	of Leige.
112	$\frac{1}{3}$	of Ruſſia.
107	$\frac{1}{24}$	of Sweden.
89	$\frac{1}{2}$	of Denmark.

A curious weighing machine was ſome time ago invented by M. Hanin of Paris, whereby the weights of the principal countries in Europe, and all the relative proportions they bear to each other, are ſhown at one view. For this he received a bounty of 20 guineas from the Society inſtituted at London, for the Encouragement of Arts, Manufactures, and Commerce. We ſhall inſert a deſcription and figure of this ingenious machine.

Plate DCCCXXXVIII.

Figure 1. repreſents the back of the machine, which being ſuſpended by the ring A, and a weight hung to the hook B, the ſpring C, C, C, made faſt by ſtrong ſcrews at *g*, is drawn downwards; and the bar D, having a rack thereon at *e*, turns the pinion *f*, in proportion to the weight of the body hanging thereto. Figure 2. ſhows the face of the machine, on which are a number of concentric circles, and the weights of ſeveral countries of Europe engraved thereon, as expreſſed by the words in a line with them. In the centre of this face is a ring fixed to the ſmall plate, turned by the pinion *f*, ſhown at figure 1. From this ring a hand projects, which, by the turning of the pinion, points to ſuch part of the circle as is marked with the weight, hung to the hook B; and thereby ſhows what weight of any of the countries mentioned, is equal to the pounds troy of London, which are engraved on the outer circle, or to the pounds avoirdupois, which are engraved on the ſecond circle, and ſo of the reſt. A ſlider moves on the hand, which may be brought to any of the circles at pleaſure, in order to point out the relative weight with greater preciſion.

Many attempts have been made to introduce an uniformity of weights and meaſures into the commercial world; but hitherto they have all failed. The accompliſhment of ſuch an undertaking would be of infinite advantage to mankind, and certainly claims the moſt ſerious attention of thoſe who by their ſituation can alone bring it about. The undertaking is indeed difficult, but ſurely not impoſſible. Something of this kind has lately been attempted in France; and if it ſucceed, as the method is ſimple, and exceedingly well adapted for calculation, it ſurely deſerves to be imitated. See *Revolution of France.*

Weight of Air, See Pneumatics, n° 14—19.

Regulation of Weights and Meaſures, is a branch of the king's prerogative. See Prerogative and Measure.

As weight and meaſure are things in their nature arbitrary and uncertain, it is therefore expedient that they be reduced to ſome fixed rule or ſtandard: which ſtandard it is impoſſible to fix by any written law or oral proclamation; for no man can, by words only, give another an adequate idea of a foot rule, or a pound weight. It is therefore neceſſary to have recourſe to ſome viſible, palpable, material ſtandard; by forming a compariſon with which all weights and meaſures may be reduced to one uniform ſize; and the prerogative of fixing this ſtandard, our ancient law veſted in the crown, as in Normandy it belonged to the duke. This ſtandard was originally kept at Wincheſter: and we find in the laws of king Edgar near a century before the conqueſt, an injunction that the one meaſure, which was kept at Wincheſter, ſhould be obſerved throughout the realm. Moſt nations have regulated the ſtandard of meaſures of length by compariſon with the parts of the human body; as the palm, the hand, the ſpan, the foot, the cubit, the ell (*ulna* or arm), the pace, and the fathom. But as theſe are of different dimenſions in men of different proportions, our ancient hiſtorians inform us, that a new ſtandard of longitudinal meaſure was aſcertained by king Henry the Firſt; who commanded that the *ulna*, or ancient ell, which anſwers to the modern yard, ſhould be made of the exact length of his own arm. And one ſtandard of meaſure of length being gained, all others are eaſily derived from thence; thoſe of greater length by multiplying, thoſe of leſs by dividing, that original ſtandard. Thus, by the ſtatute called *compoſitio ulnarum et perticarum*, five yards and an half make a perch; and the yard is ſubdivided into three feet, and each foot into 12 inches; which inches will be each of the length of three grains of barley. Superficial meaſures are derived by ſquaring thoſe of length; and meaſures of capacity by cubing them. The ſtandard of weights was originally taken from corns of wheat, whence the loweſt denomination of weights we have is ſtill called a *grain*; 32 of which are directed, by the ſtatute called *compoſitio menſurarum*, to compoſe a pennyweight, whereof 20 make an ounce, 12 ounces a pound, and ſo upwards. And upon theſe principles the firſt ſtandards were made; which, being originally ſo fixed by the crown, their ſubſequent regulations have been generally made by the king in parliament. Thus, under king Richard I. in his parliament holden at Weſtminſter, A. D. 1197, it was ordained that there ſhould be only one weight and one meaſure throughout the kingdom, and that the cuſtody of the aſſize, or ſtandard of weights and meaſures, ſhould be committed to certain perſons in every city and borough: from whence the ancient office of the king's aulnager ſeems to have been derived, whoſe duty it was, for a certain fee, to meaſure all cloths made for ſale, till the office was aboliſhed by the ſtatute 11th and 12th William III. c. 20. In king John's time, this ordinance of king Richard was frequently diſpenſed with for money; which occaſioned a proviſion to be made for enforcing it, in the great charters of king John and his ſon. Theſe original ſtandards were called *pondus regis*, and *menſura domini regis*, and are directed by a variety of ſubſequent ſtatutes to be kept in the exchequer chamber, by an officer called the *clerk of the market*, except the wine gallon, which is committed to the city of London, and kept in Guildhall.

The *Scottiſh* ſtandards are diſtributed among the oldeſt boroughs. The elwand is kept at Edinburgh, the pint at Stirling, the pound at Lanark, and the firlot at Linlithgow.

Various ſtatutes have been enacted for regulating and enforcing an uniformity of weights and meaſures; and by the articles of union, the Engliſh ſtandards are eſtabliſhed by law over all Great Britain. But the force of cuſtom is ſo ſtrong, that theſe ſtatutes have been ill obſerved. The Scottiſh ſtandards are ſtill univerſally retained for many purpoſes; and likewiſe a variety of local weights and meaſures are uſed in particular places in both countries, which differ from the general ſtandards of either.

WELD, or Wold, in botany. See Reseda.

WELDING-heat, in ſmithery, a degree of heat given to iron, &c. ſufficient to make the ſurfaces of two pieces incorporate upon being beaten together with a hammer.

WENMANNIA, in botany: A genus of plants of the claſs *octandria*, order *monogynia*, and arranged in the natural claſſification with thoſe plants, the order of which is doubtful. The calyx is four-leaved, the corolla has four petals, and the capſule is bilocular and biroſtrated. There are four ſpecies, none of which are natives of Britain.

WELL, a hole under ground, uſually of a cylindrical figure, and walled with ſtone and mortar: its uſe is to collect the water of the ſtrata around it.

Well, an apartment formed in the middle of a ſhip's hold to incloſe the pumps, from the bottom to the lower deck. It is uſed as a barrier to preſerve thoſe machines from being damaged by the friction or compreſſion of the materials contained in the hold, and particularly to prevent the entrance of ballaſt, &c. by which the tubes would preſently be choked, and the pumps rendered incapable of ſervice. By means of this encloſure, the artificers may likewiſe more readily deſcend into the hold, in order to examine the ſtate of the pumps, and repair them as occaſion requires.

Well-room of a Boat, the place in the bottom where the water lies, between the ceiling and the platform of the ſtern-ſheets, whence it is thrown out into the ſea with a ſcoop.

Burning-Well. See Burning-*Springs*.

Well of a Fiſhing-veſſel, an apartment in the middle of the hold, which is entirely detached from the reſt, being lined with lead on every ſide, and having the bottom thereof penetrated with a competent number of ſmall holes, paſſing alſo through the ſhip's floor; ſo that the ſalt-water running into the well is always kept as freſh as that in the ſea, and yet prevented from communicating itſelf to the other parts of the hold.

Well-hole, in building, is the hole left in a floor for the ſtairs to come up through.

WELLS, a city of Somerſetſhire, and ſee of a biſhop; the biſhop of Bath being alſo that of Wells.—It is ſuppoſed to take its name from the many ſprings and wells that are near it. It is not very large; but is adorned with handſome buildings, both public and private. Its cathedral is a very beautiful ſtructure, adorned with images and carved ſtone work. The biſhop's palace joins to the cathedral; and on the other ſide are the houſes for the prebendaries. In the market-place is a fine market-houſe, ſupported by pillars. It is governed by a mayor, and ſends two members to parliament. The chief manufacture is knit hoſe. W. Long. 2. 37. N. Lat. 51. 12.

WEN, a tumor or excreſcence ariſing on different parts of the body, and containing a cyſtus or bag filled with ſome peculiar kind of matter. See Nævus.

WEREGILD, the price of *homicide*; paid partly to the king for the loſs of a ſubject, partly to the lord whoſe vaſſal he was, and partly to the next of kin of the perſon ſlain.

WERST, Wurst, or *Verſt*, a Ruſſian meaſure equal to 3500 Engliſh feet. A degree of a great circle of the earth contains about 104 werſts and a half.

WERTURIAN or *Uralian Mountains*, a famous chain of mountains forming part of the boundary of Aſia. It begins diſtinctly (for it may be traced interruptedly farther ſouth) near the town of Kungur, in the goverment of Kaſan, in latitude 57. 20.; runs north, and ends oppoſite to the Waygatz ſtraight, and riſes again in the iſle of *Nova Zemlja*. The Ruſſians alſo call this range *Semennoi Poias*, or, *the girdle of the world*; from a ſuppoſition that it encircled the univerſe. Theſe were the *Riphæi montes: Pars mundi damnata a natura rerum, et denſa merſa caligine* §; of which only the ſouthern part was know to the ancients, and that ſo little as to give riſe to numberleſs fables. Beyond theſe were placed the happy *Hyperborei*, a fiction moſt beautifully related by Pomponius Mela. Moderns have not been behind-hand in exaggerating ſeveral circumſtances relative to theſe noted hills. Yſbrand Ides, who croſſed them in his embaſſy to China, aſſerts that they are 5000 toiſes or fathoms high; others, that they are covered with eternal ſnow. The laſt may be true in their more northern parts; but in the uſual paſſages over them, they are free from it three or four months.

The heights of part of this chain have been taken by M. l'Abbé d'Auteroche: who, with many aſſurances of his accuracy, ſays, that the height of the mountain Kyria near Solikamſkaia, in latitude 60°, does not exceed 471 toiſes from the level of the ſea, or 286 from the ground on which it ſtands. But, according to M. Gmelin, the mountain Pauda is much higher, being 752 toiſes above the ſea. From Peterſburg to this chain is a vaſt plain, mixed with certain elevations or platforms, like iſlands in the midſt of an ocean. The eaſtern ſide deſcends gradually to a great diſtance into the wooded and moraſſy Siberia, which forms an immenſe inclined plane to the Icy Sea. This is evident from all the great rivers taking their riſe on that ſide, ſome at the amazing diſtance of latitude 46°; and, after a courſe of above 27 degrees, falling into the Frozen Ocean, in latitude 73. 30. The Yaik alone, which riſes near the ſouthern part of the eaſtern ſide, takes a ſouthern direction, and drops into the Caſpian Sea. The Dwina, the Peczora, and a few other rivers in European Ruſſia, ſhew the inclined plane of that part. All of them run to the Northern Sea; but their courſe is comparatively ſhort. Another inclination directs the Dnieper and the Don into the Euxine, and the vaſt Wolga into the Caſpian Sea.

WESLEY (John), one of the moſt extraordinary characters that ever exiſted; whether we conſider him as a various and voluminous writer, a zealous and indefatigable preacher, or the founder of the moſt numerous ſect in the Chriſtian world; was the ſon of the Reverend Samuel Weſley, rector of Epworth in the iſle of Axholme in Lincolnſhire, and was born in that village in the year 1703. His very infancy was diſtinguiſhed by an extraordinary incident. The parſonage-houſe at Epworth was burnt to the ground, and the flames had ſpread with ſuch rapidity, that few things of value could be ſaved. His mother, in a letter to her ſon Samuel Weſley, then on the foundation at Weſtminſter ſchool, thanks God that no lives were loſt, although for ſome time they gave up *Poor Jacky*, as ſhe expreſſes herſelf; for his father had twice attempted to reſcue the child, but was beaten back by the flames. Finding all his efforts ineffectual, he reſigned him to Divine Providence. But parental tenderneſs prevailed over human fears, and Mr Weſley once more attempted to ſave his child. By ſome means equally unexpected and unaccountable, the boy got round to a window in the front of the houſe, and was taken out, by one man's leaping on the ſhoulders of another, and thus getting within his reach. Immediately on his reſcue from this very perilous ſituation the roof fell in. This extraordinary eſcape explains a certain device, in a print of Mr John Weſley, engraved by Vertue, in the year 1745, from a painting by Williams. It repreſents a houſe in flames, with this motto from the prophet, "Is he not a brand plucked out of the burning?" Many have ſuppoſed this device to be merely emblematical of his ſpiritual deliverance; but from this circumſtance it is apparent that it has a primary as well as a ſecondary meaning; it is real as well as alluſive. This fire happened when Mr Weſley was about ſix years old.

In the year 1713 he was entered a ſcholar at the charterhouſe in London, where he continued ſeven years under the tuition of the celebrated Dr Walker, and of the Reverend Andrew Took author of The Pantheon. Being elected to Lincoln college, Oxford, he became a fellow of that college about the year 1725, took the degree of Maſter of Arts in 1726, and was joint tutor with the Reverend Dr Hutchins the rector. He diſcovered very early an elegant turn for poetry. Some of his gayer poetical effuſions are proofs of a lively fancy and a fine claſſical taſte; and ſome tranſlations from the Latin poets, while at college, are allowed to have great merit. He had early a ſtrong impreſſion, like Count Zinzendorf, of his deſignation to ſome extraordinary work. This impreſſion received additional force from ſome domeſtic incidents; all which his active fancy turned to his own account. His wonderful preſervation, already noticed, naturally tended to cheriſh the idea of his being deſigned by Providence to accompliſh ſome purpoſe or other, that was out of the ordinary courſe of human events. The late Reverend

§ Plinii, Hiſt. Nat. lib. iv. cap. 12.

Samuel Badcock, in a letter inſerted in the Bibliotheca Topographica Britannica, Nº XX, ſays, "There were ſome ſtrange phenomena perceived at the parſonage at Epworth, and ſome uncommon noiſes heard there from time to time, which he was very curious in examining into, and very particular in relating. I have little doubt that he conſidered himſelf the chief object of this wonderful viſitation. Indeed his father's credulity was in ſome degree affected by it; ſince he collected all the evidences that tended to confirm the ſtory, arranged them with ſcrupulous exactneſs, in a manuſcript conſiſting of ſeveral ſheets, and which is ſtill in being. I know not what became of the ghoſt of Epworth; unleſs, conſidered as the prelude to the noiſe Mr John Weſley made on a more ample ſtage, it ceaſed to ſpeak when he began to act."

"The dawn of Mr Weſley's public miſſion (continues Mr Badcock) was clouded with myſticiſm; that ſpecies of it which affects ſilence and ſolitude; a certain inexplicable introverſion of the mind, which abſtracts the paſſions from all ſenſible objects; and, as the French Quietiſts expreſs it, perfects itſelf by an abſorption of the will and intellect, and all the faculties, into the Deity." In this *palpable obſcure* the excellent Fenelon led himſelf when he forſook the ſhades of Pindus, to wander in queſt of *pure love* with Madam Guyon! Mr Weſley purſued for a while the ſame *ignis fatuus* with Mr William Law and the Ghoſt of De Renty. A ſtate, however, ſo torpid and ignoble, ill-ſuited the active genius of this ſingular man. His elaſtic mind gained ſtrength by compreſſion; thence burſting glorious, he paſſed (as he himſelf ſomwhere ſays) "the immenſe chaſm, upborne on an eagle's wings."

The reading of the writings of this Mr William Law, the celebrated author of Chriſtian Perfection, and of A Serious Addreſs to the Chriſtian World, contributed moreover, to lead Mr John Weſley and his brother Charles, with a few of their young fellow-ſtudents, into a more than common ſtrictneſs of religious life. They received the ſacrament of the Lord's Supper every week; obſerved all the faſts of the church; viſited the priſons; roſe at four in the morning; and refrained from all amuſements. From the exact method in which they diſpoſed of every hour, they acquired the appellation of *Methodiſts;* by which their followers have been ever ſince diſtinguiſhed.

But a more particular account of the origin of this ſect, we ſhall give from a celebrated publication. "The Methodiſts (ſays the editor of this work) form a very conſiderable claſs, principally of the lower people in this country. They ſprung up about fifty years ago at Oxford, and were ſoon divided into two parties; the one under the direction of Mr George Whitfield, and the other under that of two brothers, John and Charles Weſley. Theſe leaders, and, if we except Mr William Law, founders of the Methodiſts, were educated at Oxford, received epiſcopal ordination, and always profeſſed themſelves advocates for the articles and liturgy of the eſtabliſhed church; though they more commonly practiſed the diſſenting mode of worſhip. But conceiving a deſign of forming ſeparate communities, ſuperior in ſanctity and perfection to all other Chriſtian churches, and impreſſed to a very conſiderable degree by a zeal of an extravagant and enthuſiaſtic kind, they became itinerant preachers; and, being excluded from moſt of our churches, exerciſed their miniſtry in private houſes, fields, &c. not only in Great Britain and Ireland, but alſo in America; thus collecting a very conſiderable number of hearers and proſelytes, both among the members of the eſtabliſhed church and the diſſenters. The theological ſyſtem of Mr Whitfield and his followers is Calviniſtic; that of Mr Weſley and his diſciples Arminian; and the latter maintains the poſſibility of attaining ſinleſs perfection in the preſent ſtate. The ſubordinate teachers of both theſe claſſes of Methodiſts are generally men of no liberal education; and they pretend to derive their miniſterial abilities from ſpecial communications of the ſpirit. The Methodiſts of both parties, like other enthuſiaſts, make true religion to conſiſt principally in certain affections and inward feelings which it is impoſſible to explain; but which, when analyſed, ſeem to be mechanical in their ſpring and operation; and they generally maintain, that Chriſtians will be moſt likely to ſucceed in the purſuit of truth, not by the dictates of reaſon, or the aids of learning, but by laying their minds open to the direction and influence of divine illumination: and their conduct has been directed by impulſes."

Our readers will judge for themſelves, according to their various modes of education, and to the different lights in which they may reſpectively view the doctrines of our common Chriſtianity, whether this repreſentation of the origin of the Methodiſts, and of their diſtinguiſhing tenets, be accurate and juſt.—Not preſuming to ſit in judgment on the religious opinions of any man, we ſhall only obſerve, that an appellation originally given in reproach, has been gloried in ever ſince by thoſe who have diſtinguiſhed themſelves as the followers either of Mr Whitfield or of Mr Weſley. "After the way called *Methodiſm*, ſo worſhip they the God of their fathers." But the ridicule and contempt which the ſingularity of their conduct produced, both John and Charles Weſley were well qualified to bear. They were not to be intimidated by danger, actuated by intereſt, or deterred by diſgrace.

The boundaries of this iſland were ſoon deemed by Mr Weſley too confined for a zeal which diſplayed the piety of an apoſtle; and of an intrepidity to which few miſſionaries, had been ſuperior. In 1735 he embarked for Georgia, one of the colonies, which was at that time in a ſtate of political infancy; and the great object of this voyage was to preach the goſpel to the Indian nations in the vicinity of that province. He returned to England in 1737. Of his ſpiritual labours, both in this country and in America, he himſelf has given a very copious account, in a ſeries of Journals, printed at different periods. Theſe journals drew upon our laborious preacher and his coadjutors ſome ſevere animadverſions from two right reverend prelates; Dr George Lavington biſhop of Exeter, and Dr William Warburton biſhop of Glouceſter. The former publiſhed in three parts, The Enthuſiaſm of the Methodiſts and Papiſts compared; the third part of this performance containing a perſonal charge of immoral conduct. Mr Weſley, in his vindication, publiſhed a letter to his Lordſhip, which produced a reply from the latter.

Biſhop Warburton's attack is contained in his celebrated treatiſe, entitled the Doctrine of Grace: or, The office and Operations of the Holy Spirit, vindicated from the Inſults of Infidelity, and the abuſes of Fanaticiſm: concluding with ſome thoughts, humbly offered to the conſideration of the Eſtabliſhed Clergy, with regard to the Right Method of defending Religion againſt the Attacks of either Party; 2 vols, ſmall 8vo, 1762. There is much acute reaſoning, and much poignant and ſprightly wit, in his Doctrine of Grace; but there is too much levity in it for a grave biſhop, and too much abuſe for a candid Chriſtian. On this occaſion, Mr Weſley publiſhed a letter to the biſhop, in which, with great temper and moderation, as well as with great ingenuity and addreſs, he endeavoured to ſhelter himſelf from his Lordſhip's attacks; not only under the authority of the Holy Scriptures, but of the church itſelf, as by law eſtabliſhed.

On his return from Georgia, Mr Weſley paid a viſit to

Weſley, Weſt.

Count Zinzendorf, the celebrated founder of the ſect of Moravians, or Hernhutters, at Hernuth in Upper Luſatia. In the following year he appeared again in England, and with his brother Charles, at the head of the Methodiſts. He preached his firſt field-ſermon at Briſtol, on the 2d of April 1738, from which time his diſciples have continued to increaſe. In 1741, a ſerious altercation took place between him and Mr Whitfield. In 1744, attempting to preach at an inn at Taunton, he was regularly ſilenced by the magiſtrates. Although he chiefly reſided for the remainder of his life in the metropolis, he occaſionally travelled through every part of Great Britain and Ireland, eſtabliſhing congregations in each kingdom. In 1750 he married a lady, from whom he was afterwards ſeparated. By this lady, who died in 1781, he had no children.

We have already mentioned Mr Weſley as a very various and voluminous writer. Divinity, both devotional and controverſial, biography, hiſtory, philoſophy, politics, and poetry, were all, at different times, the ſubjects of his pen: and, whatever opinion may be entertained of his theological ſentiments, it is impoſſible to deny him the merit of having done very extenſive good among the lower claſſes of people. He certainly poſſeſſed great abilities, and a fluency which was well accommodated to his hearers, and highly acceptable to them. He had been gradually declining for three years before his death; yet he ſtill roſe at four in the morning, and preached, and travelled, and wrote as uſual. He preached at Leatherhead, in Surrey, on the Wedneſday before that event. On the Friday following, appeared the firſt ſymptoms of his approaching diſſolution. The four ſucceeding days he ſpent in praiſing God; and he left this ſcene, in which his labours had been ſo extenſive and ſo uſeful, at a quarter before ten in the morning of the 2d of March 1791, in the 88th year of his age. His remains, after lying in a kind of ſtate at his chapel in the city-road, dreſſed in the ſacerdotal robes which he uſually wore, and on his head the old clerical cap, a bible in one hand, and a white handkerchief in the other, were, agreeable to his own directions, and after the manner of the interment of the late Mr Whitfield, depoſited in the cemetry behind his chapel, on the morning of the 9th March, amid an innumerable concourſe of his friends and admirers; many of whom appeared in deep mourning on the occaſion. One ſingularity was obſervable in the funeral ſervice. Inſtead of, "We give thee hearty thanks, for that it hath pleaſed thee to deliver this our brother;" it was read "our father." A ſermon, previouſly to the funeral, had been preached by Dr Thomas Whitehead, one of the phyſicians to the London hoſpital; and on the 13th the different chapels of his perſuaſion in London were hung with black.

It has been juſtly obſerved of Mr Weſley, that his labours were principally devoted to thoſe who had no inſtructor; to the highways and hedges; to the miners in Cornwall, and the coalliers in Kingſwood. Theſe unhappy creatures married and buried among themſelves, and often committed murders with impunity, before the Methodiſts ſprung up. By the humane and active endeavours of Mr Weſley and his brother Charles, a ſenſe of decency, morals, and religion, was introduced into the loweſt claſſes of mankind; the ignorant were inſtructed, the wretched relieved, and the abandoned reclaimed. His perſonal influence was greater, perhaps, than that of any other private gentleman in any country.---But the limits of this article will not permit us to expatiate further on the character of this extraordinary man.

WEST (Gilbert), was the ſon of Dr Weſt, prebendary of Wincheſter, and chaplain to king George I. but at 12 years of age loſt his father. He ſtudied at Wincheſter and Eton ſchools, and from thence was placed in Chriſt-church college, Oxford. His ſtudious and ſerious turn inclined him to take orders; but lord Cobham, his uncle, diverted him from that purſuit, and gave him a cornetcy in his own regiment. This profeſſion he ſoon quitted, on account of an opening of another nature, which preſented him with a flattering proſpect of advancement in life. A number of young gentlemen were to be elected from the univerſities, and, at the expence of the government, were to be taught foreign languages; and then ſent to the ſecretaries office, to be initiated into buſineſs, and trained there for public ſervices, as envoys, ambaſſadors, &c. Mr Gilbert Weſt was one of the few pitched upon; and on his firſt introduction into that office, lord Townſend, ſecretary of ſtate, treated him with ſingular marks of regard, and the ſtrongeſt inclinations to ſerve him were teſtified from all quarters. But his uncle lord Cobham's ſtrong oppoſition to the meaſures of the government, rendered theſe advantages entirely fruitleſs; and the miniſters honeſtly told Mr Weſt, that he muſt not expect them to diſtinguiſh his merit, as any favours conferred upon him would be imputed as done to his uncle lord Cobham. Mr Weſt now left that office, and all his views of making his fortune; and entering into marriage, retired to Wickham in Kent, where he lived in great domeſtic comfort and tranquil happineſs. He was there viſited by his valuable friends, who held the moſt delightful converſe of wit, humour, and learning, ſupported upon the principles of virtue, ſound reaſoning, and ſolid friendſhip, which rendered the whole cheerful, animating, and inſtructive. Mr William Pitt, who was one of thoſe that compoſed this happy ſociety, becoming paymaſter, appointed Mr Weſt treaſurer to Chelſea-hoſpital; and he obtained a ſeat at the council-board, in conſequence of a friendſhip contracted at ſchool with one of the duke of Devonſhire's ſons, who procured of his grace his being nominated one of the clerks extraordinary of that office. Towards the latter part of Mr Weſt's life, he wholly applied himſelf to the ſtudy of the Scriptures; being extremely anxious to try his utmoſt endeavours to reconcile the ſeeming inconſiſtencies which gave the enemies to revealed religion a handle to doubt and diſcredit their authenticity. His obſervations on the reſurrection, which, it has been ſaid, were written to confirm the wavering faith of his great friends Pitt and Lyttleton, bear ample teſtimony to his reaſoning powers and the ſincerity of his religion; while his tranſlations of Pindar ſhow him to have been an eminent Greek ſcholar, and very conſiderable poet. He had a mind replete with virtue, and was an honour to his country; but died at 50 years of age.

Weſt.
Weſtminſter.

WEST, one of the cardinal points of the horizon, diametrically oppoſite to the eaſt; and ſtrictly defined the interſection of the prime vertical with the horizon on that ſide the ſun ſets in.

WESTMINSTER, a city which forms the weſt part of the capital of Britain, but has a government diſtinct from the reſt. This city had its name from the ſituation of its abbey, anciently called a *minſter*, in reſpect of that of St Paul. That part properly called the city of Weſtminſter, comprehending the pariſhes of St John and St Margaret, was once an iſland formed by the Thames, called *Thorney iſland*, from the thorns with which it was over-run; and the abbey that ſtood in it, Thorney-abbey. The liberties of Weſtminſter contain the ſeveral pariſhes of St Martin in the Fields, St James's, St Anne, St Paul, Covent-garden, St Mary le Strand, St Clement, Danes, St George, Hanover Square, and the precinct of the Savoy. The government, both of the city and liberties, is under the juriſdiction of the dean and chapter of Weſtminſter, in civil as well as eccleſiaſtical affairs; and their authority extends to the precinct of St Martin le Grand, by Newgate-ſtreet, and in ſome towns of Eſſex, that are exempted from the juriſdiction of the biſhop of London and the archbiſhop of Canterbury; but the management of the civil part has, ever ſince the Reformation, been in the hands of laymen, elected from time to time, and confirmed by the dean and chapter. The chief of theſe laymen are the high-ſteward, the deputy-ſteward, and the high-bailiff, who hold their offices for life. There are alſo 16 burgeſſes and their aſſiſtants, out of which are elected two head-burgeſſes, one for the city, and the other for the liberties. Another officer is the high-conſtable, who has all the other conſtables under his direction.

WESTMORELAND, a county of England, bounded on the north and north-weſt by Cumberland; on the ſouth and ſouth-eaſt by Yorkſhire; and on the ſouth and ſouth-weſt by Lancaſhire. Its extent from north-eaſt to ſouth, is 40 miles, and its breadth from the eaſt projection to that in the weſt, 42.* It is generally divided into the baronies of Kendal and Weſtmoreland: the former is very mountainous, but the latter is a large champaign country. Theſe are the only principal diviſions of this county, which contains 8 market-towns and 26 pariſhes. It lies partly in the dioceſe of Cheſter, and partly in that of Carliſle. The earl of Thanet is hereditary ſheriff of the county, which ſends only four members to parliament. The air is clear, ſharp, and ſalubrious, the natives being ſeldom troubled with diſeaſes, and generally living to old age. The ſoil is various; that on the mountains is very barren, while that in the valleys is fertile, producing good corn and graſs, eſpecially in the meadows near the rivers. In the hilly parts on the weſtern borders it is generally believed there are vaſt quantities of copper ore, and veins of gold; ſome mines of copper are worked, but moſt of the ore lies ſo deep that it will not anſwer the expence. This county yields the fineſt ſlate, and abundance of excellent hams are cured here. The principal rivers are, the Eden, the Lone, and the Ken. It has alſo ſeveral fine lakes, the principal of which is Winander Mere, or Windermere Water. In the foreſt of Martindale, to the ſouth of Ulls-water, the breed of red deer ſtill exiſts in a wild ſtate. Appleby is the county town.

WESTPHALIA, a duchy of Germany, bounded to the eaſt by the biſhopric of Paderborn, and the territories of Waldeck and Heſſe; to the ſouth by the counties of Witgenſtein and Naſſau, and the duchy of Berg; to the north by the biſhopric of Munſter and the county of Lippe. It is about 40 miles in length and 30 in breadth. The lower part of it is very fruitful, yielding plenty of corn and cattle, and ſome ſalt-ſprings. The higher affords iron-ore, calamine, lead, copper, ſome ſilver and gold, fine woods, cattle, game, fiſh, with a little corn. The rivers, that either paſs through the duchy or along its borders, are the Rahr, the Lenne, the Bigge, the Dimel, and the Lippe. There are 28 towns in it, beſides boroughs and cloiſters. The provincial diets are held at Arenſberg. In the year 1180, the emperor Fred. I. made a donation of this duchy to the archbiſhopric of Cologne, which was confirmed by ſucceeding emperors; and in 1638, the laſt duke of Arenſberg ceded to it alſo the county of Arenſberg. The duchy is governed at preſent by a bailiff, under the archbiſhop, and is divided into the Hellwege, the Haarſtrank, and the Surland; or otherwiſe into the Ruden, the Werl, the Bilſtein, and the Brilon quarters.

Weſtphalia, one of the circles of Germany, anciently the people inhabiting between the Weſer and the Rhine, were called *Weſtphalians*; and hence that tract got the name of *Weſtphalia*: but the circle of that name is of a larger extent, being ſurrounded by the circle of Burgundy, or the Auſtrian Netherlands, the United Provinces, and the North Sea, with the circles of the Upper and Lower Rhine, and compriſing a great many different ſtates.

The ſummoning princes and directors of the circle of Weſtphalia, are the biſhops of Munſter, alternately with the electors of Brandenburg and Palatine, as dukes of Cleve and Juliers. The archives belonging to it were before the preſent war (1797) kept at Duſſeldorp. Its quota of men and money is ſomewhat more than the ninth part of the whole ſum granted by the empire. With reſpect to religion, it is partly Proteſtant and partly Catholic; but the Proteſtants predominate, and are, at leaſt the greater part of them, Calviniſts. The air of this country is not reckoned very wholeſome, and towards the north is extremely cold in winter. The ſoil in general is marſhy and barren; yet there is ſome good corn and paſture land: but the fruit is chiefly uſed to feed hogs; and hence it is that their bacon and hams are ſo much valued and admired.

WET couch, *coming heap*, a term uſed by the maltſters for one of the principal articles of malt-making. See Brewing, n° 4.

WETSTEIN (John James), a very learned German divine, born at Baſil in 1693. On his admiſſion to the miniſtry, he maintained a theſis *De variis Novi Teſtamenti Lectionibus*; in which he ſhowed that the great variety of readings of the New Teſtament afford no argument againſt the authenticity of the text. He had made theſe various readings the object of his attention; and travelled into foreign countries to examine all the MSS. he could come at. In 1730, he publiſhed *Prolegomena ad Novi Teſtamenti Græci editionem accuratiſſimam, &c.* Some divines, dreading his unſettling the preſent text, procured a decree of the ſenate of Baſil againſt his undertaking, and even got him prohibited from officiating in the miniſtry; on which he went to Amſterdam, where the Remonſtrants named him to ſucceed the famous Le Clerc, then ſupperannuated, as profeſſor of philoſophy and hiſtory. At laſt he publiſhed his edition of the New Teſtament, in 2 vols folio, 1752; in which he left the text as he found it, placing the various readings, with a critical commentary, underneath; ſubjoining two epiſtles of Clemens Romanus, till then unknown to the learned, but diſcovered by him in a Syriac MS. of the New Teſtament. He alſo publiſhed ſome ſmall works; and is ſaid to have been not only an univerſal ſcholar, but to have abounded in good and amiable qualities. He died at Amſterdam in 1754.

WETTERAVIA, the ſouthern diviſion of the Landgravate of Heſſe in Germany, lying along the northern bank of the river Maine, comprehending the counties of Hanau and Naſſau.

WEXFORD, a county of Ireland, in the province of Munſter, 38 miles in length, and 24 in breadth; bounded on the north by Wicklow, on the eaſt by St George's Channel, on the ſouth by the Atlantic Ocean, on the weſt by Waterford and Kilkenny, and on the north by Catherlough. It contains 109 pariſhes, and ſends 18 members to parliament. It is a fruitful country in corn and graſs; and the principal town is of the ſame name.

Wexford, a ſea-port of Ireland, capital of a county of the ſame name. It was once reckoned the chief city in Ireland, being the firſt colony of the Engliſh, and is ſtill a large handſome town, with a very commodious harbour at the mouth of the river Slana, on a bay of St George's Channel, 63 miles ſouth of Dublin. W. Long. 6. 3. N. Lat. 52. 18.

WHALE, in ichthyology. See Balæna and Physeter.

Whale, in aſtronomy, one of the conſtellations. See Astronomy, n° 406.

Whale-Bone. See Balæna, nº 2.

Whale-Fiſhery. See Fishery.

WHARF, a ſpace on the banks of a haven, creek, or hithe, provided for the convenient loading and unloading of veſſels.

WHARTON (Philip duke of), a nobleman of the moſt brilliant parts, but of the moſt whimſical, extravagant, and inconſiſtent turn of mind, was educated by his father's expreſs order at home. He very early married a young lady, the daughter of major-general Holmes, which diſappointed his father's views of diſpoſing of him in ſuch a marriage as would have been a conſiderable addition to the fortune and grandeur of his illuſtrious family; yet that amiable lady deſerved infinitely more felicity than ſhe met with by this alliance. This precipitate marriage is thought to have haſtened the death of his father; after which the duke, being free from paternal reſtraints, plunged into thoſe exceſſes which rendered him, as Pope expreſſes it,

> " A tyrant to the wiſe his heart approv'd;
> " A rebel to the very king he loved."

In the beginning of the year 1716, he began his travels; and as he was deſigned to be inſtructed in the ſtricteſt Whig principles, Geneva was thought a proper place for his reſidence. He firſt paſſed through Holland, and viſited ſeveral courts of Germany; and being arrived at Geneva, conceived ſuch a diſguſt againſt his governor, that he left him, and ſet out poſt for Lyons, where he wrote a letter to the chevalier de St George, who then reſided at Avignon, and preſented him a very fine ſtout horſe; which the chevalier no ſooner received than he ſent a man of quality to him, who took him privately to his court, where he was entertained with the greateſt marks of eſteem, and had the title of duke of Northumberland conferred upon him. He, however, remained there but one day, and then returned poſt to Lyons, whence he ſet out for Paris. He likewiſe paid a viſit to the conſort of James II. who then reſided at St Germains, to whom he alſo paid his court. During his ſtay at Paris, his winning addreſs and abilities gained him the eſteem and admiration of all the Britiſh ſubjects of rank of both parties.

About the latter end of December 1716, he arrived in England, whence he ſoon after ſet out for Ireland, where, though under age, he was allowed the honour to take his ſeat in the houſe of peers, and immediately diſtinguiſhed himſelf, notwithſtanding his former conduct, as a violent partizan for the miniſtry; in conſequence of which zeal the king created him a duke. He no ſooner came of age than he was introduced to the houſe of lords in England with the ſame blaze of reputation. In a little time he oppoſed the court, and appeared one of the moſt vigorous in defence of the biſhop of Rocheſter; and ſoon after printed his thoughts twice a-week, in a paper called the *True Briton*, ſeveral thouſands of which were diſperſed weekly.

The duke's boundleſs profuſion had by this time ſo burdened his eſtate, that by a decree of Chancery it was veſted in the hands of truſtees for the payment of his debts, allowing him a proviſion of L. 1200 *per annum* for his ſubſiſtence. This being not ſufficient to ſupport his title with ſuitable dignity, he went abroad and ſhone to great advantage, with reſpect to his perſonal character, at the imperial court. From thence he made a tour to Spain: the Engliſh miniſter was alarmed at his arrival, fearing that his grace was received in the character of an ambaſſador: upon which the duke received a ſummons under the privy-ſeal to return home; but inſtead of obeying it, he endeavoured to inflame the Spaniſh court againſt that of Great Britain, for exerciſing an act of power, as he calls it, within the juriſdiction of his Catholic majeſty. He then acted openly in the ſervice of the Pretender, and was received at his court with the greateſt marks of favour.

While his grace was thus employed, his neglected ducheſs died in England on the 14th of April 1726, without iſſue. Soon after the duke fell violently in love with M. Oberne, one of the maids of honour to the queen of Spain, the daughter of an Iriſh colonel, whoſe fortune chiefly conſiſted in her perſonal accompliſhments. All his friends, and particularly the queen of Spain, oppoſed the match; but he falling into a lingering fever, occaſioned by his diſappointment, the queen gave her conſent, and they were ſoon after married. He then ſpent ſome time at Rome, where he accepted of a blue garter, aſſumed the title of duke of Northumberland, and for a while enjoyed the confidence of the exiled prince. But not always keeping within the bounds of Italian gravity, it became neceſſary for him to remove from hence; when, going by ſea to Barcelona, he wrote a letter to the king of Spain, acquainting him that he would aſſiſt at the ſiege of Gibraltar as a volunteer. Soon after he wrote to the chevalier de St George, expreſſing a deſire to viſit his court; but the chevalier adviſed him to draw near to England.

The duke ſeemed reſolved to follow his advice; and ſetting out with his ducheſs, arrived in Paris in May 1728, whence he ſoon after proceeded to Rouen, where he took up his reſidence; and was ſo far from making any conceſſion to the government of England, that he did not give himſelf the leaſt trouble about his eſtate, or any other concern there; though, on his arrival at Rouen, he had only about L.600 in his poſſeſſion, and a bill of indictment was preferred againſt him in England for high-treaſon. Soon after the chevalier ſent him L. 2000, which he ſquandered away in a courſe of extravagance; when, to ſave the charges of travelling by land, he went from Orleans to Nantz by water, and ſtaid there till he got a remittance from Paris, which was ſquandered almoſt as ſoon as received. At Nantz he was joined by his ragged ſervants, and from hence took ſhipping with them for Bilboa, when the queen of Spain took the ducheſs to attend her perſon. About the beginning of the year 1731, the duke, who commanded a regiment, was at Lerida, but declined ſo faſt that he could not move without aſſiſtance; yet when free from pain did not loſe his gaiety. He, however, received benefit from ſome mineral waters in Catalonia; but ſoon after relapſed at a ſmall village, where he was utterly deſtitute of all the neceſſaries of life, till ſome charitable fathers of a Bernardine convent removed him to their houſe, and gave him all the relief in their power. Under their hoſpitable roof he languiſhed a week, and then died, without one friend or acquaintance to cloſe his eyes, and his funeral was performed in the ſame manner in which the fathers inter thoſe of their own fraternity.

Thus died Philip duke of Wharton, " who, like Buckingham and Rocheſter (ſays Mr Walpole), comforted all the grave and dull, by throwing away the brighteſt profuſion of parts on witty fooleries, debaucheries, and ſcrapes, which mix graces with a great character, but never can compoſe one.

" With attachment to no party, though with talents to govern any party, this lively man changed the free air of Weſtminſter for the gloom of the Eſcurial, the proſpect of king George's garter for the Pretender's; and with indifference to all religion, the frolic lord who had writ the ballad on the archbiſhop of Canterbury, died in the habit of a capuchin. It is difficult to give an account of the works of a man whoſe library was a tavern, and women of pleaſure his muſes. A thouſand ſallies of his imagination may have been loſt. There are only two volumes in 8vo, called *his Life and Writings*. Theſe contain nothing of the latter, but 74 numbers of the True Briton, and his ſpeech in defence of the biſhop of Rocheſter. His other works are the ballads above mentioned; the Drinking Match at Eden-hall, in imitation of the Chevy-Chace, printed in a miſcellany called *Whartoniana*; and a parody of a ſong ſung at the opera-houſe by Mrs Toſts. His lordſhip alſo began a play on the ſtory of the queen of Scots."

WHEAT, in botany. See TRITICUM. For the culture of wheat, ſee AGRICULTURE, n° 122—136.

The three principal kinds of bad wheat are, the *blighted*, the *ſmutty*, and the *worm-eaten*. Blighted wheat is that of which the ſtalk is a little twiſted and rickety, the blade being of a bluiſh green and curled up, the grain alſo is green and tubercled: ſmutty wheat appears as if great part of the ear had been burnt, ſome ſmall parts only being free, and, in particular, the ſtem that riſes in the centre of the ear, round which the grain is ranged: worm eaten or rotten wheat is corrupted without loſing much of its natural form, or external appearance; the huſk is filled with a greaſy, black powder, that is inſufferably fetid. It appeared, from the experiments of M. Tillet, that there was a kind of infectious quality in all thoſe kinds of wheat; ſo that if ſound wheat was ſprinkled with the flour of ſmutty or rotten wheat, the crop produced would be rotten or ſmutty. It appeared alſo, that among the grain which was produced from ground manured with the ſtraw of diſtempered wheat, there was a much greater proportion of diſtempered wheat than in that produced from ground manured with the ſtraw of good wheat: the great ſecret then was to deſtroy the principle of this contagion in the wheat that was put into the ground; and M. Tillet found, as the reſult of a great number of experiments, that if the grain, before it is ſowed, be well moiſtened with a ſolution of ſea-ſalt, or nitre, in common water, none of the enſuing crop will be ſmutty, or otherwiſe defective, either in kind or quality; not only ſuppoſing the grain that is ſowed to be ſound, and the ſoil to be good, but even ſuppoſing the grain to be ſtrewed with the flour of ſmutty wheat, and the ground manured with bad ſtraw.

Prize Diſſertation by the Academy of Bourdeaux.

The following receipt for preventing ſmutty wheat was publiſhed in 1769 by order of the Society for the Encouragement of Arts: they received it from Mr John Reynolds of Adiſham in Kent.

A tub is to be procured that has a hole at bottom, in which a ſtaff and tap-hoſe is to be fixed over a whiſp of ſtraw, to prevent any ſmall pieces of lime paſſing (as in the brewing way); this done, we put 70 gallons of water, then a corn buſhel heap-full of ſtone-lime, unſlaked, ſtirring it well till the whole is diſſolved or mixed, letting it ſtand about 30 hours, and then run it off into another tub as clear as we can (as practiſed in beer): this generally produces a hogſhead of good ſtrong lime-water, then add three pecks of ſalt, 42 pounds, which, with a little ſtirring, will ſoon diſſolve; thus we have a proper pickle for the purpoſe of brining and liming our ſeed-wheat without any manner of obſtacle, which is more than can be ſaid in doing it the common way, and greatly facilitates the drilling.

Herein we ſteep the wheat in a broad-bottomed baſket of about 24 inches diameter, and 20 inches deep (for large ſowing made on purpoſe), running in the grain gradually in ſmall quantities from 10 to 12 gallons up to 16 gallons, ſtirring the ſame. What floats, we ſkim off with a ſtrainer, and is not to be ſown: then draw up the baſket, to drain over the pickle, for a few minutes; all which may be performed within half an hour, ſufficiently pickled; and ſo proceed as before. This done, the wheat will be fit for ſowing in 24 hours, if required; but if deſigned for drilling, two hours pickled will be found beſt; and if prepared four or five days before-hand, in either caſe it makes no difference at all; but ſhould the ſeed be clammy, and ſtick to the notches in the drill-box, more lime muſt be added to the lime-water; here the maſter muſt uſe his diſcretion, as the caſe requires; for ſome lime has much more drying or aſtringent qualities in it than others. If ſea-water can be obtained conveniently, much leſs ſalt will ſuffice, but ſome will be found neceſſary even then, otherwiſe the light grains will not float, a thing of more conſequence than is generally imagined, and it ought to be ſkimmed off and thrown aſide for poultry, &c.

WHEEL, in mechanics, a ſimple machine, conſiſting of a round piece of wood, metal, or other matter, which revolves on its axis. See MECHANICS.

WHEEL-Carriages. See MECHANICS, Sect. iv.

WHEEL-Animal. See ANIMALCULE, n° 16—23.

WHEEL, Perſian. See HYDROSTATICS.

WHEEL, Potter's. See POTTERY.

WHEEL is alſo the name of a kind of puniſhment to which great criminals are put in divers countries. In ſome, aſſaſſins, parricides, and robbers on the highway, are ſaid to be condemned to the wheel, when they are to have their bones firſt broken with an iron bar on a ſcaffold, and then to be expoſed, and left to expire on the circumference of a wheel. In Germany they break their bones on the wheel itſelf. Of this cruel puniſhment, it is not certain who was the inventor: it was firſt uſed in Germany, and was, indeed, but rarely practiſed anywhere elſe, till the time of Francis I. of France; who, by an edict of the year 1534, appointed it to be inflicted on robbers on the highway.

WHEELER (Sir George), a learned traveller and divine, was the ſon of colonel Wheeler of Charing in Kent, and was born in 1650 at Breda, where his parents as royaliſts were then in exile. He travelled through various parts of Greece and the Eaſt in company with Dr James Spon of Lyons; and taking orders on his return, was inſtalled a prebend of Durham, made vicar of Baſingſtoke, and afterward rector of Houghton le Spring. He publiſhed an account of his Travels in 1682 in folio; and in 1689, his Obſervations on ancient edifices of Churches yet remaining in the Eaſt, compared with Euſebius: alſo the Proteſtant Monaſtery, or Chriſtian Œconomics. He died in 1724.

WHEELINGS, in the military art, are different motions made both by horſe and foot, either to the right and left, or to the right and left about.

General Rules for WHEELING.—The circle is divided into four equal points: thence, wheeling to the right or left, is only a quarter of the circle; wheeling to the right or left about is one half of the circle.

When you wheel to the right, you are to cloſe to the right, ſo near as to touch your right-hand man, but without preſſing him; and to look to the left, in order to bring the rank about even.

When you wheel to the left, you are to cloſe to the left, and look to the right as above directed. This rule will ſerve for all the wheeling by ranks; as when a battalion is marching by ſubdiviſions with their ranks open, then each rank wheels diſtinctly by itſelf, when it comes to the ground on which the ranks before it wheeled, but not before.

In wheeling, the men are to take particular care neither to open nor cloſe their ranks, and to carry their arms well.

In wheeling, the motion of each man is quicker or ſlower, according to the diſtance he is from the right or the left: thus, when you wheel to the right, each man moves quicker than his right-hand man; and wheeling to the left, each man moves quicker than his left-hand man; the circle that every man wheels being larger, according to the diſtance he is from the hand he wheels to; as may be ſeen by deſcribing ſeveral circles within one another, at two feet diſtance from each, which is nearly the ſpace every man is ſuppoſed to take up.

WHELK, in zoology. See Buccinum.

WHELP, the young of a dog, fox, lion, or any wild beaſt.

Whelps, in a ſhip, the ſeaman's term for thoſe brackets which are ſet up on the capſtan cloſe under the bars; they give the ſweep to it, and are ſo contrived that the cable winding about them may not ſurge ſo much as it might otherwiſe do if the body of the capſtan were quite round and ſmooth.

WHESTONE, a ſtone which ſerves for the whetting of knives and other tools upon.

WHEY, the ſerum or watery part of milk.

WHIDAH, a kingdom of Africa, on the coaſt of Guinea, and to the weſt of the Gold Coaſt; extending about 10 miles along the ſea. It is a populous country, well furniſhed with large villages; and there are ſo many ſmall ones, that they are not above a muſket-ſhot from each other.—The houſes are ſmall, round at the top, and encompaſſed with mud walls or hedges, together with a great number of all ſorts of beautiful and lofty trees, which afford the moſt beautiful proſpect in the world, inſomuch that thoſe that have been here repreſent it as a perfect paradiſe. The fields are always green, and they cultivate beans, potatoes, and fruits; nor will the negroes here let a foot of ground remain uncultivated. They ſow again the very next day after they have reaped. The inhabitants are greatly civilized, very reſpectful to each other, eſpecially to their ſuperiors, and very induſtrious. The women brew the beer, dreſs the victuals, and ſell all ſorts of commodities at the market. Thoſe that are rich employ their wives and ſlaves in tilling the land, and they carry on a conſiderable trade with the product, as well as in ſlaves; for ſome of them are able to deliver 1000 of the latter every month. The chief men have generally 40 or 50 wives, the principal captains 300 or 400, and the king 4000 or 5000. They are extremely jealous, and, on the leaſt ſuſpicion, will ſell them to the Europeans for ſlaves. If any one happen to touch one of the king's wives accidentally, he is doomed to perpetual ſlavery. It is no wonder then that the women are not fond of being the king's wives; and ſome of them will prefer a ſpeedy death to ſuch a miſerable life. They have no diſtinction of hours, days, weeks, months, or years. The rite of circumciſion is uſed here, but they are not able to tell why they uſe it, nor whence it is derived. They are ſuch great gameſters, that they will ſtake all they have at play, not excepting their wives and children. They have a vaſt number of idols; and they deify the moſt contemptible animal that they ſee firſt in a morning, and even ſtocks and ſtones. Their principal regard is for ſnakes, very high trees, and the ſea. An Engliſh factor, juſt arrived, found a ſnake in the houſe belonging to the factory, and killed it without the leaſt ſcruple; which ſo incenſed the negroes, that they were for revenging the death of the ſnake, not only upon him that killed it, but upon the whole factory; but by dint of preſents, and the interpoſition of the people of the other factories, this affair was made up, and the ſnake honourably interred. However, to prevent ſuch accidents, they gave them warning not to do the like for the future. They have oxen, cows, goats, ſheep, hogs, turkeys, ducks, and hens; which laſt are extremely plentiful. There are many elephants, buffaloes, tigers, ſeveral kinds of deer, and a ſort of hares. The fruits are citrons, lemons, oranges, bananas, tamarinds, &c. and they have vaſt numbers of palm-trees, from which they obtain wine. Whidah was conquered by the king of Dahomy. Their trade conſiſts of ſlaves, elephants teeth, wax, and honey. The Engliſh factory is 200 miles eaſt of Cape Coaſt Caſtle, within land. Bows, arrows, beautiful aſſaguays, and clubs, are the principal weapons of the nation.

WHIDAW-Bird. See Emberiza.

WHIG, a party in Britain, oppoſite to the Tories, from whom they differ chiefly in their political principles. See Tories.

WHIMBREL. See Scolopax.

WHIN, in botany. See Ulex.

WHINCHET. See Motacilla.

WHIP, or *Whip-Staff*, in a ſhip, a piece of timber, in form of a ſtrong ſtaff, faſtened into the helm, for the ſteerſman, in ſmall ſhips, to hold in his hand, in order to move the rudder, and direct the ſhip.

WHIRLPOOL, an eddy, vortex, or gulf, where the water is continually turning round.

Thoſe in rivers are very common, from various accidents, and are uſually very trivial, and of little conſequence. In the ſea they are more rare, but more dangerous. Sibbald has related the effects of a very remarkable marine whirlpool among the Orcades, which would prove very dangerous to ſtrangers, though it is of no conſequence to the people who are uſed to it. This is not fixed to any particular place, but appears in various parts of the limits of the ſea among theſe iſlands. Wherever it appears, it is very furious; and boats, &c. would inevitably be drawn in and periſh with it; but the people who navigate them are prepared for it, and always carry an empty veſſel, a log of wood, or large bundle of ſtraw, or ſome ſuch thing, in the boat with them; as ſoon as they perceive the whirlpool, they toſs this within its vortex, keeping themſelves out: this ſubſtance, whatever it be, is immediately received into the centre, and carried under water; and as ſoon as this is done, the ſurface of the place where the whirlpool was becomes ſmooth, and they row over it with ſafety: and in about an hour they ſee the vortex begin again in ſome other place, uſually at about a mile's diſtance from the firſt.

WHIRLWIND, a wind which moves in a ſpiral direction, as well as horizontally, which is exceedingly rapid and impetuous, but only of ſhort duration.

Dr Franklin's opinion of the origin of whirlwinds has been already given in the article *Water Spout*. If his theory be true, it will follow, that no hurricane ever can be ſo violent as to remove an obſtacle of the ſize of only one cubic inch, provided that was ſupported by a power equivalent to 15 pounds; for this is the utmoſt force of the atmoſphere when ruſhing into a perfect vacuum, which never could take place in the centre of a whirlwind or water-ſpout. Indeed, notwithſtanding the dreadful effects ſometimes obſerved from hurricanes and whirlwinds, we ſhall eaſily perceive, that the utmoſt of their power always falls very far ſhort of this. The diminution of the ſpecific gravity of the air by only $\frac{1}{4}$th in the middle of the column, would produce ſuch an afflux of air from all quarters, that an obſtacle preſenting a ſurface of one foot ſqnare, would require a force of 504 pounds to prevent it from being carried away; which the ſtrongeſt walls that can be built by human art could ſcarce reſiſt. Nay, even the tenth part of this, or the diminution of the gravity of the atmoſphere by $\frac{1}{40}$th part, would produce a preſſure of upwards of 50 pounds on every ſquare foot of ſurface, which, it is to be doubted, whether any of our common houſes could reſiſt.

Some philoſophers aſcribe the vacuum in the atmoſphere to which, according to Dr Franklin's theory, whirlwinds are owing, to a ſtream of electric matter ruſhing with violence into the atmoſphere out of the earth. But they do not inform

form us how this matter comes to be accumulated in that part of the earth; what induces it to paſs out of the earth: how it paſſes inviſibly through pure air; or what ſerves it for a conductor. It ſeems to be the faſhion among certain philoſophers to aſcribe every phenomenon, with the cauſe of which we are unacquainted, to electricity. But this is merely ſubſtituting a new name, and ſerves rather to retard than advance our knowledge of nature.

Some kinds of whirlwinds move with a ſlow motion, and are injurious only by their vortex; while others ſeem to do miſchief as well by their progreſſive as their whirling motion. Of this kind are thoſe called *typhons;* which, by their frequently following the courſe of rivers, ſeem thus alſo to diſcover their electrical origin. Of the deſtructive effects of theſe, we have an inſtance in what happened at Charleſtown in South Carolina, on the 1ſt of June 1761. It was firſt obſerved about noon, on land, upwards of 50 miles weſt-by-ſouth of Charleſtown, and deſtroyed ſeveral houſes, &c. as it paſſed along, in many places making wide avenues thro' the woods; from whence every tree and ſhrub was torn up, and great branches of trees were driven about in the column as it paſſed along. It directed its courſe to Aſhley river, down which it came with ſurpriſing velocity; in its appearance reſembling a column of ſmoke or vapour, whoſe motion was very irregular and tumultuous. Its momentum was ſo great, that Aſhley river was ploughed to the bottom, and the channel laid bare. As it came down this river, it made a conſtant noiſe like thunder; its diameter being computed about 300 fathoms. It was met at White Point by another of the ſame kind which came down Cooper's river, but with inferior ſtrength; however, on their meeting together, the agitation of the air was much greater, while the clouds, which were driving in all directions to the place, ſeemed to be precipitated, and whirled round with incredible velocity. It then fell upon the ſhipping in the road; entirely deſtroying ſome, and damaging others: being ſcarce three minutes in its paſſage, though the diſtance was near two leagues. In that ſhort time it did damage to the amount of L. 20,000; and had not its direction been altered by that guſt which came down Cooper's river, it muſt have totally deſtroyed Charleſtown, as no obſtacle whatever ſeemed capable of reſiſting its fury.

WHISKY, a term ſignifying *water*, and applied in Scotland and in Ireland to a diſtilled liquor, drawn from barley, which is perhaps preferable to any Engliſh malt brandy: it is ſtrong, but not pungent, and free from the empyreumatic taſte or ſmell.

WHISPERING-PLACES. See ACCOUSTICS, n° 24.

WHIST, a well known game at cards, which requires great attention and ſilence; hence the name.

This game is played by four perſons, who cut for partners; the two higheſt and the two loweſt are together, and the partners ſit oppoſite to each other: the perſon who cuts the loweſt card is to deal firſt, giving one at a time to each perſon, till he comes to the laſt card, which is turned up for the trump, and remains on the table till each perſon has played a card. The perſon on the left hand ſide of the dealer plays firſt, and whoever wins the trick is to play again, thus going on till the cards are played out. The ace, king, queen, and knave of trumps, are called *honours;* in caſe any three of theſe honours have been played between, or by either of the two partners, they reckon for two points towards the game; and if the four honours have been played between, or by either of the two partners, they reckon for four points towards the game, the game conſiſting of ten points. The honours are reckoned after the tricks; all above ſix tricks reckoning alſo towards the game.

General Rules for playing the Game of WHIST.—1. He who is to play firſt ſhould lead from the ſtrongeſt ſuit. If he has a ſequence of king, queen, and knave, or queen, knave and ten, he may ſafely lead the higheſt of the ſequence; but if he has five or ſix in number, he muſt begin with the loweſt. He muſt always begin with the higheſt trump, by which he forces out the ſuperior trumps, and can come in again, to make his ſtrong ſuit.

2. He ſhould never be afraid to play trumps when he has five in his hand, even of the ſmalleſt, although he may not have any good cards of any other ſuit.

3. With ace and king of any two ſuits, and only two or three ſmall trumps, the aces and kings ſhould be played out, in order to make as many tricks as poſſible; and having but two or three ſmall trumps, he ſhould never force his partner to trump, if he finds he cannot follow ſuit; but endeavour to throw the lead into his partner's hand.

4. He ſhould in general return his partner's lead, unleſs he has ſome capital cards of his own.

5. As this game is played with the lurch, that is, to ſave half the ſtake, five points muſt be made before the game is out: he ſhould not venture to play trumps when he is four of the game, unleſs he is very ſtrong, having at leaſt an honour and three trumps, or ace, king, and two ſmall ones.

6. When the game is ſcored nine, at which ſtage the honours reckon for nothing, he ſhould be ſtill more cautious how he plays trumps, even if he is ſtrong in hand, and give his partner an opportunity of trumping the adverſaries ſuits, in caſe he is deficient in them.

7. If his adverſaries are ſix or ſeven love of the game, he ſhould play a forward or bold game, that he may have a chance, at the riſk of a trick or two, to come up with them. If he has but three trumps and other good cards, he may play trumps, eſpecially if he has a ſequence, or queen, knave, and a ſmall one.

8. He ſhould always riſk a trick or two when the game is much in his favour; becauſe a new deal is of greater conſequence to the adverſary than one or two points are to him.

9. When the player finds there is a likelihood of either ſaving the game or his lurch, he ſhould riſk the odd trick; but if the game is five all, and he can make two tricks in his own hand, he ſhould make them, in order to ſecure the difference of two points, which make the game near two to one in his favour.

10. A good player ſhould begin with a ſmall trump, when he has ace, king, and four ſmall ones; for this reaſon, if his partner has a better trump than the laſt player, which is an equal wager but he has, he has a chance of fetching out all the trumps, by having three rounds of them.

11. The odds are always in his favour that his partner holds an honour; conſequently if he has king, queen, and four ſmall ones, he ſhould begin with a ſmall one.

12. When queen, knave, and four ſmall trumps are dealt him, he ſhould play a ſmall one firſt, the odds being in his favour that his partner holds an honour; if he has knave, ten, and four ſmall trumps, he ſhould alſo begin with a ſmall one, for the ſame reaſon.

13. If he has knave, ten, eight, and three ſmall trumps, the knave ſhould be played firſt, by which means the nine may be prevented from winning a trick, the odds being in his favour that three honours are played in two rounds.

14. If an honour is turned up againſt him on his left hand, and he has ten, nine, and eight, with two or three ſmall trumps; when he is to play, he ſhould play through the honours with the ten, which will force the dealer to play his honour to a diſadvantage, if the dealer does not

chooſe to leave it to the option of his adverſary whether he will paſs it or not; but if he has ſix trumps of a lower denomination, and not ten, nine, and eight, and no honour turned up againſt him, he ſhould begin with a ſmall one.

15. In general, when he has two capital cards in trumps, and two or three ſmall ones, he ſhould begin with a ſmall one, for the reaſon aſſigned in nº 12.

16. When he has ace, king, knave, and two ſmall trumps, or even one ſmall trump, by firſt playing the king, and putting the lead into his partner's hand, who will pay a trump; judging him to have ace and knave, from his beginning with the king: in this caſe the knave ſhould be fineſſed (A), nothing being againſt him but the queen.

17. If he has knave, ten, eight, and two ſmall trumps, by playing the knave firſt, it is odds but in two rounds of trumps the nine falls, or he may fineſſe the eight when his partner returns trumps.

18. With five trumps of a lower denomination, he ſhould begin with the ſmalleſt, unleſs he has a ſequence of ten, nine, and eight; then he ſhould begin with the ten.

19. When he has king, queen, ten, and one ſmall trump, he muſt begin with the king, and wait for his partner's return of the trumps, in order to fineſſe the ten, by which means he may win the knave.

20. In order to prevent the ten from winning, when he has queen, knave, nine, and one ſmall trump, he muſt begin with the queen. And in caſe he has knave, ten, eight, and one ſmall trump, he ſhould begin with the knave, that the nine may not win.

21. If he has ten, nine, eight, and one ſmall trump, he ſhould begin with the ten; thereby he ſtrengthens his partner's hand, leaving it at his option to take it or not.

22. He ſhould begin with a ſmall one, when he has the ten and three ſmall trumps.

23. If he has a good ſuit, and ace, king, and four ſmall trumps, he muſt play three rounds of trumps, in order to ſecure his ſtrong ſuit from being trumped.

24. When he has king, queen, ten, and three ſmall trumps, he ſhould begin with the king, becauſe he has a chance of the knave's coming down in the ſecond round: and to ſecure his ſtrong ſuit, he ſhould not wait to fineſſe the ten. If he ſhould have queen, knave, and three ſmall trumps, and ſome good ſuit to make, he muſt begin with a ſmall one.

25. If he has knave, ten, eight, and two ſmall trumps, with a ſtrong ſuit, he ſhould begin with the knave, in order to make the nine fall in the ſecond round; but if he has knave, ten, and three ſmall trumps, with a good ſuit, he ſhould play a ſmall one firſt.

26. With ten, nine, eight, and one ſmall trump, provided he has a good ſuit, he ſhould begin with the ten; by which means he may get the trumps out, and have a chance of making his ſtrong ſuit.

The following obſervations will enable a player to know that his partner has no more of a ſuit which either of them has played. Suppoſe he leads from queen, ten, nine, and two ſmall cards of any ſuit, the ſecond hand puts on the knave, his partner plays the eight; in this caſe, he having queen, ten, and nine, it is a demonſtration, if his partner plays well, that he can have no more of that ſuit. By that diſcovery, he may play his game accordingly, either by forcing his partner to trump that ſuit, if he is ſtrong in trumps, or by playing another ſuit. If he has king, queen, and ten of a ſuit, and he leads his king, his partner plays the knave; this alſo demonſtrates he has no more of that ſuit. If he has king, queen, and many more of a ſuit, and begins with the king, in ſome caſes it is good play in a partner, when he has the ace and one ſmall card in that ſuit only, to win the king with the ace; for ſuppoſe the partner to be very ſtrong in trumps, by taking the king with the ace, he gets the lead and trumps out, and having cleared the board of trumps, his partner returns his lead; and the ace being out, there is room for him to make that whole ſuit, which could not have been done if the partner had kept the ace. Suppoſe he has no other good card in his hand beſides that ſuit, he loſes nothing by the ace's taking his king; and if it ſhould ſo happen that he has a good card to bring in that ſuit, he gains all the tricks which he makes in that ſuit by this method of play: as his partner has taken his king with the ace, and trumps out upon it, he has reaſon to imagine that his partner has one of that ſuit to return him; for which reaſon he ſhould not throw away any of that ſuit, even to keep a king or queen guarded.

Method of playing when an honour is turned up on the right hand.----Suppoſe the knave is turned up on his right hand, and that he has king, queen, and ten; in order to win the knave, he muſt begin with the king; by which means, his partner may ſuppoſe him to have queen and ten remaining, eſpecially if he has a ſecond lead, and he does not proceed to play the queen.

Suppoſe the knave turned up as before, and he has ace, queen, and ten, by playing his queen, it anſwers the purpoſe of the former rule.

When the queen is turned up on his right hand, and he has ace, king, and knave, by playing his king, it anſwers the ſame purpoſe of the former rule.

In caſe an honour is turned up on his left hand, ſuppoſing he ſhould hold no honour, he ſhould play trumps through the honour as ſoon as he gets the lead; but if he ſhould hold an honour (except the ace), he muſt be cautious how he plays trumps, becauſe, in caſe his partner holds no honour, his adverſary will play his own game upon him.

Method of playing the ſequences.----The higheſt in ſequences of trumps ſhould be played, unleſs he has ace, king, and queen; and then he ſhould play the loweſt, which informs his partner of the ſtate of his game.

When he has king, queen, and knave, and two ſmall ones, which are not trumps, he ſhould begin with the knave, whether he is ſtrong in trumps or not, as he makes way for the whole ſuit by getting the ace out.

If he is ſtrong in trumps, and has a ſequence of queen, knave, ten, and two ſmall cards of a ſuit, he ſhould play the higheſt of his ſequence; for if either of the adverſaries ſhould trump that ſuit in the ſecond round, being alſo ſtrong in trumps, he will make the remainder of that ſuit, by fetching out their trumps. When he has knave, ten, and nine, and two ſmall cards of a ſuit, he may play in the like manner.

If king, queen, and knave, and one ſmall card of any ſuit, is the caſe, whether ſtrong in trumps or not, he ſhould play the king; and when there are only four in number, the ſame method of play ſhould be obſerved by inferior ſequences.

When weak in trumps, he ſhould begin by the loweſt of the ſequence, provided he has five in number, becauſe if his partner has the ace of that ſuit he will make it. If he has the ace and four ſmall cards of a ſuit, and weak in trumps, leading from that ſuit, he ſhould play the ace. When ſtrong in trumps, the game may be played otherwiſe.

(A) *Fineſſe*, is to play a ſmall card which may win, keeping the ſuperior card or cards to lay over the right hand adverſary.

Whiſt.

How to make a ſlam, or win every trick.---Suppoſe A and B partners againſt C and D, and C to deal, A to have the king, knave, nine, and ſeven of hearts, which are trumps, a quart-major in ſpades, a tierce-major in diamonds, and the ace and king of clubs. Then ſuppoſe B to have nine ſpades, two clubs, and two diamonds. Alſo ſuppoſe D to have ace, queen, ten, and eight of trumps, with nine clubs, and C to have five trumps and eight diamonds. A leads a trump, which D wins, and D is to play a club, which his partner C is to trump; C leads a trump, which his partner D wins; D then will lead a club, which C will trump; and C will play a trump, which D will win; and D having the beſt trump will play it; after which D having ſeven clubs in his hand, makes them, ſo that he ſlams A and B.

How to play any hand of cards according to the neareſt calculations of his partner's holding certain winning cards:

1	That he has not one certain winning card, is	2 to 1
2	That he has not two certain winning cards, is	17 to 2
	But it is about 5 to 4 that he has one or both, or	32 to 25
3	That he has one card out of any three certain winning cards, is about	5 to 2
4	That he has not three certain winning cards, is about 31 to 1, or	681 to 22
5	That he has not two of them, is about 7 to 2, or	547 to 156
6	That he has not one of them, is about 7 to 6, or	378 to 325
7	That he holds one or two of them, is in his favour about 13 to 6, or	481 to 222
8	And about 5 to 2 that he holds 1, 2, or all three of them.	

The uſe of theſe calculations is for a whiſt-player to play his cards to the moſt advantage. For inſtance,

As the firſt calculation is two to one that his partner does not hold one certain winning card.—Suppoſe then a ſuit is led, of which the ſecond player has the king and a ſmall one only, he ſhould put on the king, becauſe the odds are in his favour that the third player cannot win it. For the ſame reaſon, when he is ſecond player, and to lead, he ſhould play a king in preference to a queen, becauſe it is two to one the ace does not take it; but it is five to four the queen will be taken by either ace or king, which may be in the third hand.

According to the ſecond calculation, of its being five to four that his partner holds one certain winning card out of any two: If he has two honours in any ſuit, he can play to an advantage, knowing it is five to four in favour of his partner's having one of the two honours; and by the ſame rule, if he is ſecond player, having a queen and one ſmall card, by playing the queen he plays five to four againſt himſelf.

It is obvious, from the third calculation, which proves it to be five to two that his partner has one card out of any three certain winning cards, that he who plays the knave ſecond hand, having but the knave and one ſmall card of the ſame ſuit, muſt play five to two againſt himſelf, and diſcovers his game to a great diſadvantage; for which reaſon, he ſhould play the loweſt of any ſequence which he may hold in his hand, as the knave, if he has king, queen, and knave; the ten, if he has queen, knave, and ten, &c. By ſo doing, his partner has an opportunity of judging what card to play in that ſuit, according to the odds for or againſt him.

From the above calculation, if he has ace, king, and two ſmall trumps, he is entitled to win four tricks out of ſix, provided, he has four winning cards of any ſuit; or five tricks out of ſeven, if he has five winning cards of any ſuit: by playing two rounds of trumps, and taking out eight of them, it is five to two but his partner has a third trump; and if it ſhould be ſo, he makes the tricks intended.

See Hoyle's Games improved by Beaufort.

Whiſton, White.

WHISTON (William), an Engliſh divine of great parts, uncommon learning, and of a ſingular character, was born at Norton near Twycroſſe in the county of Leiceſter, where his father was rector, in 1667. He was admitted of Clarehall, Cambridge, where he purſued his ſtudies, particularly in the mathematics, and commenced tutor; which his ill health at length forced him to decline. Having entered into orders, he, in 1694, became chaplain to Dr More biſhop of Norwich; and in this ſtation he publiſhed his firſt work, intitled, *A new Theory of the Earth*, &c. in which he undertook to prove the Moſaic doctrine of the earth perfectly agreeably to reaſon and philoſophy. This work brought no ſmall reputation to the author. In the beginning of this century he was made Sir Iſaac Newton's deputy, and afterwards his ſucceſſor, in the Lucaſian profeſſorſhip of mathematics; when he reſigned a living he had in Suffolk, and went to reſide at Cambridge. About this time he publiſhed ſeveral ſcientifical works, explanatory of the Newtonian philoſophy; and he had the honour of being one of the firſt, if not the very firſt, who rendered thoſe principles popular and intelligible to the generality of readers. About the year 1710, he was known to have adopted Arian principles, and was forming projects to ſupport and propagate them: among other things, he had tranſlated the Apoſtolical Conſtitutions into Engliſh, which favoured the Arian doctrine, and which he aſſerted to be genuine. The conſequence was, that he was deprived of his profeſſorſhip, and baniſhed the univerſity; he neverthleſs purſued his ſcheme, by publiſhing the next year his Primitive Chriſtianity Revived, 4 vols, 8vo. for which the convocation fell upon him very vehemently. On his expulſion from Cambridge, Mr Whiſton ſettled in London; where without ſuffering his zeal to be intimidated, he continued to write, and to propagate his Primitive Chriſtianity, with as much ardour as if he had been in the moſt flouriſhing circumſtances. In 1721, a ſubſcription was made for the ſupport of his family, which amounted to 470 l. For though he drew profits from reading aſtronomical and philoſophical lectures, and alſo from his publications, which were very numerous, yet theſe of themſelves would have been very inſufficient: nor, when joined with the benevolence and charity of thoſe who loved and eſteemed him for his learning, integrity, and piety, did they prevent his being frequently in great diſtreſs. He continued long a member of the church of England, and regularly frequented its ſervice, though he diſapproved of many things in it: but at laſt he went over to the Baptiſts, and attended Dr Forſter's meeting at Pinner's Hall, Broadſtreet. Among other performances not ſpecified above, he wrote Memoirs of his own life and writings, which contain ſome curious particulars.

He was remarkable for ſpeaking the plaineſt truths on every occaſion, and to perſons of every degree. During the year 1725, that he, with Dr Clarke, Dr Berkeley, and others, had the honour to attend Queen Caroline on a certain day of every week, to talk of the progreſs of ſcience, her Majeſty one evening took occaſion to pay him a juſt compliment on his truth and integrity, requeſting that he would, with his uſual plainneſs, point out to her any fault that he might have obſerved in her conduct. At firſt he begged to be excuſed, adding, that few perſons could bear to have their faults plainly told to them, and leaſt of all royal perſonages, who, from their elevation, are neceſſarily ſurrounded by flatterers, to whoſe lips truth is a ſtranger.

Her Majeſty replied, that he was to conſider her not as a queen, but as a philoſopher; and that philoſophy is of very little uſe, if it cannot enable its profeſſors to bear without offence truths neceſſary to their own improvement. Upon this he told her, that the greateſt fault which he had obſerved in her conduct, was her indecent behaviour in the houſe of God, which, he aſſured her, had made very unfavourable impreſſions on the minds of many perſons, who, coming to town from diſtant parts of the country, had gone to the chapel to obtain a ſight of her majeſty, the king, and the royal family. The Queen made no reply; but in about ſix weeks afterwards renewed her requeſt, that Mr Whiſton would point out the moſt glaring improprieties in her conduct. To this he anſwered, that he had laid down a maxim from which he could not deviate, never to point out to any perſon more than one fault at a time, and never to give a ſecond reproof till he had obſerved ſome good conſequence to have ariſen from the firſt (A). Much to the Queen's honour, ſhe was pleaſed with this plain dealing, and continued to think favourably of Mr Whiſton. This honeſt, but whimſical and credulous man, died in 1762, at the advanced age of 95.

WHITBY (Dr Daniel), a very learned Engliſh writer, was born in 1638, and bred at Oxford; where, in 1664, he was elected perpetual fellow of his college. He afterward became chaplain to Dr Seth Ward, biſhop of Saliſbury; who collated him in 1668 to the prebend of Yateſbury in that church, and ſoon after to that of Huſborn and Burbach. In 1672 he was admitted chanter of the ſaid church, on the death of Mr John South, and then, or ſoon after, rector of St Edmund's church in Saliſbury. He was made a prebendary of Taunton Regis in 1696, and died in 1726. He was ever ſtrangely ignorant of worldly affairs, even to a degree that is ſcarcely to be conceived. His writings are numerous, and well known; particularly his Commentary on the New Teſtament.

WHITBY, a ſea-port town in the North Riding of Yorkſhire, ſeated on the river Eſk, near the place where it falls into the ſea. The houſes are neat, ſtrong, and convenient; the number of inhabitants about 9000. Ship-building is their principal manufacture. W. Long. 0. 24. N. Lat 54. 30.

WHITE, one of the colours of natural bodies.

WHITE of the Eye, denotes the firſt tunic or coat of the eye, called *albuginea*. See ANATOMY, n° 142.

WHITE of an Egg. See ALBUMEN and EGG.

WHITE Friars, a name common to ſeveral orders of monks, from being clothed in a white habit.

White Sea, is a bay of the Frozen Ocean, ſo called in the north part of Muſcovy, lying between Ruſſian Lapland and Samoieda; at the bottom of which ſtands the city of Archangel. This was the chief port the Ruſſians had before their conqueſt of Livonia.

WHITE Colour for painting. See CHEMISTRY, n° 703.

WHITE Copper. See CHEMISTRY, n° 1157.

WHITE Drop, Ward's. See CHEMISTRY, n° 746.

WHITE Iron, or *Tin-plate*, iron-plates, covered over with tin; for the method of making which, ſee LATTEN.

In 1681 tin-plates were manufactured in England by one Andrew Yarranton, who had been ſent to Bohemia to learn the method of making them. But the manufacture was ſoon afterwards diſcontinued. It was revived again in 1740, and is now arrived at as great, if not greater, perfection in this country than in any other.

WHITE Lead. See CHEMISTRY, n° 875.

WHITE Throat, in ornithology. See MOTACILLA.

WHITEFIELD (George), the celebrated preacher among the people called *Methodiſts*, was born in the year 1714, at the Bell in the city of Glouceſter, which was then kept by his mother. At about 12 years of age he was put to a grammar-ſchool; but his mother entering into a ſecond marriage, which proved a diſadvantageous one, he, when about 15, put on a blue apron, and ſerved her in the capacity of a drawer or waiter. After continuing about a year in this ſervile employment, ſhe turned over the buſineſs to his brother; who marrying, and George not agreeing with his ſiſter-in-law, he left the inn. Some time after, meeting with an old ſchool-fellow, then a ſervitor in Pembroke college, Oxford, he was induced to attempt getting into the ſame college in a like capacity, and ſucceeded. Here Mr Whitefield, who from his own account appears to have always had a ſtrong tincture of enthuſiaſm in his conſtitution from his very childhood, diſtinguiſhing himſelf by the auſterities of his devotion, and acquired conſiderable eminence in ſome religious aſſemblies in that city. At the age of 21, the fame of his piety recommended him ſo effectually to Dr Benſon, then biſhop of Glouceſter, that he made him a voluntary offer of ordination. Immediately after this regular admiſſion into the miniſtry, Mr Whitefield applied himſelf to the moſt extraordinary, the moſt indefatigable, duties of his character, preaching daily in priſons, fields, and open ſtreets, wherever he thought there would be a likelihood of making proſelytes. Having at length made himſelf univerſally known in England, he embarked for America, where the tenets of Methodiſm began to ſpread very faſt under his friends the Weſleys; and firſt determined upon the inſtitution of the orphan-houſe at Georgia, which he afterwards effected. After a long courſe of peregrination, his fortune increaſed as his fame extended among his followers, and he erected two very extenſive buildings for public worſhip, under the name of *Tabernacles*; one in Tottenham Court Road, and the other in Moorfields. Here, with the help of ſome aſſiſtants, he continued for ſeveral years, attended by very crowded congregations, and quitting the kingdom only occaſionally. Beſides the two tabernacles already mentioned, Mr Whitefield, by being chaplain to the counteſs dowager of Huntingdon, was connected with two other religious meetings, one at Bath, and the other at Tunbridge, chiefly erected under that lady's patronage. By a lively, fertile, and penetrating genius, by the moſt unwearied zeal, and by a forcible and perſuaſive delivery, he never failed of the deſired effect upon his ever crowded and admiring audiences. America, however, which always engaged much of his attention, was deſtined to cloſe his eyes; and he died at Newberry, about 40 miles from Boſton in New England, in 1770.

WHITEHAVEN, a ſea-port town of Cumberland, with a market on Thurſdays, and one fair on Auguſt 1ſt for merchandiſe and toys. It is ſeated on a creek of the ſea, on the north end of a great berg or hill, waſhed by the tide of flood on the weſt ſide, where there is a large rock or quarry of hard white ſtone, which gives name to the place, and which, with the help of a ſtrong ſtone wall, ſecures the harbour, into which ſmall barks may enter. It is lately much improved in its buildings, and noted for its trade in pit-coal and ſalt, there being near it a prodigious coal-mine, which runs a conſiderable way under the ſea. They have a cuſtomhouſe here; and they carry on a good trade to Ireland, Scotland, Cheſter, Briſtol, and other parts. It is 10 miles ſouth-weſt of Cockermouth, and 289 north-weſt of London. W. Long. 3. 6. N. Lat. 54 30.

(A) Biſhop Berkeley was preſent at theſe converſations, and from his ſon we received the account which we have given of them. They are likewiſe mentioned, but not ſtated ſo accurately, by Biſhop Newton in his own Life.

WHITENESS, the quality which denominates or conſtitutes a body white.

WHITES, or Fluor *Albus*. See Medicine, n° 250.

WHITING, in ichthyology. See Gadus.

WHITLOW, or Whitloe. See Surgery.

WHITSUN-Farthings, otherwiſe called *Smoke-farthings* or *Quadrantes Pentecoſtales*, a compoſition for offerings which were anciently made in Whitſun-week by every man in England, who occupied a houſe with a chimney, to the cathedral church of the dioceſe in which he lived.

WHITSUNDAY, a ſolemn feſtival of the Chriſtian church, obſerved on the fiftieth day after Eaſter, in memory of the deſcent of the Holy Ghoſt upon the apoſtles in the viſible appearance of fiery cloven tongues, and of thoſe miraculous powers, which were then conferred upon them.

It is called *Whitſunday* or *White-Sunday*; becauſe this being one of the ſtated times for baptiſm in the ancient church, thoſe who were baptiſed put on white garments, as types of that ſpiritual purity they received in baptiſm. As the deſcent of the Holy Ghoſt upon the apoſtles happened upon the day which the Jews called *Pentecoſt*, this feſtival retained the name of *Pentecoſt* among the Chriſtians.

Whitsunday Iſle, one of the New Hebrides, which lies about four miles to the ſouth, runs in the ſame direction, and is of the ſame length, having more ſloping expoſures than Aurora: it appears to be better inhabited, and to contain more plantations.

WHORTLEBERRY. See Vaccinium.

WHYTT (Dr Robert), an eminent phyſician, born at Edinburgh on the 6th September 1714, was the ſon of Robert Whytt, Eſq; of Bennochy, advocate. This gentleman died ſix months before the birth of our author, who had alſo the misfortune to be deprived of his mother before he had attained the ſeventh year of his age. After receiving the firſt rudiments of ſchool-education, he was ſent to the univerſity of St Andrew's; and after the uſual courſe of inſtruction there, in claſſical, philoſophical, and mathematical learning, he came to Edinburgh, where he entered upon the ſtudy of medicine, under thoſe eminent medical teachers, Monro, Rutherford, Sinclair, Plummer, Alſton, and Innes. After learning what was to be acquired at this univerſity, in the proſecution of his ſtudies he viſited foreign countries; and after attending the moſt eminent teachers at London, Paris, and Leyden, he had the degree of Doctor of Phyſic conferred upon him by the univerſity of Rheims in 1736, being then in the 22d year of his age.

Upon his return to his native country, he had the ſame honour alſo conferred upon him by the univerſity of St Andrew's; where he had before obtained, with applauſe, the degree of Maſter of Arts.

Not long afterwards, in the year 1737, he was admitted a Licentiate of Medicine by the Royal College of Phyſicians of Edinburgh; and the year following he was raiſed to the rank of a Fellow of the College. From the time of his admiſſion as a licentiate, he entered upon the practice of phyſic at Edinburgh; and the reputation which he acquired for medical learning, pointed him out as a fit ſucceſſor for the firſt vacant chair in the univerſity. Accordingly, when Dr Sinclair, whoſe eminent medical abilities, and perſuaſive powers of oratory, had contributed not a little to the rapid advancement of the medical ſchool of Edinburgh, found that thoſe conſpicuous talents which he poſſeſſed could no longer be exerted in the manner which they once had been when he enjoyed bodily vigour unimpaired by age and powers of mind unclouded by diſeaſe, he reſigned his academical appointments in favour of Dr Whytt.

This admiſſion into the college took place on the 20th of June 1746; and he began his firſt courſe of the inſtitutions of medicine at the commencement of the next winter-ſeſſion. The abilities which he diſplayed from his academical chair, in no particular diſappointed the expectations which had been formed of his lectures. The Latin tongue was the language of the univerſity of Edinburgh; and he both ſpoke and wrote in Latin with ſingular propriety, elegance, and perſpicuity. At that time the ſyſtem and ſentiments of Dr Boerhaave, which, notwithſtanding their errors, muſt challenge the admiration of lateſt ages were very generally received by the moſt intelligent phyſicians in Britain. Dr Whytt had no ſuch idle ardour for novelties as to throw them entirely aſide becauſe he could not follow them in every particular. The inſtitutions of Dr Boerhaave, therefore, furniſhed him with a text for his lectures; and he was no leſs ſucceſsful in explaining, illuſtrating, and eſtabliſhing the ſentiments' of the author, when he could freely adopt them, than in refuting them by clear, connected, and deciſive arguments, when he had occaſion to differ from him. The opinions which he himſelf propoſed, were delivered and enforced with ſuch acuteneſs of invention, ſuch diſplay of facts and force of argument, as could rarely fail to gain univerſal aſſent from his numerous auditors; but free from that ſelf-ſufficiency which is ever the offspring of ignorance and conceit, he delivered his concluſions with becoming modeſty and diffidence.

From the time that he firſt entered upon an academical appointment, till the year 1756, his prelections were confined to the inſtitutions of medicine alone. But at that period his learned colleague Dr Rutherford, who then filled the practical chair, who had already taught medicine at Edinburgh with univerſal applauſe for more that thirty years, and who had been the firſt to begin the inſtitution of clinical lectures at the Royal Infirmary, found it neceſſary to retire from the fatiguing duties of an office to which the progreſs of age rendered him unequal. On this criſis Dr Whytt, Dr Monro, ſen. and Dr Cullen, each agreed to take a ſhare in an appointment in which their united exertions promiſed the higheſt advantages to the univerſity. By this arrangement ſtudents, who had an opportunity of daily witneſſing the practice of three ſuch teachers, and of hearing the grounds of that practice explained, could not fail to derive the moſt ſolid advantages.

In theſe two departments, the inſtitutions of medicine in the univerſity, and the clinical lectures in the Royal Infirmary, Dr Whytt's academical labours were attended with the moſt beneficial conſequences both to the ſtudents and to the univerſity. But not long after the period we have laſt mentioned, his lectures on the former of theſe ſubjects underwent a very conſiderable change. About this time the illuſtrious Gaubius, who had ſucceeded to the chair of Boerhaave, favoured the world with his *Inſtitutiones Pathologiæ*. This branch of medicine had indeed a place in the text which Dr Whytt formerly followed; but, without detracting from the character of Dr Boerhave, it may juſtly be ſaid, that the attention he had beſtowed upon it was not equal to its importance. Dr Whytt was ſenſible of the improved ſtate in which pathology now appeared in the writings of Boerhaave's ſucceſſor; and he made no delay in availing himſelf of the advantages which were then afforded.

In the year 1762, his pathological lectures were entirely new-modelled. Following the publication of Gaubius as a text, he delivered a comment, which was read by every intelligent ſtudent with the moſt unfeigned ſatisfaction. In theſe lectures he collected and condenſed the fruits of accurate obſervation and long experience. Enriched by all the opportunities of information which he had enjoyed, and by all the diſcernment which he was capble of exerting, they were juſtly conſidered as his moſt finiſhed production.

For a period of more than twenty years, during which he was juſtly held in the higheſt eſteem as a lecturer at Edinburgh, it may readily be ſuppoſed that the extent of his practice correſponded to his reputation. In fact, he received both the firſt emoluments, and the higheſt honours, which could here be obtained. With extenſive practice in Edinburgh, he had numerous conſultations from other places. His opinion on medical ſubjects was daily requeſted by his moſt eminent contemporaries in every part of Britain. Foreigners of the firſt diſtinction, and celebrated phyſicians in the moſt remote parts of the Britiſh empire, courted an intercourſe with him by letter. Beſides private teſtimonies of eſteem, many public marks of honour were conferred upon him both at home and abroad. In 1752, he was elected a fellow of the Royal Society of London; in 1761, he was appointed firſt phyſician to the king in Scotland; and in 1764, he was choſen preſident of the Royal College of Phyſicians at Edinburgh.

But the fame which Dr Whytt acquired as a practitioner and teacher of medicine, was not a little increaſed by the information which he communicated to the medical world in different publications. His celebrity as an author was ſtill more extenſive than his reputation as a profeſſor.

His firſt publication, An Eſſay on the vital and other Involuntary Motions of Animals, although it had been begun ſoon after he had finiſhed his academical courſe of medical education, did not come from the preſs till 1751; a period of fifteen years from the time that he had finiſhed his academical courſe, and obtained a degree in medicine: but the delay of this publication was fully compenſated by the matter which it contained, and the improved form under which it appeared.

The next ſubject which employed the pen of Dr Whytt was one of a nature more immediately practical. His Eſſay on the Virtues of Lime-water and Soap in the Cure of the Stone, firſt made its appearance in a ſeparate volume in 1752. Part of this ſecond work had appeared ſeveral years before in the Edinburgh Medical Eſſays: but it was now preſented to the world as a diſtinct publication with many improvements and additions.

His third work, intitled Phyſiological Eſſays, was firſt publiſhed in the year 1755. This treatiſe conſiſted of two parts; 1ſt, An Inquiry into the Cauſes which promote the Circulation of the Fluids in the very ſmall veſſels of Animals; and 2dly, Obſervations on the Senſibility and Irritability of the Parts of Men and other Animals, occaſioned by Dr Haller's treatiſe on that ſubject. The former of theſe may be conſidered as an extenſion and farther illuſtration of the ſentiments which he had already delivered in his Eſſay on the Vital Motions, while the latter was on a ſubject of a controverſial nature. In both he diſplayed that acuteneſs of genius and ſtrength of judgment which appeared in his former writings.

From the time at which his Phyſiological Eſſays were publiſhed, ſeveral years were probably employed by our author in preparing for the preſs a larger and perhaps a more important work than any yet mentioned, his Obſervations on the Nature, Cauſes, and Cure of thoſe Diſorders which are commonly called *nervous*, *hypochondriac*, and *hyſteric*. This elaborate and uſeful work was publiſhed in the year 1764.

The laſt of Dr Whytt's writings is intitled, Obſervations on the Dropſy in the Brain. This treatiſe did not appear till two years after his death; when all his other works were collected and publiſhed in one quarto volume, under the direction of his ſon and of his intimate friend the late Sir John Pringle.

Beſides theſe five works, he wrote many other papers, which appeared in different periodical publications; particularly in the Philoſophical Tranſactions, the Medical Eſſays, the Medical Obſervations, and the Phyſical and Literary Eſſays.

At an early period of life, ſoon after he had ſettled as a medical practitioner at Edinburgh, he entered into the married ſtate. His firſt wife was Miſs Robertſon, ſiſter to General Robertſon governor of New York. By her he had two children; both of whom died in early infancy, and their mother did not long ſurvive them. A few years after the death of his firſt wife, he married as a ſecond wife Miſs Balfour, ſiſter to James Balfour, Eſq. of Pilrig. By her he had fourteen children: but in theſe alſo he was in ſome reſpects unfortunate; for ſix of them only ſurvived him, three ſons and three daughters, and of the former two are ſince dead. Although the feeling heart of Dr Whytt, amidſt the diſtreſſes of his family, muſt have often ſuffered that uneaſineſs and anxiety which in ſuch circumſtances is the unavoidable conſequence of parental affection and conjugal love; yet he enjoyed a large ſhare of matrimonial felicity. But his courſe of happineſs was terminated by the death of his wife, which happened in the year 1764; and it is not improbable that this event had ſome ſhare in haſtening his own death; for in the beginning of the year 1765 his health was ſo far impaired, that he became incapable of his former exertions. A tedious complication of chronical ailments, which chiefly appeared under the form of diabetes, was not to be reſiſted by all the medical ſkill which Edinburgh could afford: and at length terminated in death, on the 15th of April 1766, in the 52d year of his age.

WIBURGH, a conſiderable town of Denmark, in North Jutland, with a biſhop's ſee, remarkable for being the ſeat of the chief court of juſtice in the province. The hall where the council aſſembles has the archives of the country, and eſcaped the terrible fire that happened in the year 1726, and which burned the cathedral-church, that of the Black Friars, the town-houſe, and the biſhop's palace; but they have all been rebuilt more magnificent than before. It is ſeated on the lake Weter, in a peninſula 25 miles north-weſt of Sleſwick, and 110 north-by-weſt of Copenhagen. E. Long. 9. 50. N. Lat. 56. 20.

WICKER, ſignifies made of ſmall twigs.

WICKET, a ſmall door in the gate of a fortified place, &c. or a hole in a door through which to view what paſſes without.

WICKLIFF (John), the firſt divine in Europe who had reſolution to attempt a reformation of religion, was born about the year 1324, in the pariſh of Wycliff, near Richmond, in Yorkſhire. He was educated at Oxford, firſt in Queen's, and afterwards in Merton college, of which he was a probationer-fellow. Having acquired the reputation of a man of great learning and abilities, in 1361 he was choſen maſter of Baliol-hall, and in 1365 conſtituted warden of Canterbury college, by the founder archbiſhop Simeon de Iſlip; but was, in 1367, ejected by the regulars, together with three ſecular fellows. He thought their proceedings arbitrary, and therefore appealed to the pope; but inſtead of obtaining redreſs, in 1370 the ejectment was confirmed. This diſappointment probably contributed ſomewhat towards his enmity to the ſee of Rome, or rather to confirm that enmity; for he had long before written againſt the pope's exactions and corruptions of religion. However, his credit in the univerſity continued; for having taken the degree of doctor in divinity, he read public lectures with great applauſe; in which he frequently expoſed the impoſitions of the Mendicant friars. About this time he publiſhed a defence of his ſovereign Edward III. againſt the pope, who had inſiſted on the homage to which his predeceſſor king John had agreed. This defence was the cauſe of Wickliff's introduction at court, and of his being ſent one of the ambaſſadors in 1374 to Bruges, where they met the pope's nuncios, in order to ſettle ſeveral eccleſiaſtical matters relative to the pope's authority. In the mean time Wickliff was preſented by the king to the rectory of Lutterworth in Leiceſterſhire, and in 1375 he obtained a prebend in the church of Weſtbury in Glouceſterſhire. Wickliff continued hitherto without moleſtation, to oppoſe the papal authority; but in 1377 a bull was ſent over to the archbiſhop of Canterbury, and to Courtney biſhop of London, ordering them to ſecure this arch-heretic, and lay him in irons; at the ſame time the pope wrote to the king, requeſting him to favour the biſhops in the proſecution: he alſo ſent a bull to Oxford, commanding the univerſity to give him up. Before theſe bulls reached England, Edward III. was dead, and Wickliff protected by John duke of Lancaſter, uncle to Richard II. favoured by the queen-mother, and ſupported by the citizens of London, eluded the perſecution of pope Gregory IX. who died in 1378. In the following year this intrepid reformer preſented to parliament a ſevere paper againſt the tyranny of Rome, wrote againſt the papal ſupremacy and infallibility, and publiſhed a book *On the Truth of the Scriptures*, intended to prepare the way for an Engliſh tranſlation of them, in which he had made conſiderable progreſs. In 1381 he publiſhed *Sixteen Concluſions*; in the firſt of which he ventured to expoſe the grand article of tranſubſtantiation. Theſe concluſions being condemned by the chancellor of Oxford, Wickliff appealed to the king and parliament; but being deſerted by his unſteady patron the duke of Lancaſter, he was obliged to make a confeſſion at Oxford; and by an order from the king was expelled the univerſity. He now retired to his living of Lutterworth, where he finiſhed his tranſlation of the bible. This verſion, of which there are ſeveral manuſcript copies in the libraries of the univerſities, Britiſh Muſeum, &c. is a very literal tranſlation from the Latin vulgate. In 1383 he was ſuddenly ſtruck with the palſy; a repetition of which put an end to his life in December 1384. He was buried in his own church, where his bones were ſuffered to reſt in peace till the year 1428, when, by an order from the pope, they were taken up and burnt.—Beſides a number of works that have been printed, he left a prodigious number of manuſcripts; an accurate liſt of which may be ſeen in Biſhop Tanner's *Bib. Brit. Hib.* Some of them are in the Bodleian Library, others in the Britiſh Muſeum, &c.

Wickliff was doubtleſs a very extraordinary man, conſidering the times in which he lived. His natural ſagacity diſcovered the abſurdities and impoſitions of the church of Rome, and he had the honeſty and reſolution to promulgate his opinions, which a little more ſupport would probably have enabled him to eſtabliſh; they were evidently the foundation of the ſubſequent reformation.

WICKLOW, a county of Ireland, in the province of Leinſter; bounded on the north by the county of Dublin; on the eaſt by the Iriſh Sea; on the ſouth by Wexford; and on the weſt by Kildare and Catherlough. It is 33 miles in length, 20 in breadth, and indifferently fruitful. It contains 54 pariſhes, and ſends 10 members to parliament.

Wicklow, the capital of a county of the ſame name, in Ireland; ſeated on the ſea-ſide, with a narrow harbour, at the mouth of the river Leitrim, over which ſtands a rock, inſtead of a caſtle, ſurrounded by a ſtrong wall, 24 miles ſouth of Dublin. W. Long. 6. 7. N. Lat. 52. 55.

WIDGEON, in ornithology. See Anas.

WIDOW, a woman who has loſt her huſband.

WIFE, a married woman, or one joined with, and under the protection of, a huſband. See Husband.

Isle of WIGHT, an iſland lying on the ſouth coaſt of Hampſhire, from which it is ſeparated by a narrow channel. It is about 21 miles in length, and 13 in breadth. It is nearly divided into equal parts by the river Mede or Cowes, which riſing in the ſouthern angle, enters at the northern, into the channel, oppoſite the mouth of Southampton Bay. The ſouth coaſt is edged with very ſteep cliffs of chalk and freeſtone, hollowed into caverns in various parts. The weſt ſide is fenced with ridges of rocks, of which the moſt remarkable are thoſe called, from their ſharp extremities, the *Needles*. Between the iſland and the main are various ſandbanks, eſpecially off the eaſtern part, where is the ſafe road of St Helen's. Acroſs the iſland, from eaſt to weſt, runs a ridge of hills, forming a tract of fine downs, with a chalky or marly ſoil, which feed a great number of fine-fleeced ſheep. Rabbits are alſo very plentiful here. To the north of this ridge the land is chiefly paſture: to the ſouth of it is a rich arable country, producing great crops of corn. The variety of proſpects which this iſland affords, its mild air, and the neat manner in which the fields are laid out, render it a very delightful ſpot. It is devoted almoſt ſolely to huſbandry, and has no manufactory. It is one of the principal reſources of the London market for unmalted barley. Among its products are to be reckoned a pure white pipe-clay and a fine white chryſtalline ſand; of the latter of which great quantities are exported for the uſe of the glaſs-works in various parts. Its principal town is the borough of Newport: it likewiſe contains the two ſmall boroughs of Newtown and Yarmouth.

WILD-FIRE. See *Wild-fire*.

WILDERNESS, in gardening, a kind of grove of large trees, in a ſpacious garden, in which the walks are commonly made, either to interſect each other in angles, or have the appearance of meanders and labyrinths.

Wilderneſſes (ſays Mr Miller) ſhould always be proportioned to the extent of the gardens in which they are made; for it is very ridiculous to ſee a large wilderneſs planted with tall trees in a ſmall ſpot of ground; and, on the other hand nothing can be more abſurd than to ſee little paltry ſquares, or quarters of wilderneſs-work, in a magnificent large garden. As to the ſituation of wilderneſſes, they ſhould never be placed too near the habitation, nor ſo as to obſtruct any diſtant proſpect of the country, there being nothing ſo agreeable as an unconfined proſpect: but where, from the ſituation of the place, the ſight is confined within the limits of the garden, nothing can ſo agreeably terminate the proſpect as a beautiful ſcene of the various kinds of trees judiciouſly planted; and if it is ſo contrived that the termination is planted circularly, with the concave towards the ſight, it will have a much better effect than if it end in ſtraight lines or angles. The plants ſhould always be adapted to the ſize of the plantation; for it is very abſurd for tall trees to be planted in the ſmall ſquares of a little garden; and in large deſigns, ſmall ſhrubs will have a mean appearance. It ſhould alſo be obſerved never to plant evergreens among deciduous trees; but always to place the evergreens in a wilderneſs in a ſeparate part by themſelves, and that chiefly in ſight.

As to the walks, thoſe that have the appearance of meanders, where the eye cannot diſcover more than twenty or thirty yards in length, are generally preferable to all others, and theſe ſhould now and then lead into an open circular piece of graſs; in the centre of which may be placed either an obeliſk, ſtatue, or fountain; and if in the middle of the wilderneſs there be contrived a large opening, in the centre of which may be erected a dome or banqueting houſe, ſurrounded with a green plot of graſs, it will be a conſiderable addition to the beauty of the whole. From the ſides of the walks and openings, the trees ſhould riſe gradually one above another to the middle of the quarters; where ſhould always be planted the largeſt growing trees, ſo that the heads of all the trees may appear to view, while their ſtems will be hid from the ſight. Thus, in thoſe parts which are planted with deciduous trees, roſes, honeyſuckles, ſpiræa frutex, and other kinds of low-flowering ſhrubs, may be planted next the walks and openings; and at their feet, near the ſides of the walks, may be planted primroſes, violets, daffadils, &c. not in a ſtraight line, but ſo as to appear accidental, as in a natural wood. Behind the firſt row of ſhrubs ſhould be planted ſyringas, althæa frutex, mezereons, and other flowering ſhrubs of a middle growth; and theſe may be backed with many other ſorts of trees riſing gradually to the middle of the quarters.

The part planted with evergreens may be diſpoſed in the following manner, *viz.* in the firſt line next the great walks may be placed the lauruſtinus, boxes, ſpurge-laurel, juniper, ſavin, and other dwarf evergreens. Behind theſe may be placed laurels, hollies, arbutuſes, and other evergreens of a larger growth. Next to theſe may be planted alaternuſes, phyllireas, yews, cypreſſes, Virginian cedars, and other trees of the ſame growth; behind theſe may be planted Norway and ſilver firs, the true pine, and other ſorts of the fir growth; and in the middle ſhould be planted Scotch pines, pinaſter, and other ſorts of the larger growing evergreens; which will afford a moſt delightful proſpect if the different ſhades of the greens are curiouſly intermixed.

But beſide the grand walks and openings (which ſhould always be laid with turf, and kept well mowed), there ſhould be ſome ſmaller ſerpentine walks through the middle of the quarters, where perſons may retire for privacy; and by the ſides of theſe private walks may alſo be ſcattered ſome wood-flowers and plants; which, if artfully planted, will have a very good effect.

In the general deſign for theſe wilderneſſes, there ſhould not be a ſtudied and ſtiff correſpondency between the ſeveral parts; for the greater diverſity there is in the diſtribution of theſe, the more pleaſure they will afford.

WILKINS (Dr John), a moſt ingenious and learned Engliſh biſhop, was the ſon of a goldſmith of Oxford, and was born in 1614. He adhered to the parliament during the civil wars, by whom he was made warden of Wadham college in 1648: he married afterwards the ſiſter of Oliver Cromwell, and procured a diſpenſation to retain his wardenſhip notwithſtanding. Richard Cromwell made him maſter of Trinity college, Cambridge, from which he was ejected on the Reſtoration. He then became preacher to Gray's-Inn, rector of St Laurence Jewry, London, dean of Rippon, and in 1668 was promoted to the biſhopric of Cheſter: he died in 1672. Biſhop Wilkins thought it prudent to ſubmit to the powers in being; he therefore ſubſcribed to the ſolemn league and covenant while it was enforced, and was equally ready to ſwear allegiance to king Charles when he was reſtored: this, with his moderate ſpirit toward diſſenters, rendered him not very agreeable to churchmen. His mathematical and philoſophical works, which contain many ingenious and curious pieces, conſidering the time when they were written, have been collected in one vol. 8vo. He publiſhed alſo ſome theological tracts. He was the firſt preſident of the Royal Society.

WILL, that faculty of the mind by which it embraces or rejects any thing offered to it. See Metaphysics.

Will, or *Laſt Will*, in law, ſignifies the declaration of a man's mind and intent relating to the diſpoſition of his lands, goods, or other eſtate, or of what he would have done after his death. In the common law there is a diſtinction made between a will and a teſtament: that is called a *will* where lands or tenements are given; and when the diſpoſition concerns goods and chattels alone, it is termed a *teſtament*. See Testament.

Will-with-a-whiſp, or *Jack-with-a-lanthorn*, two popular names for the meteor called *ignis fatuus*. See Light, n° 46.

WILLIAM *of* Malmsbury, an hiſtorian of conſiderable merit in the reign of king Stephen; but of whoſe life few particulars are known. According to Bale and Pits, he was ſurnamed *Somerſetus*, from the county in which he was born. From his own preface to his ſecond book *De Regibus Anglorum*, it appears that he was addicted to learning from his youth; that he applied himſelf to the ſtudy of logic, phyſic, ethics, and particularly to hiſtory. He retired to the Benedictine convent at Malmſbury, became a monk, and was made precentor and librarian; a ſituation which much favoured his intention of writing the hiſtory of this kingdom. In this monaſtery he ſpent the remainder of his life, and died in the year 1142. He is one of our moſt ancient and moſt faithful hiſtorians. His capital work is that intitled *De Regibus Anglorum*, in five books; with an Appendix, which he ſtyles *Hiſtoriæ Novellæ*, in two more. It is a judicious collection of whatever he found on record relative to England, from the invaſion of the Saxons to his own times.

William of Newbury, ſo called from a monaſtery in Yorkſhire, of which he was a member, wrote a hiſtory which begins at the conqueſt and ends at the year 1197. His Latin ſtyle is preferred to that of Matthew Paris; and he is intitled to particular praiſe, for his honeſt regard to truth, in treating the fables of Jeffery of Monmouth with the contempt they deſerve; as well as for expreſſing his approbation of Henry II.'s deſign of reforming the clergy, by bringing them under the regulation of the ſecular power.

William of Wykeham, biſhop of Wincheſter, was born in the village of Wykeham, in the county of Southampton, in 1324. He had his education at Wincheſter and Oxford. Having continued near ſix years in the univerſity, his patron Nicholas Wedal, governor of the province of Southampton, took him into his family, and appointed him his counſellor and ſecretary. He could not have made choice of a fitter perſon for that employment, no man in that age writing or ſpeaking more politely than Wykeham. For this reaſon Edington, biſhop of Wincheſter, lord high-treaſurer of the kingdom, appointed him his ſecretary three years after, and alſo recommended him to king Edward III. who took him into his ſervice. Being ſkilled in geometry and architecture, he was appointed ſurveyor of the royal buildings, and alſo chief juſtice in eyre: he it was who ſuperintended the building of Windſor caſtle. He was afterward chief ſecretary of ſtate, a keeper of the privy-ſeal; and in 1367 ſucceeded Edington in the ſee of Wincheſter. A little after he was appointed lord high chancellor and preſident of the privy-council. That he might well diſcharge the ſeveral functions of his employments, both eccleſiaſtical and civil, he endeavoured, on one hand, to regulate his own life according to the ſtricteſt maxims, and to promote ſuch pariſh-prieſts only as were able to give due inſtructions to their pariſhioners, and at the ſame time led exemplary lives: on the other hand, he did all in his power to cauſe juſtice to be exactly adminiſtered. In 1371 he reſigned his chancellorſhip, lordſhip, and ſome time after the great ſeal. Edward being returned to England, after having carried on a very ſucceſsful war in France, found his exchequer in great diſorder. The duke of Lancaſter, one of his ſons, at the head of ſeveral lords, having brought complaints againſt the clergy, who then enjoyed moſt poſts in the kingdom, the king removed them from their employments. But the laymen, who were raiſed to them, behaved ſo ill, that the king was forced to reſtore the eccleſiaſtics. The duke of Lancaſter ſhowed ſtrong animoſity to the clergy, and ſet every engine at work to ruin Wykeham. He impeached him of extortion, and of diſguiſing things, and obliged him to appear at the King's-bench. He got ſuch judges appointed as condemned him; and not ſatisfied with depriving him of all the temporalities of his biſhopric, he adviſed Edward to baniſh him: but this prince rejected the propoſal, and afterward reſtored to Wykeham all that he had been diveſted of. Richard II. was but eleven years old when Edward died: whereby the duke of Lancaſter had an eaſy opportunity of reviving the accuſations againſt the biſhop of Wincheſter: nevertheleſs Wykeham cleared himſelf. Then he founded two noble colleges, the one in Oxford, the other in Wincheſter. Whilſt he was exerting his utmoſt endeavours to improve theſe two fine foundations, he was recalled to court, and in a manner forced to accept of the office of lord high-chancellor in 1389. Having excellently diſcharged the duties of that employment for three years, he obtained leave to reſign it, foreſeeing the diſturbances that were going to break out. Being returned to his church, he finiſhed his college, and built there ſo magnificent a cathedral, that it almoſt equals that of St Paul's in London. He laid out ſeveral ſums in things advantageous to the public and to the poor; notwithſtanding which, in 1397 he was in great danger; for he and ſome others were impeached of high-treaſon in open parliament: however, he was again fully cleared. From that time till his death he kept quiet in his dioceſe, and there employed himſelf in all the duties of a good prelate. He died in 1404, in the 81ſt year of his age.

William, the name of ſeveral kings of England. See England, n° 87--92, and Britain, n° 302.

Fort-William, a fortreſs in the Highlands of Scotland, erected in king William's reign, as was alſo a ſmall town adjoining, called *Maryburgh*, in honour of his queen. It is ſituated in Inverneſsſhire, on a narrow arm of the ſea called *Loch Eil*, which might eaſily, by a very ſhort canal, be united to the Weſtern ſea. Fort-William is of a triangular form, having two baſtions, and is capable of admitting a garriſon of 800 men; but could not be defended againſt an attack, as it is commanded by ſeveral hills in the neighbourhood.

William's Fort, is a factory of Aſia belonging to the Eaſt-India company, ſeated on one of the branches of the river Ganges, in the kingdom of Bengal. The fort was firſt built in the ſhape of an irregular tetragon of brick and mortar; and the town has nothing regular in it, becauſe every one built a houſe as he liked beſt, and for his own conveniency. The governor's houſe is within the fort, and is the beſt piece of architecture in theſe parts. Here there are alſo convenient lodgings for the factors and writers, with ſtore-houſes for the company's goods, and magazines for ammunition. About 50 yards from the fort is the church, built by the charity of merchants reſiding here. The town is called *Calcutta*, and has a pretty good hoſpital for the ſick, though few come out of it alive. It is governed by a mayor and aldermen, as moſt of the company's factories in the Eaſt Indies now are. In 1757 it was ſurpriſed by the nabob of Bengal, who took it, and put moſt of thoſe that had made reſiſtance into a place called the *Black Hole*, where moſt of them were ſmothered. This nabob was afterwards killed, and another ſet up in his room, more friendly to the Engliſh; and the factory was re-eſtabliſhed. E. Long. 86. 0. N. Lat. 22. 27.

Sweet-William. See Dianthus.

WILLIAMSBURG, a town of North America, in Virginia, and formerly capital of that ſtate. It is ſituated between two creeks; one falling into James, and the other into York River. The diſtance of each landing place is about a mile from the town, which, with the diſadvantage of not being able to bring up large veſſels, and the want of enterpriſe in the inhabitants has occaſioned its decay. Here is a college, deſigned for the education of the Indians, but which, on account of their averſion to learning, never anſwered the purpoſe. It is 60 miles eaſt of Richmond. W. Long. 76. 30. N. Lat. 37. 10.

WILLIAMSTADT, a ſea-port town of Holland. It is a handſome ſtrong place, and the harbour is well frequented. It was built by William prince of Orange in 1585; and in 1732 belonged to the ſtadtholder of Frieſland. The river near which it is built is called *Butterſliet* or *Holland Diep*; and is one of the Bulwarks of the Dutch on the ſide of Brabant, where they always keep a garriſon, This place made a gallant defence in 1793 againſt the French, who were obliged to raiſe the ſiege. It is 15 miles north-eaſt of Bergen-op-Zoom, and 12 ſouth-weſt of Dort. E. Long. 4. 30. N. Lat. 51. 39.

WILLIS (Dr Thomas), a celebrated Engliſh phyſician, was born at Great Bodwin, in Wiltſhire, in 1621, and ſtudied at Chriſt-church college, Oxford. When that city was garriſoned for the king, he, among other ſcholars, bore arms for his Majeſty, and devoted his leiſure hours to the ſtudy of phyſic. The garriſon of Oxford at length ſurrendering to the parliament, he applied himſelf to the practice of his profeſſion; and ſoon rendered himſelf famous by his care and ſkill. He appropriated a room as an oratory for divine ſervice according to the church of England, whither moſt of the loyaliſts in Oxford daily reſorted. In 1660, he became Sedleian profeſſor of natural philoſophy, and the ſame year took the degree of doctor of phyſic. In 1664, he diſcovered the famous medicinal ſpring at Alſtropp, near Brackley. He was one of the firſt members of the Royal Society, and ſoon made his name illuſtrious by his excellent writings. In 1666, after the fire of London, he removed to Weſtminſter; and his practice became greater than that of any of the phyſicians his contemporaries. Soon after his ſettlement in London, his only ſon Thomas falling into a conſumption, he ſent him to Montpelier in France for the recovery of his health; and it proved ſucceſsful. His wife alſo labouring under the ſame diſorder, he offered to leave the town; but ſhe, not ſuffering him to neglect the means of providing for his family, died in 1670. He died at his houſe in St Martin's in 1675, and was buried near her in Weſtminſter-abbey. Dr Willis was extremely modeſt and unambitious, and refuſed the honour of knighthood. He was remarkably pious: As he roſe early in the morning, that he might be preſent at divine ſervice, which he conſtantly frequented before he viſited his patients, he procured prayers to be read beyond the accuſtomed times while he lived; and at his death ſettled a ſtipend of 20l. *per annum* to continue them. He was a liberal benefactor to the poor wherever he came, having from his early practice allotted part of his profits to charitable uſes. He was exact and regular in all his hours: and though his table was the reſort of moſt of the great men of London, yet he was remarkable for his plainneſs, and his being a man of little diſcourſe, complaiſance, or ſociety; but he was juſtly admired for his deep inſight into natural and experimental philoſophy, anatomy, and chemiſtry; for his ſucceſsful practice; and for the elegance and purity of his Latin ſtyle. He wrote, 1. A treatiſe in Engliſh, intitled *A plain and eaſy Method for preſerving thoſe that are well from the Infection of the Plague, and for curing ſuch as are infected*. 2. Several Latin works, which were collected and printed at Amſterdam, in 1682, in 2 vols 4to.

WILLUGHBY (Francis), a celebrated natural hiſtorian, was the only ſon of Sir Francis Willughby, knight. He was fond of ſtudy from his childhood, and held idleneſs in abhorrence; he being ſo great an economiſt with regard to his time, as not willingly to loſe or miſapply the leaſt part of it, by which means he obtained great ſkill in all branches of learning, and particularly in the mathematics. But obſerving that the hiſtory of animals was in a great meaſure neglected by his countrymen, he particularly applied himſelf to that province; and for this purpoſe carefully read over what had been written on that ſubject by others. He then travelled ſeveral times over his native country; and afterwards into France, Spain, Italy, Germany, and the Low Countries, attended by his ingenious friend Mr John Ray. It is remarkable, that, notwithſtanding the advantages of birth, fortune, and parts, he was as humble as any man of the meaneſt fortune; was ſober, temperate, and chaſte: ſcrupulouſly juſt; ſo true to his word and promiſe, that a man might venture his eſtate and life upon it; ſo faithful and conſtant to his friend, as never to deſert him when fortune frowned upon him; and remarkably pious, patient, and ſubmiſſive to the divine will. This is the character given of him by Mr Ray, whoſe veracity none will doubt. This ingenious and learned gentleman died in 1672, at 37 years of age; having impaired his health by his application. He wrote, 1 *Ornithologiæ libri tres*, folio, which was afterwards tranſlated into Engliſh, with an Appendix by Mr Ray, in folio. 2. *Hiſtoriæ Piſcium libri quatuor*, folio. 3. Letters of Francis Willughby, Eſq; added to Philoſophical Letters between the learned Mr Ray and ſeveral of his correſpondents, publiſhed, in 8vo, by William Derham. 4. Several ingenious papers in the Philoſophical Tranſactions.

WILMOT (John), earl of Rocheſter, a great wit in the reign of Charles II. the ſon of Henry earl of Rocheſter, was born in 1648. He was taught grammar and claſſical learning at the free-ſchool at Burford; where he obtained a quick reliſh of the beauties of the Latin tongue, and afterwards became well verſed in the authors of the Auguſtine age. In 1659, he was admitted a nobleman of Wadham college, where he obtained the degree of maſter of arts. He afterwards travelled through France and Italy; and at his return was made one of the gentlemen of the bed-chamber to the king, and comptroller of Woodſtock Park. In 1665, he went to ſea, and was in the Revenge, commanded by Sir Thomas Tiddiman, when an attack was made on the port of Bergen in Norway; during the whole action he ſhowed the greateſt reſolution, and gained a high reputation for courage; which he ſupported in a ſecond expedition, but afterwards loſt it in a private adventure with Lord Mulgrave.

Before the earl of Rocheſter travelled, he had given into the moſt diſorderly and intemperate way of living; at his return, however, he ſeemed to have got the better of it entirely. But falling into the company of the courtiers, who continually practiſed theſe exceſſes, he became ſo ſunk in debauchery, that he was for five years together ſo given up to drinking, that during all that time he was never cool enough to be maſter of himſelf. His violent love of pleaſure, and his diſpoſition to extravagant mirth, carried him to great exceſſes. The firſt involved him in ſenſuality, and the other led him into many adventures and ridiculous frolics. Once diſguiſing himſelf ſo that he could not be known by his neareſt friends, he ſet up in Tower-ſtreet for an Italian mountebank, and there diſperſed his noſtrums for ſome weeks. He often diſguiſed himſelf as a porter, or as a beggar, ſometimes to follow a mean amour; at other times, he would go about merely for diverſion, in odd ſhapes; and acted his part ſo naturally, that he could not be known even by his friends. In ſhort, by his conſtant indulgence in wine, women, and irregular frolics, he entirely wore out an excellent conſtitution before he was 30 years of age. In October 1679, when recovering from a violent diſeaſe, which ended in a conſumption, he was viſited by Dr Burnet, upon an intimation that ſuch a viſit would be agreeable to him. Dr Burnet publiſhed an account of his conferences with Lord Rocheſter; in which it appears, that though he had lived the life of a libertine and atheiſt, yet he died the death of a penitent Chriſtian. His death happened in 1680; ſince which time his poems have been various times printed, both ſeparately and together: but when once he obtained the character of a lewd and obſcene writer, every thing in that ſtrain was fathered upon him; and thus many pieces not of his writing have crept into the later editions of his works. The author of the Catalogue of Royal and Noble Authors ſays, he was "a man whom the Muſes were fond to inſpire, and aſhamed to avow, and who practiſed without the leaſt reſerve that ſecret which can make verſes more read for their defects than their merits. Lord Rocheſter's Poems have much more obſcenity than wit, more wit than poetry, and more poetry than politeneſs." His writings, beſides thoſe already mentioned, are, A Satyre againſt Mankind; Nothing, a poem; Valentinian, a tragedy; Fifty-four Letters to Henry Saville, and others; Seven more to his Wife and Son: a Letter on his deathbed to Dr Burnet. He alſo left behind him ſeveral other papers, and a Hiſtory of the Intrigues of the Court of Charles II. but his mother, a very devout lady, ordered all his papers to be burned.

WILSON (Florence), known in the republic of letters by the name of *Florentius Voluſinus*, was born at Elgin in the ſhire of Murray in Scotland, and educated in the univerſity of Aberdeen. Travelling to England with an intention to improve his fortune, he had the felicity to be introduced to cardinal Wolſey, who appointed him tutor to one of his nephews. In that capacity he went to Paris, and continued there till the cardinal's death. During his reſidence in that city he became acquainted with the learned cardinal Bellai, archbiſhop of Paris, who allowed him a penſion, and meant to have appointed him royal profeſſor of the Greek and Latin languages in the univerſity of Paris: but Bellai being diſgraced, Wilſon's proſpects faded with the fortunes of his patron, whom nevertheleſs he attended on his journey to Rome. Wilſon was taken ill at Avignon, and the cardinal proceeded without him. After his recovery, he paid a viſit to the celebrated cardinal Sabolet, the Mecænas of his time, who was alſo biſhop of Carpentras, where he then reſided. The cardinal was ſo charmed with his erudition, that he appointed him profeſſor of the learned languages, with a ſtipend of 100 piſtoles *per annum*.

During his reſidence at Carpentras, he wrote his celebrated treatiſe *De Animi Tranquillitate*. Mackenzie ſays that he afterwards taught philoſophy in Italy; and that, being at length deſirous of returning to Scotland, he began his journey homeward, was taken ill at Viene in Dauphiny, and died there in the year 1547. He was generally eſteemed an accompliſhed linguiſt, an admirable philoſopher, and an excellent Latin poet. He wrote, beſide the above treatiſe, 1. *Poemata*. Lond. 1619, 4to. 2. *Commentatio quæ-*

dam theologica in aphoriſmos diſſecta, per Sebaſt Gryph. 3. *Philoſophiæ Ariſtot. Synopſis*, lib. iv.

Wilson (Thomas), lord biſhop of Sodor and Man, was born in 1663, at Burton, in the county of Cheſter. He received the rudiments of his education at the county town, and from thence was removed to the univerſity of Dublin. His allowance at the univerſity was 20l. a year; a ſum, ſmall as it may now appear, which was in thoſe days ſufficient for a ſober youth in ſo cheap a country as Ireland.

His firſt intention was to have applied to the ſtudy of phyſic; but from this he was diverted by archdeacon Hewetſon, by whoſe advice he dedicated himſelf to the church. He continued at college till the year 1686, when, on the 29th of June, he was ordained deacon.

The exact time of Mr Wilſon's leaving Dublin is not known: but on account of the political and religious diſputes of thoſe days, it was ſooner than he intended. On the 10th of December, in the ſame year, he was licenſed to the curacy of New Church in Winwick, of which Dr Sherlock, his maternal uncle, was rector. His ſtipend was no more than 30l. a-year; but being an excellent economiſt, and having the advantage of living with his uncle, this ſmall income was not only ſufficient to ſupply his own wants, but it enabled him to ſupply the wants of others; and for this purpoſe he ſet apart one tenth of his income. In 1692 he was appointed domeſtic chaplain to William earl of Derby, and tutor to his ſon James Lord Strange, with a ſalary of 30l. a-year. He was ſoon after elected maſter of the alms houſe at Latham, which brought him in 20l. a-year more. Having now an income far beyond his expectations, or his wiſhes, except as it increaſed his ability to do good, he ſet apart one fifth of his income for pious uſes, and particularly for the poor. In ſhort, as his income increaſed, he increaſed the portion of it which was allotted to the purpoſes of charity. At firſt he ſet apart a tenth, then a fifth, afterwards a third, and laſtly, when he became a biſhop, he dedicated the full half of his revenues to pious and charitable uſes.

He had not been long in the ſervice of Lord Derby, before he was offered the valuable living of Buddeſworth in Yorkſhire; which he refuſed to accept, as being inconſiſtent with the reſolves of his conſcience againſt non-reſidence, Lord Derby chooſing ſtill to retain him as chaplain and tutor to his ſon. In 1697 he was promoted, not without ſome degree of compulſion on the part of his patron, to the biſhopric of the Iſle of Man; a preferment which he held 58 years. In 1698 he married Mary, daughter of Thomas Patten, Eſq; of Warrington. By this lady, who ſurvived her marriage about ſix years, he had four children; none of whom ſurvived him except the late Dr Wilſon, prebendary of Weſtminſter.

"The annual receipts of the biſhopric (ſays the author of his memoirs) did not exceed 300l. in money. Some neceſſaries in his houſe, as ſpices, ſugar, wine, books, &c. muſt be paid for with money; diſtreſſed or ſhipwrecked mariners, and ſome other poor objects, required to be relieved with money; but the poor of the iſland were fed and clothed, and the houſe in general ſupplied from his demeſnes, by exchange, without money. The poor, who could weave or ſpin, found the beſt market at Biſhop's-court, where they bartered the produce of their labour for corn. Taylors and ſhoemakers were kept in the houſe conſtantly employed, to make into garments or ſhoes that cloth or leather which his corn had purchaſed; and the aged and infirm were ſupplied according to their ſeveral wants. Mr Moore of Douglas informed the editor, that he was once witneſs to a pleaſing and ſingular inſtance of the Biſhop's attention to ſome aged poor of the iſland. As he was diſtributing ſpectacles to ſome whoſe eye-ſight failed them, Mr Moore expreſſed his ſurpriſe, as he well knew not one of them could read a letter. 'No matter (ſaid the Biſhop with a ſmile), they will find uſe enough for them; theſe ſpectacles will help them to thread a needle, to mend their clothes, or, if need be, to keep themſelves free from vermin."

So great was the biſhop's attachment to his flock, that no temptation could ſeduce him from their ſervice. He more than once refuſed the offer of an Engliſh biſhopric. There is an anecdote of his lordſhip and cardinal Fleury, which does great credit to them both. The cardinal wanted much to ſee him, and ſent over on purpoſe to inquire after his health, his age, and the date of his conſecration, as they were the two oldeſt biſhops, and he believed the pooreſt, in Europe; at the ſame time inviting him to France. The biſhop ſent the cardinal an anſwer, which gave him ſo high an opinion of him, that the cardinal obtained an order that no French privateer ſhould ravage the Iſle of Man.

This good prelate lived till the year 1755, dying at the advanced age of 93. His works have lately been publiſhed in 2 vols 4to.

WILTON, a market town in Wiltſhire, three miles weſt of Saliſbury. It was once ſo conſiderable as to give title to the county. It formerly had 12 churches; and Odo, brother-in-law to William I. was biſhop of Wilton: only one now remains. It ſends members to parliament, and is the place where the knights of the ſhire are choſen. It has a great manufactory of carpets, which are brought to high perfection. Wilton is famous for lord Pembroke's ſeat, ſo well known through Europe for its containing a grand aſſemblage of the productions of the greateſt and moſt ancient maſters in painting and ſculpture.—Two fairs are held here annually.

WILTSHIRE, a county of England, bounded on the weſt by Somerſetſhire, on the eaſt by Berkſhire and Hampſhire, on the north by Glouceſterſhire, and on the ſouth by Dorſetſhire and part of Hampſhire. The length amounts to 39 miles; its breadth to 30; and its circumference to 140. It contains 29 hundreds, 23 market-towns, 304 pariſhes, and about 876,000 ſouls. Beſides two members for the ſhire, and two for the city of Saliſbury, each of the following towns ſends two members to parliament, *viz.* Wilton, Downton, Hindon, Heyteſbury, Weſtbury, Calne, Devizes, Chippanham, Malmſbury, Cricklade, Great Bedwin, Ludgerſhall, Old Sarum, Wooton-Baſſet, Marlborough.

The air of this country is very healthy, not only in the more low and level parts, but alſo on the hills. The ſoil of the vales is very rich, and produces corn and graſs in great plenty. The beautiful downs in the ſouth yield the fineſt paſture for ſheep, with which they are overſpread. The greateſt diſadvantage the county labours under is want of fuel, as there are no coal-pits, and but little wood. This county is noted for great quantities of very fine cheeſe, and for its manufacture of broad cloth, to which it was invited by the great plenty and fineneſs of its wool. Beſides a number of leſſer ſtreams, it is watered by the rivers Iſis, Kennet, Upper and Lower Avon, Willy, Burne, and Nadder, which are well ſtored with fiſh.

WINCHELSEA, a town in Suſſex, which has no market, but has one fair on May 14th for cattle and pedlars ware. It was an ancient place, at leaſt the old town, which was ſwallowed up by the ocean in 1250. It is now dwindled to a mean place, though it retains its privileges, and ſends two members to parliament. It is ſeated on a rocky cliff, on an inlet of the ſea; and had a haven, now choked up. It had 18 pariſh-churches, now reduced to one. The market-houſe is in the midſt of the town, from whence run four paved ſtreets, at the end of which are four ways, which had formerly buildings on each ſide for a conſiderable diſtance. It is 2 miles ſouth-weſt of Rye, and 71 ſouth-eaſt of London. It is governed by a mayor and jurats, though it has but about 70 houſes. Three of the gates are ſtill ſtanding, but much decayed. E. Long. 0. 44. N. Lat. 50. 58.

Winchelsea (Anne counteſs of), a lady of excellent genius, eſpecially in poetry, was maid of honour to the ducheſs of York, ſecond wife to king James II. and was afterwards married to Heneage, ſecond ſon of the earl of Winchelſea. One of the moſt conſiderable of the counteſs of Winchelſea's poems was that on the Spleen. A collection of her poems was printed at London in 1713, containing a tragedy never acted, entitled *Ariſtomenes*. The counteſs died in 1720 without iſſue, as her huſband did in 1726.

WINCHESTER, the capital of the county of Hampſhire in England. It is a very ancient city, ſuppoſed to have been built ſeveral centuries before Chriſt. The Romans called it *Venta Belgarum*, the Britons *Caer Givent*, and the Saxons *Witanceaſter*; whence came the preſent name. It ſtands upon the river Itchin, in a bottom ſurrounded with chalky hills; and is generally allowed to have been a conſiderable place in the time of the Romans. Some of the firſt converts to Chriſtianity are ſuppoſed to have lived here. In the caſtle, near the weſt-gate, many of the Saxon kings anciently kept their courts. The cathedral was founded by Kenegulfe, a king of the Mercians; but there were many Chriſtians, and places for their worſhip here, long before that period. It is a large pile, and has a venerable look, but is not very elegant. Beſides the tombs, there are many curious pieces of workmanſhip in it; the chief of which are, 1. The font, erected in the time of the Saxons. 2. Copper ſtatues of James I. and Charles I. 3. The biſhop's throne. 4. The ſtalls of the dean and prebendaries. 5. The aſcent to the choir and altar. 6. The pavement, inlaid with marble of diverſe colours, in various figures. 7. The altar piece, reckoned the nobleſt in England. 8. The paintings in the windows, eſpecially the great eaſt window. At the hoſpital of the Holy Croſs, every traveller that knocks at the door may claim a manchet of white bread and a cup of beer; of which a great quantity is provided every day for that purpoſe. This hoſpital was intended for the maintenance of a maſter and 30 penſioners, but only 14 are now maintained in it; and the maſter enjoys a revenue of 800l. a-year. This city is about a mile and a half in compaſs, and almoſt ſurrounded with a wall of flint, has ſix gates, large ſuburbs, broad clean ſtreets; but the private houſes are in general but ordinary, many of them being very old. The city is interſperſed with a great many gardens, which contribute to its beauty and healthineſs. The corporation conſiſts of a mayor, high-ſteward, recorder, alderman, two coroners, two bailiffs, 24 common-council men, a town clerk, four conſtables, and four ſerjeants at mace; and the city gives title of *marquis* to the duke of Bolton. A Roman highway leads from hence to Alton; and went formerly, as it is thought, from thence to London. The charming downs in the neighbourhood contribute greatly to the health and pleaſure of the inhabitants. The river Itchin is navigable for barges from hence to Southampton. W. Long. 1. 21. N. Lat. 51. 5.

WINCKLEMAN (Abbé John), was born at Stendall. in the old Marche of Brandenburgh, in 1718. His father was a ſhoemaker. This wonderful man, to all appearance deſtined by his birth to ſuperintend a little ſchool in an obſcure town of Germany, raiſed himſelf to the office of preſident of antiquities in the Vatican. After having been ſeven years profeſſor in the college of Seehauſen near Salswedel, he went into Saxony, where he reſided ſeven years more, and was librarian to count Bunau, at Nothenitz. When he left this place, 1754, he went to Dreſden, where he formed an acquaintance with the ableſt artiſts, and particularly with M. Oeſer, an excellent painter, and one of the beſt draughtſmen of the age. In that year he abjured Lutheraniſm, and embraced the Roman Catholic religion. In September 1755, he ſet out for Italy, and arrived at Rome in December following. His principal object was to ſee the Vatican library, and to examine the ruins of Herculaneum.

Mr Winckleman carried with him into Italy a ſenſe of beauty and art, which led him inſtantly to admire the maſter-pieces of the Vatican, and with which he began to ſtudy them. He ſoon increaſed his knowledge; and it was not till after he had thus purified his taſte and conceived an idea of ideal beauty, which led him into the greateſt ſecrets of art, that he began to think of the explanation of other monuments, in which his great learning could not fail to diſtinguiſh him. His erudition enabled him to fill up his principal plan of writing the "Hiſtory of Art." In 1756 he planned his "Reſtoration of Ancient Statues," and a larger work on the "Taſte of the Greek Artiſts;" and deſigned an account of the galleries of Rome and Italy, beginning with a volume on the Belvedere ſtatues, in the manner of Richardſon, who, he ſays, only ran over Rome. He alſo intended a hiſtory of the corruption of taſte in art, the reſtoration of ſtatues, and an illuſtration of the obſcure points of mythology. All theſe different eſſays led him to his "Hiſtory of Art," and his "Monumenti Inediti." It muſt, however, be confeſſed, that the firſt of theſe works has not all the clearneſs and preciſion that might be expected in its general plan and diviſion of its parts and objects; but it has enlarged and extended the ideas both of antiquaries and collectors. The deſcription of the gems and ſulphurs of the Scotch cabinet contributed not a little to extend Mr Winckleman's knowledge. Few perſons have opportunities of contemplating ſuch vaſt collections. The engravings of Lippet and count Caylus are all that many can arrive at. Mr Wickleman's Monumenti Inediti, of which he had begun the third vol. 1767, ſeem to have ſecured him the eſteem of antiquaries. Had he lived, we ſhould have had a work long wiſhed for; a complete collection of the bas-reliefs diſcovered from the time of Bartoli to the preſent, the greater part of which are in the poſſeſſion of cardinal Albani.

When cardinal Albani ſucceeded to the place of librarian of the Vatican, he endeavoured to get a place for the Hebrew language for Winckleman, who refuſed a canonry, becauſe he would not take the tonſure. The elector of Saxony gave him, 1761, unſolicited, the place of counſellor Richter, the direction of the royal cabinet of medals and antiquities at Dreſden. Upon the death of the Abbé Venuti, 1762, he was appointed preſident of the antiquities of the apoſtolic chamber, with power over all diſcoveries and exportations of antiquities and pictures. This is a poſt of honour, with an income of 160 ſcudi *per annum*. He had a proſpect of the place of preſident of antiquities in the Vatican, going to be created at 16 ſcudi *per* month, and was named correſponding member of the Academy of Inſcriptions. The king of Pruſſia offered him by Col. Quintus Icilius the place of librarian and director of his cabinet of medals and antiquities, void by the death of M. Gautier de la Croze, with a handſome appointment. He made no ſcruple of accepting the offer; but when it came to the pope's ears, he added an appointment out of his own purſe, and kept him at Rome.

In April 1768, he left Rome, to go with M. Cavaceppi over Germany and Switzerland. When he came to Vienna, he was ſo pleaſed with the reception he met with, that he made a longer ſtay there than he had intended. But, being ſuddenly ſeized with a ſecret uneaſineſs and extraordinary deſire to return to Rome, he ſet out for Italy, putting off his viſits to his friends in Germany to a future opportunity. As he paſſed through Trieſte, he was aſſaſſinated, June 8. 1768, by a wretch named Arcangeli, a native of Campiglio, a town in the territory of Piſtoia, with whom he had made an acquaintance on the road. This miſcreant had been condemned for a robbery to work in fetters four years, and then to be baniſhed the Auſtrian territories, on an oath never to return. He had obtained a mitigation of one of his ſentences, and retired to Venice; but, changing his quarters backwards and forwards he was ſo reduced in circumſtances that he at length took up his lodgings at the inn to which the Abbé happened to come. Arcangeli paid ſuch aſſiduous court to him, that he entirely gained his confidence; and having been favoured with a ſight of the valuable preſents which he had received at Vienna, formed a deſign to murder and rob him. He bought a new ſharp knife on purpoſe; and as the Abbé (who had in the moſt friendly manner invited him to Rome) was ſitting down in his chair, early in the morning, he threw a rope over his head, and before he could diſengage himſelf, ſtabbed him in five different places. The Abbé had ſtill ſtrength to get down to the ground floor, and call for help; and being laid on a bed in the midſt of the moſt violent pain, he had compoſure ſufficient to receive the laſt ſacraments, and to make his will, in which he appointed cardinal Alexander Albani his reſiduary legatee, and expired in the afternoon. The murderer was ſoon after apprehended; and executed on the wheel oppoſite the inn, June 26.

Abbé Winckleman was a middle-ſized man: he had a very low forehead, ſharp noſe, and little black hollow eyes, which gave him an aſpect rather gloomy than otherwiſe. If he had any thing graceful in his phyſiognomy, it was his mouth. A fiery and impetuous diſpoſition often threw him into extremes. Naturally enthuſiaſtic, he often indulged an extravagant imagination; but as he poſſeſſed a ſtrong and ſolid judgment, he knew how to give things a juſt and intrinſic value. In conſequence of this turn of mind, as well as a neglected education, a cautious reſerve was a quality he little knew. If he was bold in his deciſions as an author, he was ſtill more ſo in his converſation, and has often made his friends tremble for his temerity. If ever man knew what friendſhip was, that man was Mr Winckleman, who regularly practiſed all its duties; and for this reaſon he could boaſt of having friends among perſons of every rank and condition.

WIND is a ſenſible agitation of the atmoſphere, occaſioned by a quantity of air flowing from one place to another.

As navigation depends in a great meaſure upon the direction and force of the winds, as the temperature of climates is greatly influenced by them, and as they are abſolutely neceſſary to preſerve the ſalubrity of the atmoſphere, it is not ſurpriſing that they have very much engaged the attention of mankind. To be acquainted with the laws by which they are regulated, and to be able to calculate beforehand the conſequences of theſe laws, has been in every age the eager wiſh of philoſophers. But whether it has been owing to an improper method of ſtudying this ſubject, or to its lying beyond the reach of the human faculties, philoſophers have not made that progreſs in it which the ſanguine imaginations of ſome individuals led them to expect. Many diſcoveries indeed have been made; and from the numbers and the genius of the philoſophers at preſent engaged in this ſtudy, others equally important may be expected. But, notwithſtanding this, many of the phenomena remain unexplained, and a rational and ſatisfactory theory ſeems ſtill beyond our reach. It will not be expected, that where philoſophers in general have failed, we ſhall ſucceed. If we can collect the facts hitherto aſcertained, and explain ſuch of them as the late diſcoveries have enabled us to underſtand, we truſt we ſhall obtain the indulgence of the Public, though we cannot boaſt of throwing much new light on this difficult ſubject.

Hiſtory of the Winds.

As the winds of the torrid zone differ in ſeveral important particulars from thoſe which blow without the tropics, we ſhall firſt deſcribe them, and afterwards thoſe of the temperate zones.

1 Winds of the Torrid Zone.

I. In thoſe parts of the Atlantic and Pacific ocean which lie neareſt the equator, there is a regular wind during the whole year called the *trade-wind*. On the north ſide of the equator it blows from the north-eaſt, varying frequently a point or two towards the north or eaſt; and on the ſouth ſide of it, from the ſouth eaſt; changing ſometimes in the ſame manner towards the ſouth or eaſt. The ſpace included between the ſecond and fifth degree of north latitude is the internal limit of theſe two winds. There the winds can neither be ſaid to blow from the north nor the ſouth; calms are frequent, and violent ſtorms. This ſpace varies a little in latitude as the ſun approaches either of the tropics.—In the Atlantic ocean the trade winds extend farther north on the American than on the African coaſt; and as we advance weſtward, they become gradually more eaſterly, and decreaſe in ſtrength*. Their force diminiſhes likewiſe as we approach their utmoſt boundaries. It has been remarked alſo, that as the ſun approaches the tropic of Cancer, the ſouth-eaſt winds become gradually more ſoutherly, and the north-eaſt winds more eaſterly: exactly the contrary takes place when the ſun is approaching the tropic of Capricorn §.

2 The trade-wind.

3 Monſoons.

The trade-wind blows conſtantly in the Indian ocean from the 10th degree of ſouth latitude to near the 30th: But to the northward of this the winds change every ſix months, and blow directly oppoſite to their former courſe. Theſe regular winds are called *monſoons*, from the Malay word *mooſſin*, which ſignifies "a ſeaſon †." When they ſhift their direction, variable winds and violent ſtorms ſucceed, which laſt for a month and frequently longer; and during that time it is dangerous for veſſels to continue at ſea.

The monſoons in the Indian ocean may be reduced to two; one on the north and another on the ſouth ſide of the equator; which extend from Africa to the longitude of New Holland and the eaſt coaſt of China, and which ſuffer partial changes in particular places from the ſituation and inflection of the neighbouring countries.

1. Between the 3d and 10th degrees of ſouth latitude the ſouth-eaſt trade-wind continues from April to October; but during the reſt of the year the wind blows from the north-weſt ‡. Between Sumatra and New Holland this monſoon blows from the ſouth during our ſummer months, approaching gradually to the ſouth-eaſt as we advance towards the coaſt of New Holland; it changes about the end of September, and continues in the oppoſite direction till April §. Between Africa and Madagaſcar its direction is influenced by the coaſt; for it blows from the north-eaſt from October to April, and during the reſt of the year from the ſouth-weſt ¶.

2. Over all the Indian ocean, to the northward of the 3d degree of ſouth latitude, the north-eaſt trade-wind blows from October to April, and a ſouth-weſt wind from April to October ||. From Borneo, along the coaſt of Malacca and

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* Dr Halley, Phil. Tranſ. Abr. vol. ii. p. 134.

§ Ibidem.

† Foreſt's Voyage, p. 95.

‡ Dr Halley, Phil. Tranſ. Abr. vol. ii. p. 136.

§ Ibidem.

¶ Bruce's Travels, vol. i. p. 459.

|| Dr Halley, ibid.

and as far as China, this monſoon in ſummer blows nearly from the ſouth, and in winter from the north by eaſt §. Near the coaſt of Africa, between Mozambique and Cape Guardeſan, the winds are irregular during the whole year, owing to the different monſoons which ſurround that particular place.—Monſoons are likewiſe regular in the Red Sea; between April and October they blow from the north-weſt, and during the other months from the ſouth-eaſt, keeping conſtantly parallel to the coaſt of Arabia*.

§ Dr Halley, ibid.

* Bruce's Travels, vol. I. ch. 4.

Monſoons are not altogether confined to the Indian Ocean; on the coaſt of Brazil, between Cape St Auguſtine and the iſland of St Catherine, the wind blows between September and April from the eaſt or north-eaſt, and between April and September from the ſouth-weſt†.—The bay of Panama is the only place on the weſt ſide of a great continent where the wind ſhifts regularly at different ſeaſons: there it is eaſterly between September and March; but between March and September it blows chiefly from the ſouth and ſouth-weſt.

† Sir Walter Raleigh's Voyage, Foreſt's Voy. p. 97.

Such in general is the direction of the winds in the torrid zone all over the Atlantic, Pacific, and Indian Oceans; but they are ſubject to particular exceptions, which we ſhall now endeavour to enumerate.—On the coaſt of Africa, from Cape Bayador to Cape Verde, the winds are generally north-weſt; from hence to the iſland of St Thomas near the equator they blow almoſt perpendicular to the ſhore, bending gradually, as we advance ſouthwards, firſt to the weſt and then to the ſouth-weſt ||. On the coaſt of New Spain likewiſe, from California to the Bay of Panama, the winds blow almoſt conſtantly from the weſt or ſouth-weſt except during May, June, and July, when land-winds prevail, called by the Spaniards *Popogayos*. On the coaſt of Chili and Peru ¶, from 20° or 30° ſouth latitude, to the equator, and on the parallel coaſt of Africa, the wind blows during the whole year from the ſouth, varying according to the direction of the land towards which it inclines, and extending much farther out to ſea on the American than the African coaſt. The trade-winds are alſo interrupted ſometimes by weſterly winds in the Bay of Campeachy and the Bay of Honduras.

|| Halley, ibid.

¶ Sir Walter Raleigh's Voyage. Dr Gurden, Phil. Tranſ. Abr. vol. ii. p. 132.

As to the countries between the tropics, we are too little acquainted with them to be able to give a ſatisfactory hiſtory of their winds.

4
Sea and land breezes.

In all maritime countries between the tropics of any extent, the wind blows during a certain number of hours every day *from* the ſea, and during a certain number *towards* the ſea from the land; theſe winds are called the *ſea and land breezes*. The ſea breeze generally ſets in about ten in the forenoon, and blows till ſix in the evening; at ſeven the land-breeze begins, and continues till eight in the morning, when it dies away*. During ſummer the ſea breeze is very perceptible on all the coaſts of the Mediterranean Sea‡, and even ſometimes as far north as Norway||.

* Marſden's Hiſt. of Sumatra, p. 17. Buffon's Nat. Hiſt. vol. i. p. 385.

‡ Volney's Travels.

|| Pontoppidan's Nat. Hiſt. of Norway.

5
Winds in St Lewis and Balama.

In the iſland of St Lewis on the coaſt of Africa, in 16° north latitude, and 16° weſt longitude, the wind during the rainy ſeaſon, which laſts from the middle of July to the middle of October, is generally between the ſouth and eaſt; during the reſt of the year it is for the moſt part eaſt or north-eaſt in the morning; but as the ſun riſes, the wind approaches gradually to the north, till about noon it gets to the weſt of north, and is called a *ſea-breeze*. Sometimes it ſhifts to the eaſt as the ſun deſcends, and continues there during the whole night. In February, March, April, May, and June, it blows almoſt conſtantly between the north and weſt§. In the iſland of Balama, which lies likewiſe on the weſt coaſt of Africa, in the 11th degree of north latitude, the wind during nine months of the year blows from the ſouth-weſt; but in November and December a very cold wind blows from the north eaſt*.

§ Dr Schotte, Phil. Tranſ. vol. lxx. art. 25.

* P. Beaver, Eſq; See Map in Wadſtrom's Eſſay on Colonization.

6
Bornou and Fezzan.

In the kingdom of Bornou, which lies between the 16th and 20th degree of north latitude, the warm ſeaſon is introduced about the middle of April by ſultry winds from the ſouth-eaſt, which bring along with them a deluge of rain†. In Fezzan, which is ſituated about the 25th degree of north latitude, and the 35th degree of eaſt longitude, the wind from May to Auguſt blows from the eaſt, ſouth-eaſt, or ſouth-weſt, and is intenſely hot ‡.

† African Aſſociation, p. 600.

‡ Ibid.

7
Abyſſinia.

In Abyſſinia the winds generally blow from the weſt, north-weſt, north, and north-eaſt. During the months of June, July, Auguſt, September, and October, the north and north-eaſt winds blow almoſt conſtantly, eſpecially in the morning and evening; and during the reſt of the year they are much more frequent than any other winds*.

* Bruce's Travels. vol. iv. p. 651.

8
Calcutta, Madras,

9
And St Domingo.

At Calcutta, in the province of Bengal, the wind blows during January and February from the ſouth-weſt and ſouth; in March, April, and May, from the ſouth; in June, July, Auguſt, and September, from the ſouth and ſouth-eaſt; in October, November, and December, from the north-weſt*.—At Madras the moſt frequent winds are the north and north-eaſt.—At Tivoli in St Domingo, and at Iles de Vaches, the wind blows ofteneſt from the ſouth and ſouth-eaſt‡.—From theſe facts it appears, that in moſt tropical countries with which we are acquainted, the wind generally blows *from* the neareſt ocean, except during the coldeſt months, when it blows *towards* it.

* Aſiatic Reſearches, vols. i. and ii. Appen.

‡ P. Cotte, Jour. de Phyſ. 1791.

10
Winds of the North Temperate Zone.

II. In the temperate zones the direction of the winds is by no means ſo regular as between the tropics. Even in the ſame degree of latitude, we find them often blowing in different directions at the ſame time; while their changes are frequently ſo ſudden and ſo capricious, that to account for them has hitherto been found impoſſible. When winds are violent, and continue long, they generally extend over a large tract of country; and this is more certainly the caſe when they blow from the north or eaſt than from any other points§. By the multiplication and compariſon of Meteorological Tables, ſome regular connection between the changes of the atmoſphere in different places may in time be obſerved, which will at laſt lead to a ſatisfactory theory of the winds. It is from ſuch tables chiefly that the following facts have been collected.

§ Derham's Phyſico-Theology, ch. ii.

11
Of America,

In Virginia, the prevailing winds are between the *ſouth-weſt*, *weſt*, *north*, and *north-weſt*; the moſt frequent is the *ſouth-weſt*, which blows more conſtantly in June, July, and Auguſt, than at any other ſeaſon. The *north-weſt* winds blow moſt conſtantly in November, December, January, and February*.—At Ipſwich in New England the prevailing winds are alſo between the *ſouth-weſt*, *weſt*, *north*, and *north-eaſt*; the moſt frequent is the *north-weſt*†: But at Cambridge, in the ſame province, the moſt frequent wind is the *ſouth-eaſt*‡.—The predominant winds at New York are the *north* and *weſt* §: And in Nova Scotia *north-weſt* winds blow for three-fourths of the year||.—The ſame wind blows moſt frequently at Montreal in Canada; but at Quebec the wind generally follows the direction of the river St Lawrence, blowing either from the *north-eaſt* or *ſouth-weſt* ¶.—At Hudſon's Bay *weſterly* winds blow for three fourths of the year; the *north-weſt* wind occaſions the greateſt cold, but the *north* and *north-eaſt* are the vehicles of ſnow*.

* Jefferſon's Virginia, p. 123.

† Tranſ. Amer. Acad. vol. i. p. 336.

‡ M. Cotte, Journ. de Phyſ. 1791.

§ Ibid.

|| Preſent State of Nova Scotia and Canada, p. 38.

¶ Cotte, ibid.

* Pennant's Supp. to Arctic Zool. p. 41.

It appears from theſe facts, that weſterly winds are moſt frequent over the whole eaſtern coaſt of North America; that in the ſouthern provinces ſouth-weſt winds predominate; that the north-weſt become gradually more frequent as we approach the frigid zone.

In Egypt, during part of May, and during June, July, Auguſt, 12 Egypt, Auguſt, and September, the wind blows almoſt conſtantly from the *north*, varying ſometimes in June to the *weſt*, and in July to the *weſt* and the *eaſt*; during part of September, and in October and November, the winds are variable, but blow more regularly from the *eaſt* than any other quarter; in December, January, and February, they blow from the *north*, *north-weſt*, and *weſt*; towards the end of February they change to the *ſouth*, in which quarter they continue till near the end of March; during the laſt days of March and in April they blow from the *ſouth-eaſt*, *ſouth*, and *ſouth-weſt*, and at laſt from the *eaſt*; and in this direction they continue during a part of May‡.

13 The Mediterranean, In the Mediterranean the wind blows nearly three-fourths of the year from the *north*; about the equinoxes there is always an *eaſterly* wind in that ſea, which is generally more conſtant in ſpring than in autumn†. Theſe obſervations do not apply to the gut of Gibraltar, where there are ſeldom any winds except the *eaſt* and the *weſt*.—At Baſtia, in the iſland of Corſica, the prevailing wind is the *ſouth-weſt**.

14 Syria and other parts of Aſia, In Syria the *north* wind blows from the autumnal equinox to November; during December, January, and February, the winds blow from the *weſt* and *ſouth-weſt*; in March they blow from the *ſouth*, in May from the *eaſt*, and in June from the *north*. From this month to the autumnal equinox the wind changes gradually as the ſun approaches the equator; firſt to the *eaſt*, then to the *ſouth*, and laſtly to the *weſt*†.—At Bagdad the moſt frequent winds are the *ſouth-weſt* and *north-weſt*; at Pekin, the *north* and the *ſouth*‡; at Kamtſchatka, on the north-eaſt coaſt of Aſia, the prevailing winds blow from the *weſt* §.

15 Italy, In Italy the prevailing winds differ conſiderably according to the ſituation of the places where the obſervations have been made: At Rome and Padua they are *northerly*, at Milan *eaſterly*†.—16 Spain, All that we have been able to learn concerning Spain and Portugal is, that on the weſt coaſt of theſe countries the *weſt* is by far the moſt common wind, particularly in ſummer; and that at Madrid the wind is *north-eaſt* for the greateſt part of the ſummer, blowing almoſt conſtantly from the Pyrenean mountains‡.—17 Switzerland, At Berne in Switzerland the prevailing winds are the *north* and *weſt*; at St Gottard, the *north-eaſt*; at Lauſanne, the *north-weſt* and *ſouth-weſt* §.

18 France, Father Cotte has given us the reſult of obſervations made at 86 different places of France ‖; from which it appears, that along the whole ſouth coaſt of that kingdom the wind blows moſt frequently from the *north*, *north-weſt*, and *north-eaſt*; on the weſt coaſt, from the *weſt*, *ſouth-weſt*, and *north-weſt*; and on the north coaſt, from the *ſouth-weſt*. That in the interior parts of France the *ſouth-weſt* wind blows moſt frequently in 18 places; the *weſt* wind in 14; the *north* in 13; the *ſouth* in 6; the *north-eaſt* in 4; the *ſouth-eaſt* in 2; the *eaſt* and *north-weſt* each of them in one.—19 The Netherlands, On the weſt coaſt of the Netherlands, as far north as Rotterdam, the prevailing winds are probably the *ſouth-weſt*, at leaſt this is the caſe at Dunkirk and Rotterdam‡. It is probable alſo that along the reſt of this coaſt, from the Hague to Hamburgh, the prevailing winds are the *north-weſt*, at leaſt theſe winds are moſt frequent at the Hague and at Franeker §.—The prevailing wind at Delft is the *ſouth-eaſt*; and at Breda the *north* and the *eaſt*†.

20 Germany, In Germany the *eaſt* wind is moſt frequent at Gottingen, Munich, Weiſſemburg, Duſſeldorf, Saganum, Erford, and at Buda in Hungary; the *ſouth-eaſt* at Prague and Wirtzburg; the *north-eaſt* at Ratiſbone; and the *weſt* at Manheim and Berlin ‡.

21 Britain, From an average of ten years of the regiſter kept by order of the Royal Society, it appears, that at London the winds blow in the following order:

WINDS.	DAYS.	WINDS.	DAYS.
South-weſt -	112	South-eaſt -	32
North-eaſt -	58	Eaſt -	26
North-weſt -	50	South -	18
Weſt -	53	North -	16

It appears, from the ſame regiſter, that the *ſouth-weſt* wind blows at an average more frequently than any other wind during every month of the year, and that it blows longeſt in July and Auguſt; that the *north-eaſt* blows moſt conſtantly during January, March, April, May, and June, and moſt ſeldom during February, July, September and December; and that the *north-weſt* wind blows oftener from November to March, and more ſeldom during September and October than any other months. The *ſouth-weſt* winds are alſo moſt frequent at Briſtol, and next to them are the *north-eaſt* §.

The following table of the winds at Lancaſter has been drawn up from a regiſter kept for ſeven years at that place ¶:

WINDS.	DAYS.	WINDS.	DAYS.
South-weſt -	92	South-eaſt -	35
North-eaſt -	67	North -	30
South -	51	North-weſt -	26
Weſt -	41	Eaſt -	17

The following table is an abſtract of nine years obſervations made at Dumfries by Mr Copland†.

WINDS.	DAYS.	WINDS	DAYS.
South -	82½	North -	36½
Weſt -	69	North-weſt -	25½
Eaſt -	68	South-eaſt -	18½
South-weſt -	50½	North-eaſt -	14½

The following table is an abſtract of ſeven year's obſervations made by Mr Meek at Cambuſlang near Glaſgow‡:

WINDS.	DAYS.	WINDS.	DAYS.
South-weſt -	174	North-eaſt -	104
North-weſt -	140	South-eaſt -	47

It appears, from the regiſter from which this table was extracted, that the *north-eaſt* wind blows much more frequently in April, May, and June, and the *ſouth-weſt* in July, Auguſt, and September, than at any other period. We learn from the Statiſtical account of Scotland, that the *ſouth-weſt* is by far the moſt frequent wind all over that kingdom, eſpecially on the weſt coaſt. At Saltcoats in Airſhire, for inſtance, it blows three-fourths of the year; and along the whole coaſt of Murray, on the *north-eaſt* ſide of Scotland, it blows for two-thirds of the year. Eaſt winds are common over all Great Britain during April and May; but their influence is felt moſt ſeverely on the eaſtern coaſt.

The following table exhibits a view of the number of days during which the weſterly and eaſterly winds blow in a year at different parts of the iſland. Under the term *weſterly* are included the north-weſt, weſt, ſouth weſt, and ſouth; the term *eaſterly* is taken in the ſame latitude.

Years of Obſer.	Places.	WIND Weſterly.	 Eaſterly.
10	London -	233	132
7	Lancaſter -	216	149
51	Liverpool‡ -	170	175
9	Dumfries -	227,5	137,5
10	Branxholm, 54 miles ſouth-weſt of Berwick §, -	232	133
7	Cambuſlang -	214	151
8	Hawkhill, near Edinburgh†, -	229,5	135.5
	Mean	217,4	144,7

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‡ Volney's Travel's, vol. i. p. 58.

† Ibid. p. 59 and 65.

* Cotte, ibid.

† Volney's Trav. vol. i p. 326.

‡ Cotte, ibid.

§ Pennant's Arctic Zool. p. cxiii.

† Cotte, ibid.

‡ Bohun's Hiſt. of Winds, p. 116.

§ Cotte, ibid.

‖ Ibid.

‡ Ibid.

§ Ibid.

† Ibid.

‡ Ibid.

§ Phil. Tranſ. vol. lxvi. p. 2.

¶ Manch. Tranſ vol. iv. p. 234.

† Ibid.

‡ Statiſtical Account of Scotland, vol. v. p. 245.

‡ Mancheſter Tranſ. vol. iv.

§ Edinburgh Tranſ. vol. i. p. 203.

† Ibid

22 Ireland,

In Ireland the *ſouth-weſt* and *weſt* are the grand trade-winds, blowing moſt in ſummer, autumn and winter, and leaſt in ſpring. The *north-eaſt* blows moſt in ſpring, and nearly double to what it does in autumn and winter. The *ſouth-eaſt* and *north weſt* are nearly equal and moſt frequent after the north-weſt and weſt ‡.

23 North of Europe.

At Copenhagen the prevailing winds are the *eaſt* and *ſouth-eaſt*; at Stockholm, the *weſt* and *north* ||. In Ruſſia, from an average of a regiſter of 16 years, the winds blow from November to April in the following order:

	Weſt.	N. W.	Eaſt.	S. W.	South.	N. E.	N.	S. E.
Days	45	26	23	22	20	19	14	12

And during the other ſix months,

	Weſt.	N. W.	Eaſt.	S. W.	South.	N. E.	N.	S. E.
Days	27	27	19	24	22	15	32	18

The *weſt* wind blows during the whole year 72 days; the *north-weſt* 53; the *ſouth-weſt* and *north* 46 days each. During ſummer it is calm for 41 days, and during winter for 21*. In Norway the moſt frequent winds are the *ſouth*, the *ſouth-weſt*, and *ſouth-eaſt*. The wind at Bergen is ſeldom directly weſt, but generally ſouth-weſt or ſouth-eaſt; a north-weſt, and eſpecially a north-eaſt wind, are but little known there†.

From the whole of theſe facts, it appears that the moſt frequent winds on the ſouth coaſts of Europe are the north, the north-eaſt, and north-weſt; and on the weſtern coaſt, the ſouth-weſt, that in the interior parts which lie moſt contiguous to the Atlantic Ocean, ſouth-weſt winds are alſo moſt frequent, but that eaſterly winds prevail in Germany. Weſterly winds are alſo moſt frequent on the north-eaſt coaſt of Aſia.

24 Winds of the South Temperate Zone.

It is probable that the winds are more conſtant in the ſouth temperate zone, which is in a great meaſure covered with water, than in the north temperate zone, where their direction muſt be frequently interrupted and altered by mountains and other cauſes.

25 Of the Cape of Good Hope,

M. de la Baille, who was ſent thither by the French king to make aſtronomical obſervations, informs us, that at the Cape of Good Hope the main winds are the *ſouth-eaſt* and *north-weſt*; that other winds ſeldom laſt longer than a few hours; and that the *eaſt* and *north-eaſt* winds blow very ſeldom. The *ſouth-eaſt* wind blows in moſt months of the year, but chiefly from October to April; the *north-weſt* prevails during the other ſix months, bringing along with it rain, and tempeſts, and hurricanes. Between the Cape of Good Hope and New Holland the winds are commonly weſterly, and blow in the following order: *north-weſt*, *ſouth-weſt*, *weſt*, *north*‡.

26 Of the South Sea.

In the great South Sea, from latitude 30° to 40° ſouth, the *ſouth-eaſt* trade-wind blows moſt frequently, eſpecially when the ſun approaches the tropic of Capricorn; the wind next to it in frequency is the *north-weſt*, and next to that is the *ſouth-weſt*. From ſouth latitude 40° to 50° the prevailing wind is the *north-weſt*, and next the *ſouth-weſt*. From 50° to 60° the moſt frequent wind is alſo the *north-weſt*, and next to it is the *weſt*.*

Thus it appears that the trade-winds ſometimes extend farther into the ſouth temperate zone than their uſual limits, particularly during ſummer; that beyond their influence the winds are commonly weſterly, and that they blow in the following order: *north-weſt*, *ſouth-weſt*, *weſt*.

27 General obſervations.

Thus have we finiſhed the hiſtory of the direction of the winds. In the torrid zone they blow conſtantly from the north-eaſt, on the north ſide of the equator, and from the ſouth-eaſt on the ſouth ſide of it. In the north temperate zone they blow moſt frequently from the ſouth-weſt; in the ſouth temperate zone from the north-weſt, changing, however, frequently to all points of the compaſs, and in the north temperate zone blowing particularly during ſpring from the north-eaſt.

28 Velocity of wind.

As to the velocity of the wind, its variations are almoſt infinite; from the gentleſt breeze to the hurricane, which tears up trees and blows down houſes. It has been remarked, that our moſt violent winds take place when neither the heat nor the cold is greateſt; that violent winds generally extend over a great tract of country; and that they are accompanied with ſudden and great falls in the mercury of the barometer. The wind is ſometimes very violent at a diſtance from the earth, while it is quite calm at its ſurface. On one occaſion Lunardi went at the rate of 70 miles an hour in his balloon, though it was quite calm at Edinburgh when he aſcended, and continued ſo during his whole voyage. See PNEUMATICS.

For the inſtruments invented to meaſure the velocity of the wind, ſee ANEMOSCOPE and ANEMOMETER.

Theory of the Winds.

29 The atmoſphere a fluid

THE atmoſphere is a fluid ſurrounding the earth, and extending to an unknown height. Now all fluids tend invariably to a level: if a quantity of water be taken out of any part of a veſſel, the ſurrounding water will immediately flow in to ſupply its place, and the ſurface will become level as before; or if an additional quantity of water be poured into any part of the veſſel, it will not remain there, but diffuſe itſelf equally over the whole. Such exactly would be the caſe with the atmoſphere. Whatever therefore deſtroys the equilibrium of this fluid, either by increaſing or diminiſhing its bulk in any particular place, muſt at the ſame time occaſion a wind.

30 Capable of dilatation and expanſion

Air, beſides its qualities in common with other fluids, is alſo capable of being dilated and compreſſed. Suppoſe a veſſel filled with air: if half the quantity which it contains be drawn out by means of an air-pump, the remainder will ſtill fill the veſſel completely, or if twice or three times the original quantity be forced in by a condenſer, the veſſel will ſtill be capable of holding it.

Rarefied air is lighter, and condenſed air heavier, than common air. When fluids of unequal ſpecific gravities are mixed together, the heavier always deſcend, and the lighter aſcend. Were quickſilver, water, and oil, thrown into the ſame veſſel together, the quickſilver would uniformly occupy the bottom, the water the middle, and the oil the top. Were water to be thrown into a veſſel of oil, it would immediately deſcend, becauſe it is heavier than oil. Exactly the ſame thing takes place in the atmoſphere. Were a quantity of air, for inſtance, to be ſuddenly condenſed at a diſtance from the ſurface of the earth, being now heavier than before, it would deſcend till it came to air of its own denſity; or, were a portion of the atmoſphere at the ſurface of the earth to be ſuddenly rarefied, being now lighter than the ſurrounding air, it would immediately aſcend.

31 By heat and cold.

If a bladder half filled with air be expoſed to the heat of a fire, the air within will ſoon expand, and diſtend the bladder; if it be now removed to a cold place, it will ſoon become flaccid as before. This ſhows that heat rarefies and that cold condenſes air. The ſurface of the torrid zone is much more heated by the rays of the ſun than the frozen or temperate zones, becauſe the rays fall upon it much more perpendicularly. This heat is communicated to the air near the ſurface of the torrid zone, which being thereby rarefied, aſcends; and its place is ſupplied by colder air, which ruſhes in from the north and ſouth.

32 The heat of the ſun,

The diurnal motion of the earth is greateſt at the equator, and diminiſhes gradually as we approach the poles, where

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‡ Rutty's Hiſt. of the Weather, &c. in Dublin.

|| Cotte, Jour. de Phyſ. 1791.

* Guthrie on the climate of Ruſſia, Edin. Tranſ. vol. ii.

† Pontoppidan's Nat. Hiſt. of Norway part i.

‡ Meteor. Tables at the end of Philip's & White's voyages.

* Wale's Meteor. Tables.

it ceaſes altogether. Every ſpot of the earth's ſurface at the equator moves at the rate of 15 geographical miles in a minute; at the 40° of latitude, it moves at about 11½ miles in a minute; and at the 30°, at nearly 13 miles. The atmoſphere, by moving continually round along with the earth, has acquired the ſame degree of motion; ſo that thoſe parts of it which are above the equator move faſter than thoſe which are at a diſtance. Were a portion of the atmoſphere to be tranſported in an inſtant from latitude 30° to the equator, it would not immediately acquire the velocity of the equator; the eminences of the earth therefore would ſtrike againſt it, and it would aſſume the appearance of an eaſt wind. This is the caſe in a ſmaller degree with the air that flows towards the equator, to ſupply the place of the rarefied air, which is continually aſcending: and this when combined with its real motion from the north and ſouth, muſt cauſe it to aſſume the appearance of a north-eaſterly wind on this ſide the equator, and of a ſouth-eaſterly beyond it.

33 The earth's diurnal motion.

The motion weſtwards occaſioned by this difference in celerity alone would not be great; but it is farther increaſed by another circumſtance. Since the rarefaction of the air in the torrid zone is owing to the heat derived from the contiguous earth, and ſince this heat is owing to the perpendicular rays of the ſun, thoſe parts muſt be hotteſt where the ſun is actually vertical, and conſequently the air over them muſt be moſt rarefied; the contiguous parts of the atmoſphere will therefore be drawn moſt forcibly to that particular ſpot. Now, ſince the diurnal motion of the ſun is from eaſt to weſt, this hotteſt ſpot will be continually ſhifting weſtwards, and this will occaſion a current of the atmoſphere in that direction. That this cauſe really operates, appears from a circumſtance already mentioned: when the ſun approaches either of the tropics, the trade-wind on the ſame ſide of the equator aſſumes a more eaſterly direction, evidently from the cauſe here mentioned; while the oppoſite trade-wind, being deprived of this additional impulſe, blows in a direction more perpendicular to the equator.

34 And the action of the moon,

The weſterly direction of the trade-winds is ſtill farther increaſed by another cauſe. Since the attraction of the ſun and moon produces ſo remarkable an effect upon the ocean, we cannot but ſuppoſe that an effect equally great at leaſt is produced upon the atmoſphere. Indeed as the atmoſphere is nearer the moon than the ſea is, the effect produced by attraction upon it ought to be greater. When we add to this the elaſticity of the air, or that diſpoſition which it has to dilate itſelf when freed from any of its preſſure, we cannot but conclude that the tides in the atmoſphere are conſiderable. Now ſince the apparent diurnal motion of the moon is from eaſt to weſt, the tides muſt follow it in the ſame manner, and conſequently produce a conſtant motion in the atmoſphere from eaſt to weſt. This reaſoning is confirmed by the obſervations of ſeveral philoſophers, particularly of M. Caſſan §, that in the torrid zone the barometer is always two-thirds of a line higher twice every 24 hours than during the reſt of the day; and that the time of this riſe always correſponds with the tides of the ſea; a proof that it proceeds from the ſame cauſe.

§ Journal de Phyſique, Avril 1790.

35 Produce the trade-winds.

All theſe different cauſes probably combine in the production of the trade-winds; and from their being ſometimes united, and ſometimes diſtinct or oppoſite, ariſe all thoſe little irregularities which take place in the direction and force of the trade-winds.

Since the great cauſe of theſe winds is the rarefaction of the atmoſphere by the heat of the ſun, its aſcenſion, and the conſequent ruſhing of colder air from the north and ſouth, the internal boundary of the trade-winds muſt be that parallel of the torrid zone which is hotteſt, becauſe there the aſcenſion of the rarefied air muſt take place. Now ſince the ſun does not remain ſtationary, but is conſtantly ſhifting from one tropic to the other, we ought naturally to expect that this boundary would vary together with its exciting cauſe; that therefore when the ſun is perpendicular to the tropic of Cancer, the north-eaſt trade-winds would extend no farther ſouth than north latitude 23,5°; that the ſouth-eaſt wind would extend as far north; and that when the ſun was in the tropic of Capricorn, the very contrary would take place. We have ſeen, however, that though this boundary be ſubject to conſiderable changes from this very cauſe, it may in general be conſidered as fixed between the ſecond and fifth degrees of north latitude.

36 The internal limit of which

37 Is the parallel of greateſt mean heat,

Though the ſun be perpendicular to each of the tropics during part of the year, he is for one half of it at a conſiderable diſtance; ſo that the heat which they acquire while he is preſent, is more than loſt during his abſence. But the ſun is perpendicular to the equator twice in a year, and never farther diſtant from it than 23½°; being therefore twice every year as much heated, and never ſo much cooled, as the tropics, its mean heat muſt be greater, and the atmoſphere in conſequence generally moſt rarefied at that place. Why then, it will be aſked, is not the equator the boundary of the two trade-winds? To ſpeak more accurately than we have hitherto done, the internal limit of theſe winds muſt be that parallel where the mean heat of the earth is greateſt. This would be the equator, were it not for a reaſon which ſhall now be explained.

38 Which is on the north ſide of the equator;

It has been ſhown by aſtronomers, that the orbit of the earth is an ellipſis and that the ſun is placed in one of the phoci. Were this orbit to be divided into two parts by a ſtraight line perpendicular to the tranſverſe axis, and paſſing through the centre of the ſun, one of theſe parts would be leſs than the other; and the earth, during its paſſage through this ſmaller part of its orbit, would conſtantly be nearer the ſun than while it moved through the other portion. The celerity of the earth's motion in any part of its orbit is always proportioned to its diſtance from the ſun; the nearer it is to the ſun, it moves the faſter; the farther diſtant, the ſlower. The earth paſſes over the ſmaller portion of its orbit during our winter; which muſt therefore be ſhorter than our ſummer, both on account of this part of the orbit being ſmaller than the other, and on account of the increaſed celerity of the earth's motion. The difference, according to Caſſini, is 7 days, 23 hours, and 53 minutes. While it is winter in the northern, it is ſummer in the ſouthern, hemiſphere; wherefore the ſummer in the ſouthern hemiſphere muſt be juſt as much ſhorter than the winter as our winter is ſhorter than our ſummer. The difference, therefore, between the length of the ſummer in the two hemiſpheres is almoſt 16 days. The ſummer in the northern hemiſphere conſiſts of 190¼ days, while in the ſouthern it conſiſts only of 174½. They are to one another nearly in the proportion of 14 to 12,8; and the heat of the two hemiſpheres may probably have nearly the ſame proportion to one another. The internal limit of the trade-winds, ought to be that parallel where the mean heat of the globe is greateſt: this would be the equator, if both hemiſpheres were equally hot; but ſince the northern hemiſphere is the hotteſt, that parallel ought to be ſituated ſomewhere in it; and ſince the difference between the heat of two hemiſpheres is not great, the parallel ought not to be far diſtant from the equator (A).

39 Becauſe the mean heat of the north hemiſphere is greateſt,

The

(A) This parallel could be determined by calculation, provided the mean heat of both the ſegments into which it divides

Wind.

40 Cauſe of he mon- ons.

The trade-wind would blow regularly round the whole globe if the torrid zone were all covered with water. If the Indian Ocean were not bounded by land on the north, it would blow there in the ſame manner as it does in the Atlantic and Pacific Oceans. The rays of light paſs through a tranſparent body without communicating any, or at leaſt but a ſmall degree of heat. If a piece of wood be incloſed in a glaſs veſſel, and the focus of a burning glaſs directed upon it, the wood will be burnt to aſhes, while the glaſs through which all the rays paſſed is not even heated. When an opaque body is expoſed to the ſun's rays, it is heated in proportion to its opacity. If the bulb of a thermometer be expoſed to the ſun, the quickſilver will not riſe ſo high as it would do if this bulb were painted black. Land is much more opaque than water; it becomes therefore much warmer when both are equally expoſed to the influence of the ſun. For this reaſon, when the ſun approaches the tropic of Cancer, India, China, and the adjacent countries, become much hotter than the ocean which waſhes their ſouthern coaſts. The air over them becomes rarefied, and aſcends, while colder air ruſhes in from the Indian Ocean to ſupply its place. As this current of air moves from the equator northward, it muſt, for a reaſon already explained, aſſume the appearance of a ſouth-weſt wind; and this tendency eaſtward is increaſed by the ſituation of the countries to which it flows. This is the cauſe of the ſouth-weſt monſoon, which blows during ſummer in the northern parts of the Indian Ocean. Between Borneo and the coaſt of China its direction is almoſt due north, becauſe the country to which the current is directed lies rather to the weſt of north; a circumſtance which counteracts its greater velocity.

In winter, when the ſun is on the ſouth ſide of the equator, theſe countries become cool, and the north-eaſt trade-wind reſumes its courſe, which, had it not been for the interference of theſe countries, would have continued the whole year.

As the ſun approaches the tropic of Capricorn, it becomes almoſt perpendicular to New Holland: that continent is heated in its turn, the air over it is rarefied, and colder air ruſhes in from the north and weſt to ſupply its place. This is the cauſe of the north-weſt monſoon, which blows from October to April, from the third to the tenth degree of ſouth latitude. Near Sumatra its direction is regulated by the coaſt: this is the caſe alſo between Africa and Madagaſcar.

The ſame cauſe which occaſions the monſoons, gives riſe to the winds which blow on the weſt coaſts of Africa and America. The air above the land is hotter and rarer, and conſequently lighter than the air above the ſea; the ſea air therefore flows in, and forces the lighter land atmoſphere to aſcend.

Wind.

41 And of the ſea and land breezes.

The ſame thing will account for the phenomena of the ſea and land breezes. During the day, the cool air of the ſea, loaded with vapours, flows in upon the land, and takes the place of the rarefied land air. As the ſun declines, the rarefaction of the land air is diminiſhed: thus an equilibrium is reſtored. As the ſea is not ſo much heated during the day as the land, neither is it ſo much cooled during the night; becauſe it is conſtantly expoſing a new ſurface to the atmoſphere. As the night approaches, therefore, the cooler and denſer air of the hills (for where there are no hills there are no ſea and land breezes) falls down upon the plains, and preſſing upon the now comparatively lighter air of the ſea, cauſes the land-breeze.

42 Air circulates in the torrid zone,

The rarefied air which aſcends between the ſecond and fifth degrees of north latitude, has been ſhown to be the principal cauſe of the trade-winds. As this air aſcends, it muſt become gradually colder, and conſequently heavier; it would therefore deſcend again if it were not buoyed up by the conſtant aſcent of new rarefied air. It muſt therefore ſpread itſelf to the north and ſouth, and gradually mix in its paſſage with the lower air; and the greater part of it probably does not reach far beyond the 30°, which is the external limit of the trade-wind. Thus there is a conſtant circulation of the atmoſphere in the torrid zone; it aſcends near the equator, diffuſes itſelf toward the north and ſouth, deſcends gradually as it approaches the 30°, and returning again towards the equator, performs the ſame circuit. It has been the opinion of the greater part of thoſe who have conſidered this ſubject, that the whole of the rarefied air which aſcends near the equator, advances towards the poles and deſcends there. But if this were the caſe, a conſtant wind would blow from both poles towards the equator, the trade-winds would extend over the whole earth; for otherwiſe the aſcent of air in the torrid zone would very ſoon ceaſe. A little reflection muſt convince us that it cannot be true: rarefied air differs nothing from the common air except in containing a greater quantity of heat. As it aſcends, it gradually loſes this ſuperfluous heat. What then ſhould hinder it from deſcending, and mixing with the atmoſphere below? That there is a conſtant current of ſuperior air, however, towards the poles, cannot be doubted; but it conſiſts principally of hydrogen gas. We ſhall immediately attempt to aſſign the reaſon why its accumulation at the pole is not always attended with a north wind.

43 And moves weſtward,

If the attraction of the moon and the diurnal motion of the ſun have any effect upon the atmoſphere, and that they have ſome effect can hardly be diſputed, there muſt be a real

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vides the globe were known. Let the radius of this globe be $= 1$, the circumference of a great circle $= 6$, and conſequently the arc of a great circle $= 3$, and the ſolid contents of a hemiſphere $= 2$. Since the internal limit of the trade-winds is not far diſtant from the equator, we may conſider that portion of the ſphere intercepted between it and the equator as a cylinder, the baſe of which is the equator, and its height the arc intercepted between the equator and the internal limit of the trade-winds. Let this arc be x, and conſequently the cylinder itſelf $= 3x$, equal to the exceſs of the ſouthern ſegment into which this internal limit divides the globe above the northern. Let the heat of the northern ſegment be $= n$, and that of the ſouthern $= s$. The ſouthern ſegment is $= 2 + 3x$, the northern $= 2 - 3x$. Now let us ſuppoſe that the bulk of each ſegment is reciprocally as its heat, and we ſhall have this formula, $2 + 3x : 2 - 3x :: n : s$. Wherefore $x = \frac{2n - 2s}{3n + 3s}$. Now if we ſuppoſe $n = 14$, and $s = 12.8$, $\frac{2n - 2s}{3n + 3s}$ is $= \frac{2{,}4}{80{,}4}$. To reduce this value of x to degrees, we muſt multiply it by 60, ſince a great circle was made $= 6$: it gives 1° 48′ 27″ as the internal limit of the trade wind. This is too ſmall by 2° 11′ 33″. But the value which we have found is only that of the ſine of the arc intercepted between the equator and the internal limit; the arc itſelf would be ſomewhat greater; beſides, the proportion between the heat of the two ſegments is an aſſumed quantity, and may probably be greater than their difference in bulk: and one reaſon for this may be, the great proportion of land in the northern compared with the ſouthern ſegment. See the *Journal de Phyſique, Mai* 1791.

44 And ſtrikes againſt the American mountains;

real motion of the air weſtwards within the limits of the trade-winds. When this body of air reaches America, its further paſſage weſtwards is ſtopt by the mountains which extend from one extremity of that continent to the other. From the momentum of this air, when it ſtrikes againſt the ſides of theſe mountains, and from its elaſticity, it muſt acquire from them a conſiderable velocity, in a direction contrary to the firſt, and would therefore return eaſtwards again if this were not prevented by the trade-winds. It muſt therefore ruſh forwards in that direction where it meets with the leaſt reſiſtance; that is, towards the north and ſouth. As air is nearly a perfectly elaſtic body, when it ſtrikes againſt the ſides of the American mountains its velocity will not be perceptibly diminiſhed, though its direction be changed. Continuing, therefore, to move with the velocity of the equator, when it arrives at the temperate zones it will aſſume the appearance of a north-eaſt or ſouth-eaſt wind. To this is to be aſcribed the frequency of ſouth-weſt winds over the Atlantic Ocean and weſtern parts of Europe. Whether theſe winds are equally frequent in the Northern Pacific Ocean, we have not been able to aſcertain; but it is probable that the mountains in Aſia produce the ſame effect as thoſe in America.

45 Which occaſions our ſouth-weſt winds.

It is not impoſſible that another circumſtance may alſo contribute to the production of theſe winds. In the article Weather, we endeavoured to prove that the annual evaporation exceeds conſiderably the quantity of rain which falls; and found reaſon to conclude, therefore, that part of the evaporated water was decompounded in the atmoſphere. In that caſe, the oxygen, which is rather heavier than common air, would mix with the atmoſphere; but the hydrogen (a cubic foot of which weighs only 41.41 grains, while a cubic foot of oxygen weighs 593.32 grains) would aſcend to the higher regions of the atmoſphere.

46 Air generated in the torrid zone,

By what means this decompoſition is accompliſhed (if it takes place at all) we cannot tell. There are probably a thouſand cauſes in nature of which we are entirely ignorant. Whether heat and light, when long applied to vapours, may not be able to decompound them, by uniting with the hydrogen, which ſeems to have a greater attraction for heat than oxygen has; or whether the electrical fluid may not be capable of producing this effect—are queſtions which future obſervations and experiments muſt determine. Dr Franklin filled a glaſs tube with water, and paſſed an electrical ſhock through it; the tube was broken in pieces, and the whole water diſappeared. He repeated the experiment with ink inſtead of water, and placed the tube upon white paper: the ſame effects followed; and the ink, though it diſappeared completely, left no ſtain on the paper. Whether the water in theſe caſes was decompoſed or not, it is impoſſible to ſay; but the ſuppoſition that it was, is not improbable. An experiment might eaſily be contrived to determine the point.

This decompoſition would account for the frequency of ſouth-weſt winds, particularly in ſummer; for thus new air is furniſhed to ſupply the place of that which is forced northwards by the cauſes already explained. Perhaps it may be a confirmation of this conjecture, that the ſouth-weſt winds generally extend over a greater tract of country than moſt other winds which blow in the temperate zones. What has been ſaid of ſouth-weſt winds, holds equally with regard to north-weſt winds in the ſouth temperate zone.

47 And accumulating at the pole

After ſouth-weſt winds have blown for ſome time, a great quantity of air will be accumulated at the pole, at leaſt if they extend over all the northern hemiſphere: and it appears from comparing the tables kept by ſome of our late navigators in the Northern Pacific Ocean with ſimilar tables kept in this iſland, that this is ſometimes the caſe ſo far as relates to the Atlantic and Pacific Oceans. When this accumulation becomes great, it muſt, from the nature of fluids, and from the elaſticity of air, preſs with a conſiderable and increaſing force on the advancing air; ſo that in time it becomes ſtronger than the ſouth-weſt wind. This will occaſion at firſt a calm, and afterwards a north wind; which will become gradually eaſterly as it advances ſouthwards, from its not aſſuming immediately the velocity of the earth. The maſs of the atmoſphere will be increaſed in all thoſe places over which this north-eaſt wind blows: this is confirmed by the almoſt conſtant riſe of the barometer during a north-eaſt wind.

48 Produces north-eaſt winds.

Whatever tends to increaſe the bulk of the atmoſphere near the pole, muſt tend alſo to increaſe the frequency of north-eaſt winds; and if there be any ſeaſon when this increaſe takes place more particularly, that ſeaſon will be moſt liable to theſe winds. During winter the northern parts of Europe are covered with ſnow, which is melted in the beginning of ſummer, when the heat of the ſun becomes more powerful. Great quantities of vapour are during that time raiſed, which will augment both the bulk and weight of the atmoſphere; eſpecially if the conjecture about the converſion of vapour into air has any foundation. Hence north-eaſt winds are moſt prevalent during May and June (B).

But it will be ſaid, if this hypotheſis were true, the ſouth-weſt and north-eaſt winds ought to blow alternately, and continue each of them for a ſtated time; whereas the ſouth-weſt wind blows ſometimes longer and ſometimes ſhorter, neither is it always followed by a north-eaſt wind.

49 Decompoſitions of air at the pole,

If the conjecture about the decompoſition of vapour in the torrid zone be true, the hydrogen which formed a part of it will aſcend from its lightneſs, and form a ſtratum above the atmoſpherical air, and gradually extend itſelf, as additional hydrogen riſes, towards the north and ſouth, till at laſt it reaches the poles. The lightneſs of hydrogen is owing to the great quantity of heat which it contains: as it approaches the poles it muſt loſe a great part of this heat, and may in conſequence become heavy enough to mix with the atmoſphere below. Oxygen makes a part of the atmoſphere; and its proportion near the poles may ſometimes be greater than ordinary, on account of the additional quantity brought thither from the torrid zone. Mr Cavendiſh mixed oxygen and hydrogen together in a glaſs jar; and upon making an electrical ſpark paſs through them, they immediately combined, and formed water.

That there is electric matter at the poles, cannot be doubted. The Abbé Chappe informs us, that he ſaw thunder and lightning much more frequently at Tobolſki and other parts of Siberia than in any other part of the world. In the north of Europe the air, during very cold weather, is exceedingly electric: ſparks can be drawn from a perſon's hands and face, by combing his hair, or even powdering

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(B) The frequency of north-eaſt winds during theſe months is the greateſt defect in the climate of Scotland, and is felt indeed ſeverely over all Great Britain. In the united ſtates of America, theſe winds keep pace with the clearing of the land. Some time ago, in Virginia, they did not reach farther than Williamſburgh; now they reach to Richmond, which is ſituated conſiderably farther weſt, and are even beginning to be felt ſtill farther within the country *. Might it not be poſſible then to prevent the frequency of theſe winds in this country, by planting trees along the whole eaſt coaſt? It is a pity that the experiment were not tried: were it to ſucceed, it would very materially improve the climate.

* Jefferſon's State of Virginia p. 128.

dering him with a puff. Æpinus was an eye-witneſs to this fact, and to ſtill more aſtoniſhing proofs of the electricity of the atmoſphere during great colds.

50
By electricity.

May not the appearance of the aurora borealis be owing to the union of oxygen and hydrogen by the intervention of the electric fluid? That it is an electrical phenomenon at leaſt, can hardly be doubted. Artificial electricity is much ſtrengthened during an aurora, as Mr Volta and Mr Canton have obſerved; and the magnetic needle moves with the ſame irregularity during an aurora that has been obſerved in other electrical phenomena. This fact we learn from Bergman and De la Lande. Many philoſophers have attempted to demonſtrate, that auroræ boreales are beyond the earth's atmoſphere; but the very different reſults of their calculations evidently prove that they were not poſſeſſed of ſufficient data.

51
Another cauſe of ſouth-eaſt Winds;

If this conjecture be true, part of the atmoſphere near the poles muſt at times be converted into water. This would account for the long continuance of ſouth-weſt winds at particular times: when they do ſo, a decompoſition of the atmoſphere is going on at the pole. It would render this conjecture more probable, if the barometer fell always when a ſouth-weſt wind continues long.

If this hypotheſis be true, a ſouth-weſt wind ought always to blow after auroræ boreales; and we are informed by Mr Winn*, that this is actually the caſe. This he found never to fail in 23 inſtances. He obſerved alſo, that when the aurora was bright, the gale came on within 24 hours, but did not laſt long; but if it was faint and dull, the gale was longer in beginning, and leſs violent, but it continued longer. This looks like a confirmation of our conjecture. Bright auroræ are probably nearer than thoſe which are dull. Now, if the aurora borealis be attended with a decompoſition of a quantity of air, that part of the atmoſphere which is neareſt muſt firſt ruſh in to ſupply the defect, and the motion will gradually extend itſelf to more diſtant parts. Juſt as if a hole were bored in the end of a long veſſel filled with water, the water neareſt the hole would flow out immediately, and it would be ſome time before the water at the other end of the veſſel began to move. The nearer we are to the place of precipitation, the ſooner will we feel the ſouth-weſt wind. It ought therefore to begin ſooner after a bright aurora, becauſe it is nearer than a dull and faint one. Precipitations of the atmoſphere at a diſtance from the pole cannot be ſo great as thoſe which take place near it; becauſe the cold will not be ſufficient to condenſe ſo great a quantity of hydrogen; ſouth weſt winds, therefore, ought not to laſt ſo long after bright as after dull auroræ. Winds are more violent after bright auroræ, becauſe they are nearer the place of precipitation; juſt as the water near the hole in the veſſel runs ſwifter than that which is at a conſiderable diſtance.

* Philoſophical Tranſactions for 1772.

If theſe conjectures have any foundation in nature, there are two ſources of ſouth-weſt winds; the firſt has its origin in the trade-winds, the ſecond in precipitations of the atmoſphere near the pole (c). When they originate from the firſt cauſe, they will blow in countries farther ſouth for ſome time before they are felt in thoſe which are farther north; but the contrary will take place when they are owing to the ſecond cauſe. In this laſt caſe, too, the barometer will ſink conſiderably; and it actually does ſo conſtantly after auroræ, as we are informed by Mr Madiſon ‡, who paid particular attention to this ſubject. By keeping accurate meteorological tables in different latitudes, it might eaſily be diſcovered whether theſe conſequences be true, and conſequently whether the above conjectures be well or ill grounded.

‡ Philad. Tranſ. vol. ii. p. 142.

52
Another cauſe of north-eaſt winds.

There are alſo two ſources of north-eaſt winds; the firſt is an accumulation of air at the pole (d), the ſecond a precipitation of the atmoſphere in the torrid zone. For the diſcovery of this laſt cauſe we are indebted to Dr Franklin. In 1740 he was prevented from obſerving an eclipſe of the moon at Philadelphia by a north-eaſt ſtorm, which came on about ſeven o'clock in the evening. He was ſurpriſed to find afterwards that it had not come on at Boſton till near 11 o'clock: and upon comparing all the accounts which he received from the ſeveral colonies of the beginning of this and other ſtorms of the ſame kind, he found it to be always an hour later the farther north-eaſt, for every 100 miles.

"From hence (ſays he) I formed an idea of the courſe of the ſtorm, which I will explain by a familiar inſtance. I ſuppoſe a long canal of water ſtopped at the end by a gate. The water is at reſt till the gate is opened: then it begins to move out through the gate, and the water next the gate is firſt in motion, and moves on towards the gate; and ſo on ſucceſſively, till the water at the head of the canal is in motion, which it is laſt of all. In this caſe all the water moves indeed towards the gate; but the ſucceſſive times of beginning the motion are in the contrary way, viz. from the gate back to the head of the canal. Thus, to produce a north-eaſt ſtorm, I ſuppoſe ſome great rarefaction of the air in or near the gulph of Mexico; the air riſing thence has its place ſupplied by the next more northern, cooler, and therefore denſer, and heavier air; a ſucceſſive current is formed, to which our coaſt and inland mountains give a north-eaſt direction †."

† Franklin's Philoſophical Letters, p. 389.

53
Cauſe of north-weſt winds.

Currents of air from the poles naturally, as has been obſerved, aſſume a north-eaſt direction as they advance ſouthwards; becauſe their diurnal motion becomes leſs than that of the earth. Various circumſtances, however, may change this direction, and cauſe them to become north, or even north-weſt, winds. The ſouth-weſt winds themſelves may often prove ſufficient for this; and violent rains, or great heat,

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(c) We are now rather doubtful whether the firſt cauſe here aſſigned be ſo general as we at firſt imagined. The almoſt conſtant ſinking of the barometer when a ſouth wind blows, ſeems to indicate, that it is generally occaſioned by decompoſitions of the atmoſphere. Nor are we certain that *mountains* are adequate to produce the effect aſſigned them.

(d) When the ice, which, in Ruſſia accumulates on the inſides of the windows of the common people's houſes, thaws, it lets looſe a quantity of mephitic air, producing all the dangerous effects of charcoal (*Dr Guthrie of the Climate of Ruſſia, Edin. Tranſ.* vol. ii. p. 220.). May not then a quantity or air be extricated from ice during its thawing? And may not this be another ſource of north-eaſt winds? We are not ignorant of the experiment which Dr Garnet made to diſcover this (ſee *Mancheſter Tranſactions*, vol. iv.); and that he found that ice in this country ſets looſe no air in the act of thawing. But Dr Guthrie has ſhown us, in the eſſay above referred to, that water, by being long expoſed to intenſe cold, changes its nature, and acquires qualities which it had not before. Would it not be worth the while of the philoſophers in Ruſſia, and other cold countries, to inveſtigate this a little farther? We would recommend it to the conſideration of the ingenious Dr Guthrie himſelf; who, from his ſituation, has the beſt opportunities of inveſtigating the matter completely. It is certainly of very great importance, and might lead to diſcoveries that would remove our preſent difficulties in meteorology, and enable us to give a ſatisfactory and uſeful theory of the weather.

heat, by leſſening or rarefying the atmoſphere in any country, will produce the ſame effect in countries to the weſtwards when north winds happen to be blowing.

54 Why they are ſo frequent in North America.

In North America, the north-weſt winds become gradually more frequent as we advance northwards. The eaſt coaſt of this continent, where the obſervations were made from which this concluſion was drawn, is alone cultivated; the reſt of the country is covered with wood. Now cultivated countries are well known to be warmer than thoſe which are uncultivated; the earth in the latter is ſhaded from the ſun, and never heated by his rays. The air, therefore, in the interior parts of America, muſt be conſtantly colder than near the eaſt coaſt. This difference will hardly be perceptible in the ſouthern parts, becauſe there the influence of the ſun is very powerful; but it will become gradually greater as we advance northwards, becauſe the influence of the ſun diminiſhes, and the continent becomes broader. Hence north-weſt winds ought to become more frequent upon the eaſt coaſt as we advance northwards; and they will probably ceaſe to blow ſo often as ſoon as the whole continent of North America becomes cultivated.

55 Cauſes of eaſt and weſt winds.

Thus have we attempted to explain the cauſes which produce the more general winds that prevail in the torrid and temperate zones. The eaſt and weſt winds, when they are not partial and confined to a very ſmall portion of the atmoſphere, ſeem to be nothing elſe but currents of air brought from the north or ſouth by the cauſes already mentioned, and prevented from proceeding farther by contrary currents. If theſe currents have come from the north, they will aſſume the appearance of eaſt winds; becauſe their diurnal motion will be leſs than that of the more ſouthern latitudes over which they are forced to remain ſtationary. The ſouthern currents will become weſt winds, for a contrary reaſon. This will furniſh us with a reaſon for the coldneſs of eaſt winds, compared with weſt winds. If this account be true, there ought very frequently to be a weſt wind in a latitude to the ſouth of thoſe places where an eaſt wind blows. This might eaſily be determined by keeping accurate regiſters of the winds in different latitudes, and as nearly as poſſible under the ſame meridian; and upon the reſult of theſe obſervations the truth or falſehood of the above conjecture muſt finally reſt.

56 Partial winds.

Beſides theſe more general winds, there are others which extend only over a very ſmall part of the earth. Theſe originate from many different cauſes. The atmoſphere is compoſed of three different kinds of air, oxygen, azote, and carbonic acid; to which may be added water. Great quantities of each of theſe ingredients are conſtantly changing their aerial form, and combining with various ſubſtances; or they are ſeparating from other bodies, aſſuming the form of air, and mixing with the atmoſphere. Partial voids, therefore, and partial accumulations, muſt be continually taking place in different parts of the atmoſphere, which will occaſion winds varying in direction, violence, and continuance, according to the ſuddenneſs and the quantity of air deſtroyed or produced. Beſides theſe there are many other ingredients conſtantly mixing with the atmoſphere, and many partial cauſes of condenſation and rarefaction in particular places. To theſe, and other cauſes probably hitherto unknown, are to be aſcribed all thoſe winds which blow in any place beſides the general ones already explained; and which, as they depend on cauſes hitherto at leaſt reckoned contingent, will probably for ever prevent uniformity and regularity in the winds. All theſe cauſes, however, may, and probably will, be diſcovered: the circumſtances in which they will take place, and the effects which they will produce, may be known; and whenever this is the caſe, the winds of any place may in ſome meaſure be reduced to calculation.

It is of importance, in the firſt place, to know the general winds, and the cauſes which produce them; they will blow ofteneſt in every country, continue longeſt, and in a great meaſure ſtamp the nature of the climate. To explain theſe has been the intention of this eſſay; and though we have probably failed of ſucceſs, our attempt, we hope, will not be altogether uſeleſs. The facts which are here collected will at leaſt facilitate the labours of the future inquirer. Were accurate obſervations made over the whole globe of the direction and velocity of the winds, and eſpecially of the time when they begin and ceaſe to blow, ſo much light would be thrown in a ſhort time upon this important ſubject, that a theory of the winds might be formed, capable of explaining all the phenomena, and really uſeful to the human race.

Hot Winds. See Samiel.

Wind-Flower. See Anemony.

Wind-Mill, a kind of mill, the internal parts of which are much the ſame with thoſe of a water-mill: from which, however, it differs, in being moved by the impulſe of the wind upon its ſails or vanes, which are to be conſidered as a wheel in axis. See Mechanics, nº 62.

Wind Gage. See *Wind-Gage*.

Wind-Galls, in farriery. See there § xxxiii.

Wind-Gun. See *Air-Gun*.

Inſtruments for meaſuring the ſtrength, velocity, &c. *of the Wind*. See *Wind-Gage*, Anemometer, and Anemoscope.

Wind-Hatch, in mining, a term uſed to expreſs the place at which the ore is taken out of the mines.

Wind-Shock, a name given by our farmers to a diſtemper to which fruit-trees, and ſometimes timber-trees, are ſubject. It is a ſort of bruiſe and ſhiver throughout the whole ſubſtance of the tree; but the bark being often not affected by it, it is not ſeen on the outſide, while the inſide is twiſted round, and greatly injured. It is by ſome ſuppoſed to be occaſioned by high winds; but others attribute it to lightning. Thoſe trees are moſt uſually affected by it whoſe boughs grow more out on one ſide than on the other. The beſt way of preventing this in valuable trees, is to take care in the plantation that they are ſheltered well, and to cut them frequently in a regular manner while young.

Wind-Taught, in ſea-language, denotes the ſame as ſtiff in the wind. Too much rigging, high maſts, or any thing catching or holding wind aloft, is ſaid to hold a ſhip wind-taught; by which they mean, that ſhe ſtoops too much in her ſailing in a ſtiff gale of wind. Again, when a ſhip rides in a main ſtreſs of wind and weather, they ſtrike down her top-maſts, and bring her yards down, which elſe would hold too much wind, or be too much diſtended and wind-taught.

Wind-Sails, a ſort of wide tube or funnel of canvas, employed to convey a ſtream of freſh air downward into the lower apartments of a ſhip.

This machine is uſually extended by large hoops ſituated in different parts of its height. It is let down perpendicularly through the hatches, being expanded at the lower end like the baſe of a cone; and having its under ſide open on the ſide which is placed to windward, ſo as to receive the full current of wind; which entering the cavity, fills the tube, and ruſhes downwards into the lower regions of the ſhip. There are generally three or four of theſe in our capital ſhips of war, which, together with the ventilators, contribute greatly to preſerve the health of the crew.

WINDAGE *of a Gun*, is the difference between the diameter of the bore and the diameter of the ball.

WINDLASS, a machine uſed for raiſing huge weights, as guns, ſtones, anchors, &c.

It is very ſimple, conſiſting only of an axis or roller, ſupported horizontally at the two ends by two pieces of wood and a pulley; the two pieces of wood meet at top, being placed diagonally ſo as to prop each other; the axis or roller goes through the two pieces, and turns in them. The pulley is faſtened at top where the pieces join. Laſtly, there are two ſtaves or handſpikes which go through the roller, whereby it is turned, and the rope which comes over the pulley is wound off and on the ſame.

WINDLASS, in a ſhip, is an inſtrument in ſmall ſhips, placed upon the deck, juſt abaft the fore-maſt. It is made of a piece of timber ſix or eight feet ſquare, in form of an axletree, whoſe length is placed horizontally upon two pieces of wood at the ends thereof, and upon which it is turned about by the help of handſpikes put into holes made for that purpoſe. This inſtrument ſerves for weighing anchors, or hoiſting of any weight in or out of the ſhip, and will purchaſe much more than any capſtan, and that without any danger to thoſe that heave; for if in heaving the windlaſs about, any of the handſpikes ſhould happen to break, the windlaſs would pall of itſelf.

WINDOW, an aperture or open place in the wall of a houſe to let in the light. See ARCHITECTURE, nº 78.

The word is Welch, *uynt dor*, ſignifying the paſſage for the wind. Window is yet provincially denominated *windor* in Lancaſhire; i. e. *wind-door*, or the paſſage for air, as that for people was peculiarly called the *door*.

Before the uſe of glaſs became general, which was not till towards the end of the 12th century, the windows in Britain ſeem generally to have been compoſed of paper. Properly prepared with oil, this forms no contemptible defence againſt the intruſions of the weather, and makes no incompetent opening for the admiſſion of the light. It is ſtill uſed by our architects for the temporary windows of unfiniſhed houſes, and not unfrequently for the regular ones of our work-ſhops. But ſome of the principal buildings we may reaſonably ſuppoſe to have been windowed in a ſuperior manner. They could, however, be furniſhed merely with lattices of wood or ſheets of linen, as theſe two remained the only furniture of our cathedrals nearly to the eighth century; and the lattices continued in ſome of the meaner towns of Lancaſhire to the 18th; and in many diſtricts of Wales, and many of the adjoining parts of England, are in uſe even to the preſent moment. Theſe ſeem all to have been fixed in frames that were called *capſamenta*, and now therefore *caſements* in Wales and Lancaſhire.

WINDSOR, a borough-town of Berkſhire, 22 miles weſt of London, moſt remarkable for the magnificent palace or caſtle ſituated there on an eminence, which commands the adjacent country for many miles, the river Thames running at the foot of the hill. The knights of the garter are inſtalled in the royal chapel here. It ſends two members to parliament. W. Long. 0. 36. N. Lat. 51. 30.

WINDWARD, in the ſea language, denotes any thing towards that point from whence the wind blows, in reſpect of a ſhip: thus windward-tide, is the tide which runs againſt the wind.

WINE, an agreeable ſpirituous liquor, produced by fermentation from thoſe vegetable ſubſtances that contain ſaccharine matter. A very great number of vegetable ſubſtances may be made to afford wine, as grapes, currants, mulberries, elder, cherries, apples, pulſe, beans, peas, turneps, radiſhes, and even graſs itſelf. Hence, under the claſs of wines or vinous liquors, come not only wines, abſolutely ſo called, but alſo ale, cyder, &c.

Chaptal's Chemiſtry, part iv. ſect. v. chap. 6.

1 Method of making wine.

Wine, however, is in a more particular manner appropriated to the liquor drawn from the fruit of the vine. The proceſs of making wine is as follows: when the grapes are ripe, and the ſaccharine principle is developed, they are then preſſed, and the juice which flows out is received in veſſels of a proper capacity, in which the fermentation appears, and proceeds in the following manner: At the end of ſeveral days, and frequently after a few hours, according to the heat of the atmoſphere, the nature of the grapes, the quantity of the liquid, and the temperature of the place in which the operation is performed, a movement is produced in the liquor, which continually increaſes; the volume of the fluid increaſes; it becomes turbid and oily; carbonic acid is diſengaged, which fills all the unoccupied part of the veſſel, and the temperature riſes to the 72,5th degree. At the end of ſeveral days theſe tumultuous motions ſubſide, the maſs falls, the liquor becomes clearer, and is found to be leſs ſaccharine, more odorant, and of a red colour, from the reaction of the ardent ſpirit upon the colouring matter of the pellicle of the grape.

The wine is uſually taken out of the fermenting veſſels at the period when all the phenomena of fermentation have ſubſided. When the maſs is ſettled, the colour of the liquor is well developed, when it has become clear, and its heat has diſappeared; it is put into caſks, where, by a ſecond inſenſible fermentation, the wine is clarified, its principles combine more perfectly together, and its taſte and ſmell become more and more developed. If this fermentation be ſtopped or ſuffocated, the gaſeous principles are retained, and the wine is briſker, and more of the nature of muſt.

It appears, from the intereſting experiments of the Marquis de Bullion, that the vinous fermentation does not take place unleſs tartar be preſent.

2 Cauſes of imperfect fermentation.

The cauſes of an imperfect fermentation are the following: 1. If the heat be too little, the fermentation languiſhes, the ſaccharine and oily matters are not ſufficiently elaborated, and the wine is unctuous and ſweet. 2. If the ſaccharine body be not ſufficiently abundant, as happens in rainy ſeaſons, the wine is weak, and the mucilage which predominates cauſes it to become ſour by its decompoſition. 3. If the juice be too watery, concentrated and boiling muſt is added. 4. If the ſaccharine principle be not ſufficiently abundant, the defect may be remedied by the addition of ſugar. Macquer has proved that excellent wine may be made of verjuice and ſugar; and M. de Bullion has made wine at Bellejames with the verjuice of his vine rows and moiſt ſugar.

There have been many diſputes to determine whether grapes ſhould be preſſed with the ſtalks or without. This depends on the nature of the fruit. When they are highly charged with ſaccharine and mucilaginous matter, the ſtalk corrects the inſipidity of the wine by its bitter principle: but when, on the contrary, the juice is not too ſweet, the ſtalk renders it drier, and very rough.

3 Colouring matter of wine.

The colouring principle of wine is of a reſinous nature, and is contained in the pellicle of the grape; and the fluid is not coloured until the wine is formed; for until then there is nothing which can diſſolve it: and hence it is that white wine may be made of red grapes, when the juice of the grape is expreſſed, and the huſk thrown away. If wine be evaporated, the colouring principle remains in the reſidue, and may be extracted by ſpirit of wine. Old wines loſe their colour, a pellicle being precipitated, which is either depoſited on the ſides of the bottles, or falls to the bottom. If wine be expoſed to the heat of the ſun during the ſummer, the colouring matter is detached in a pellicle, which falls to the bottom: when the veſſel is opened, the diſcolouring is more ſpeedy, and it is effected in two or three days during the ſummer. The wine thus deprived of its colour is not perceptibly weakened.

4 Vinous fermentation explained.

The vinous fermentation has been examined with great accuracy by M. Lavoiſier. According to him, the vegetable juice of which wine is to be made conſiſts of oxygen, hydrogen, and carbon, combined with one another in different proportions, ſo as to form chiefly water and ſugar. The fermentation produces a ſeparation of the elements, and a new combination of them; a quantity of the oxygen and carbon combine and fly off in the ſtate of carbonic acid; part of the carbon, oxygen, and hydrogen, combine firſt with each other, and then altogether, to form alcohol; another part forms acetous acid; the water ſtill remains, and a reſiduum falls to the bottom compoſed of the three elements combined in other proportions.

5 Ingredients in different wines.

The different kinds of wines produced in Europe and other parts of the world are many; the principal of them and their qualities are well known: a catalogue of them would ſerve no purpoſe here. We ſhall, however, ſubjoin a table of the quantities of the ingredients of the principal kinds from Newmann's Chemiſtry.

A quart of	Highly rectified Spirit.			Thick, oily, unctuous, reſinous matter.			Gummy and tartareous matter.			Water.			
	oz.	dr.	gr.	oz.	dr.	gr.	oz.	dr.	gr.	lb.	oz.	dr.	gr.
Aland	1	6	00	3	2	00	1	5	00	2	5	3	00
Alicant	3	6	00	6	0	20	0	1	40	2	2	6	00
Burgundy	2	2	00	0	4	00	0	1	40	2	9	0	20
Carcaſſone	2	6	00	0	4	10	0	1	20	2	8	4	30
Champagne	2	5	20	0	6	40	0	1	00	2	8	3	00
French	3	0	00	0	6	40	0	1	00	2	8	0	20
Frontignac	3	0	00	3	4	00	0	5	20	2	4	6	30
Vin Grave	2	0	00	0	6	00	0	2	00	2	9	0	00
Hermitage	2	7	00	1	2	00	0	1	40	2	7	5	20
Madera	2	3	00	3	2	00	2	0	00	2	4	3	00
Malmſey	4	0	00	4	3	00	2	3	00	2	1	2	00
Vino de Monte Pulciano	2	6	00	0	3	00	0	2	40	2	8	0	20
Moſelle	2	2	00	0	4	20	0	1	30	2	9	0	10
Muſcadine	3	0	00	2	4	00	1	0	00	2	5	4	00
Neufschatel	3	2	00	4	0	00	1	7	00	2	2	7	00
Palm Sec	2	3	00	2	4	00	4	4	00	2	2	5	00
Pontac	2	0	00	0	5	20	0	2	00	2	9	0	40
Old Rheniſh	2	0	00	1	0	00	0	2	20	2	8	5	40
Rheniſh	2	2	00	0	3	20	0	1	34	2	9	1	06
Salamanca	3	0	00	3	4	00	2	0	00	2	3	4	00
Sherry	3	0	00	6	0	00	2	2	00	2	0	6	00
Spaniſh	1	2	00	2	4	00	9	4	00	1	10	6	00
Vino Tinto	3	0	00	6	4	00	1	6	00	2	0	6	00
Tokay	2	2	00	4	3	00	5	0	00	2	0	3	00
Tyrol red wine	1	4	00	1	2	00	0	4	00	2	8	6	00
Red wine	1	6	00	0	4	40	0	2	00	2	9	3	20
White	2	0	00	0	7	00	0	3	00	2	7	0	00

The colour of wine is frequently artificial; a deep red is almoſt always the effect of artificial additions, as of the red-woods, elder-berries, bilberries, &c. In France no ſecret is made of theſe practices, the colouring matters being publicly thrown out after they have been uſed.

6 Adulteration of wine.

It is well known to be a common practice among wine-coopers, innkeepers, and other dealers in wines, to adulterate bad wine in order to conceal its defects: if, for inſtance, the wine be ſour, they throw into it a quantity of ſugar of lead, which entirely takes away the ſour taſte. For ſimilar purpoſes alum is often mixed with wine. Such ſubſtances, however, are well known to be extremely pernicious to the human conſtitution; it becomes of importance therefore to be able to detect them whenever they happen to be contained in wine. Several chemiſts who have turned their attention to this ſubject, have furniſhed us with teſts for this purpoſe.

7 To detect lead in wine.

Watſon's Chemical Eſſays, vol. iii. p. 371.

To diſcover lead diſſolved in wine, boil together in a pint of water an ounce of quicklime and half an ounce of flour of brimſtone; and when the liquor, which will be of a yellow colour, is cold, pour it into a bottle, and cork it up for uſe. A few drops of this liquor being dropt into a glaſs of wine or cyder containing *lead*, will change the whole into a colour more or leſs *brown*, according to the quantity of lead which it contains. If the wine be wholly free from lead, it will be rendered turbid by the liquor, but the colour will be rather a dirty white than a black brown.

By this teſt, however, iron is alſo precipitated when diſſolved in wine, and is apt to be taken for lead; a miſtake which has ruined ſeveral honeſt merchants. The following teſt is therefore preferable, as not liable to the ſame inconvenience.

8 Another method.

Take equal parts of calcined oyſter-ſhells and crude ſulphur in fine powder, and put them in a crucible, which put into a fire, and raiſe the heat ſuddenly till it has been expoſed to a white heat for 15 minutes. Then take it out, let it cool, beat the ingredients to powder, and put them into a well corked bottle. To prepare the teſt-liquor, put 20 grains of this powder, together with 120 grains of cream of tartar, and put them into a ſtrong bottle, fill it up with water, boil it for an hour, and let it cool. Cork the bottle immediately, and ſhake it from time to time. After ſome hours repoſe, decant off the clear liquor into an ounce vial. having firſt put 22 drops of muriatic acid into each vial. Cork theſe vials accurately with a little wax mixed up with a little turpentine. One part of this liquor, mixed with three parts of ſuſpected wine, will diſcover the preſence of the ſmalleſt quantity of lead or copper, by a very ſenſible black precipitate, and of arſenic by an orange precipitate; but will have no effect on iron, if there be any: the preſence of which, however, may be aſcertained by adding a little potaſh, which will turn the liquor black if there be any iron. Pure wine remains limpid after the addition of this liquor ‡.

9 State of lead in wine.

As this ſubject is of importance, we ſhall add M. Fourcroy's obſervations on the ſtate in which lead exiſts in wine, and on the methods of diſcovering its preſence: "Of the different principles which compoſe wine, there was no doubt (ſays he) but that acids were the only ones which were capable of diſſolving oxyd *(calx)* of lead. But was it the tartareous acid always contained in larger or ſmaller quantity in wine, or the acetous acid developed in thoſe which have become ſharp, and which there is a greater temptation to ſweeten? Experience had proved to me that the acidulous tartrite of potaſh, or the cream of tartar, takes oxyd of lead from the acetous acid, and a precipitate of tartrite of lead is formed; the pure tartareous acid prepared in Scheele's method produces the ſame effect. In order to underſtand how the ſharp wine which contains theſe two acids can hold the oxyd of lead in ſolution, I made the experiments which gave me the following reſults: 1. The acidulous tartrite *(crem. tart.)* has no ſenſible action upon the oxyds of lead; 2. The pure tartareous acid has a ſlight action upon the oxyds, and forms on their ſurface a little tartrite of lead *(tartariſed lead)*, in

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‡ Journal de Phyſique, October 1791.

a white powder; 3. Wine which only contains the tartareous acidule, would not have any action upon the ſemi-vitrous oxyd of lead or litharge; 4. Sharp wine which we attempt to ſweeten by this oxyd of lead, acts firſt upon it by the acetous acid it contains; 5. When this acetite of lead is formed, the tartareous acid precipitates it in the form of tartrite of lead: this is proved by the precipitate which the ſolution of the acetite of lead or ſugar of lead forms in the wine; 6. But the acetous acid, if it be in large enough quantity, rediſſolves the tartrite of lead in the wine juſt as diſtilled water would. Bergman has pointed out this ſolution of tartrite of lead in acetous acid for diſtinguiſhing the tartareous ſalt from the ſulfat of lead (*vitriol of lead*); 7. As this ſolution of tartrite of lead in the acetous acid is much quicker, and more eaſy in ſharp wines than in diſtilled water and vinegar, it is probable that the cauſe of this difference depends upon the citric and malic acids which I have found in wine, and which I ſhall take notice of again on another occaſion; 8. Litharged wine then, or wine ſweetened with lead, contains tartrite diſſolved in the acetous acid, and perhaps at the ſame time in the malic and citric acids.

10 It forms an aceto-tartrite of lead.

“It was neceſſary afterwards to know the properties of this combination. What experience has taught me is as follows: I particularly examined the tartrite of lead and its ſolution in acetous acid. The tartrite of lead is ſcarcely at all ſoluble in water; it is in the form of powder, or of ſmall white grains which have no ſenſible taſte; when it is diſſolved in vinegar, the vinegar is ſoftened, its ſharpneſs is diminiſhed remarkably, and the ſolution takes a ſlight ſweetiſh taſte, much leſs ſtrong than that of the pure acetite of lead. This taſte proves that the union of the tartrite of lead with vinegar is not only a ſolution like that of ſalt in water, by which the properties of the ſalt are not changed, but a combination which gives occaſion to new properties. It is a kind of a triple ſalt, different from thoſe we have hitherto known, formed of two acids and of one baſe; whereas the other triple ſalts deſcribed hitherto are compoſed of one acid and two baſes. I name this new triple ſalt *aceto-tartrite of lead.* The acetous acid adheres to it more than water in a common ſolution: what is remarkable in this combination is, that the two acids appear to adhere to the baſe with an equal force, although they have a different attraction for it: nothing is neceſſary to produce this equilibrium, but to unite firſt the oxyd of lead with the acid to which it adheres the moſt ſtrongly, and afterwards to put this firſt compound in contact with the weaker acid.

11 Other methods of detecting this ſalt.

“It was neceſſary, in order to diſcover eaſy and certain methods of aſcertaining the preſence of lead in wine, to examine with care the properties and phenomena of the decompoſitions of the aceto-tartrite of lead. Fixed alkalis and ammoniac (*volatile alkali*) precipitate from this ſalt an oxyd of lead, which is of a greyiſh white colour; but as they occaſion a precipitate in pure wine, they cannot be of any uſe. The ſulphuric (*vitriolic*) acid decompoſes the aceto-tartrite of lead, and forms with it inſtantly ſulfat of lead; which being very little ſoluble, and very heavy, is precipated. The oxalic, or pure ſaccharine acid, and the acidulous oxalat, or the ſalt of ſorrel of the ſhops, likewiſe decompoſe this ſalt, and take from it the lead. The oxalat of lead is precipitated in great abundance: theſe two acids, the ſulphuric and oxalic acids, not producing any precipitate in pure wine, are very proper to ſhow the preſence of lead in wine. The ſulfat and oxalat of lead, when they are precipitated from wine, are coloured, whereas they are very white when they are formed in diſtilled water; but their red or brown colour does not prevent us from diſcovering them by a very ſimple method. If the precipitates be collected with care, and are cautiouſly heated upon a coal with a blow-pipe, they ſmoke, become white, exhale vapours, paſs ſucceſſively thro' the ſtates of the red and yellow oxyds of lead, and at length are reduced into metallic globules at the inſtant they are perceived to be agitated by a very evident efferveſcence: if we ceaſe to blow at this inſtant, we obtain globules upon the charcoal. In order to this, it is neceſſary, however, that the charcoal be ſolid, and be not cracked, and that we ſhould not have blowed too ſtrongly; otherwiſe the globules would be abſorbed, and would diſappear. The ſulfat of lead requires a longer time to be reduced than the oxalat of the ſame metal, and there is a greater hazard of loſing the metallic particles, which, beſide, are in ſmall quantity.

“To theſe two firſt proceſſes, already ſufficiently certain of themſelves, I wiſhed to be able to add one which might be capable of pointing out inſtantly the preſence of lead, by an appearance belonging excluſively to this metal, and which might unite to this advantage that of manifeſting very ſmall quantities of it. Diſtilled water impregnated with ſulphurated hydrogenous gas, or hepatic gas, extricated from ſolid alkaline ſulphurets (*livers of ſulphur*) by acids, preſented me with theſe properties. This ſolution blackens very deeply that of the aceto-tartrite of lead, and renders $\frac{1}{1000}$th of this ſalt in water or in wine very ſenſible. The ſenſibility of this reactive is ſuch, that we may dilute litharged wine with a ſufficient quantity of water to take away almoſt entirely the colour of the wine, and this reactive will ſtill produce a very manifeſt alteration. The ſulphurated water has, beſides, the advantage not to occaſion any change in the wines which do not contain a metallic ſubſtance, and it is not precipitated by the acids of wine, like the ſolutions of alkaline ſulphurets. In order to procure this reactive pure, it is neceſſary to prepare it at the inſtant of the experiment, by receiving in a vial full of diſtilled water, and inverted upon a ſhelf of a ſmall hydro-pneumatic apparatus, filled with diſtilled water, the ſulphurated hydrogenous gas, ſeparated from the ſolid ſulphuret of potaſh by the ſulphuric or muriatic acid, and firſt filtered through water in another vial; when the ſecond vial contains the third of its volume of the ſulphurated hydrogenous gas, the gas is ſhaken ſtrongly with the water, which fills the two thirds of the vial; and when the abſorption is over, the teſt liquor is prepared. This reactive changes very quickly in the air: it is neceſſary to make it the moment it is to be employed, and to keep it in a veſſel quite full and well corked. If there were any fear that the black colour and the precipitation by the gaſeous ſulphurated water ſhould not be ſufficient to prove the preſence of lead in ſpirituous liquors, I would obſerve that this fear would be diminiſhed by employing the three reactives mentioned in this memoir, and by depending only on the correſpondent effects of theſe three reactives: but all ſuſpicion would be removed, by reducing the three precipitates by the blow-pipe, and obtaining globules of lead from each of them.”

12 Method of detecting alum diſſolved in wine.

Some years ago, the Academy of Lyons propoſed the following prize queſtion, What is the beſt method of aſcertaining the preſence and the quantity of *alum* diſſolved in wine, eſpecially in very deep coloured red wine? The prize was gained by M. J. S. Beraud. From his experiments, it appears that a mixture of lime-water and wine in any proportion whatever, will at the end of 12 or 15 hours furniſh a quantity of cryſtals, which may be ſeparated by filtration, and that theſe cryſtals will be eaſieſt diſcovered when the quantities of wine and lime-water are equal; but that wine containing alum diſſolved in it, will not form cryſtals when mixed with lime-water, but merely depoſits a muddy ſediment. To know therefore whether any wine contains alum or not, we have only to mix a ſmall quantity of it with lime-water: if cryſtals are formed, it contains no alum; if not, it does. Again, if wine contains alum, the reſiduum that remains after filtration will, as it dries, ſplit into quadrilateral ſegments, which will detach themſelves from the paper which contains them; but if the wine contains no alum, the reſiduum, after it is dry, will remain united and attached to the paper. If one meaſure of wine and two-thirds of a meaſure of lime-water depoſit cryſtals, we are certain that if the wine contains alum, the proportion of that alum to the wine will be leſs than 1 to 1152; if, when equal parts of wine and lime-water are mixed, no cryſtals be depoſited, we may be ſure that more than $\frac{1}{400}$th part of the maſs of wine conſiſts of alum.

A great proportion of the wine conſumed in Britain is brought from Spain and Portugal; government has always diſcouraged the importation of French wines by heavy taxes. We are not ſure how far ſuch conduct is founded on good policy, as the French wines are confeſſedly the beſt, and might be the cheapeſt; but ſuch is the jealouſy and enmity that has always ſubſiſted between Britain and France, that both nations have been contented to injure themſelves provided they could do a greater injury to their neighbours. Beſides, the advantages which Britain derives from the Portugal trade are very great, and it would not be eaſy perhaps to ſecure them on any other terms.

13 Directions for the treatment of imported wines.

It may be worth while to inſert here a few directions about the treatment of wines after they have been imported into this country.—On landing, the leſs they are expoſed the better; for they are affected by the ſeaſons, and more or leſs by climate. March and April are the proper times for ſhipping wines from France, and they will be landed in England and Ireland in the ſame degree of temperature. The great art in keeping wines is to prevent their fretting, which is done by keeping them in the ſame degree of heat. In ſpring and fall, the wines in Bourdeaux are ſubject to changes that may be dangerous, if not prevented by neceſſary rackings: theſe changes are ſolely the effect of the ſeaſons. If wines are chilled, and of courſe turn foul, from being ſhipped and landed in cold weather, they will ſoon recover by putting them in a warm vault, well covered with ſaw-duſt. As ſoon as they are in the vault, they ought to be covered up. But if ſhipped and landed in ſummer, if the ſmalleſt degree of fermentation be found on them, it will be requiſite to dip the bung clothes in brandy, and leave the bungs looſe for ſome days, to give it time to cool; and if in a fortnight or three weeks the fermentation do not ceaſe, and the wine become bright, it will be proper to rack it (matching the hogſheads well with brimſtone), and force it with the whites of eight eggs. If it then becomes fine, bung it tight, and let it remain ſo until it is bottled. If wines new landed are wanted ſoon for the bottle, it will be neceſſary to force them immediately, and let them remain bunged cloſe for at leaſt a month, to recover from the forcing, or if two months the better; for wines bottled in high order come much ſooner into drinking than if bottled when flat, which all wines are after forcing. Wine muſt never be bottled the leaſt foul, which produces a tendency to fret; and if bottled in this ſtate, will never come in order, but may poſſibly be loſt: for this there is no remedy but repeated rackings; and care muſt be taken (after rinſing the hogſheads well and drawing them) to burn a good piece of match in them. This cools the wine, and there is no danger of hurting the colour, for it recovers it in a little time: but if it did, it is abſolutely neceſſary; for if wine is ſuffered to continue on the fret, it will wear itſelf to nothing. Wines bottled in good order may be fit to drink in ſix months; but they are not in perfection before twelve: from that to two years they may continue ſo; but it would be improper to keep them longer, for wines in general have not the body they had formerly, from the vines being too much forced.

It ſometimes happens that wines ſcuddy and ſtubborn will not fall with one or even two forcings. It will then be proper to give them five or ſix gallons of good ſtrong wine, and force them with the whites of a dozen eggs, with a tea-ſpoonful of ſand produced from ſawing marble, or a ſmall ſpoonful of fine ſalt. Bottled wine in winter ſhould be well covered with ſaw-duſt, and if the vaults are cold and damp, ſtrew it deep on the floor; if ſaw-duſt is thrown upon the hogſheads, and their ſides are bedded ſome inches thick, it will keep them from the fret.

The ſame treatment is to be regarded with white wines, except that they require to be higher matched, particularly Muſcat wines; ſuch as Frontignac, Beziers, &c. which being often ſweetened with honey, are very ſubject to fret; and theſe only frequent rackings, with a great deal of brimſtone, can cool. Hermitage, from not being ſufficiently dried, and poſſeſſing more richneſs than claret is alſo very liable to come on the fret, and will require much the ſame treatment as the Muſcat wines. Attention ſhould be had to bottle in fine weather, when the wind is north; but to avoid cold or froſty weather. The months of April and October are favourable. The beſt time to bottle port wine is four years after the vintage, and to keep them two years in bottle before you begin to uſe them. When wines are racked, and the lees immediately paſſed thro' flannel bags into cloſe-necked jars, and directly bottled, there will be very little loſt by rackings, as the wine when fine may ſerve for filling up.

When wines are deſtined for warm climates, it may be proper to rinſe the hogſheads with brandy; and in bottling many rinſe the bottles and corks with it. Wines that have remained a certain time (three or four months) in a vault and made leſs or more lee, ought never to be ſent into the country without firſt racking them, otherwiſe they may be liable to fret; and if bottled in that ſtate, may riſk being loſt.

Wines which may be ordered for immediate drinking will be forced on the ſhipping, and in a few weeks after they are landed will be fit for the bottle. The forcings proper for claret are the whites of a dozen eggs, beat up with a tea-ſpoonful of fine ſalt, and well worked with a forcing rod. Take care to uſe no bad egg. This is for one hogſhead.

The forcing for white wine is iſinglas diſſolved in wine. One ounce is ſufficient for two hogſheads. No ſalt is to be uſed in forcing the white wines. See *Croft on Wines*, 8vo, 1788.

14 Receipt for making raiſin-wine.

We ſhall here inſert the following receipt for making *raiſin-wine*.—To a 20 gallon veſſel take 100 pounds of raiſins; pick off the ſtalks, chop them groſsly, and put them into an open tub more wide than deep. Add two parts in three of the water to them, and let them ſtand 15 days, ſtirring them well every day. Then ſtrain and preſs them, putting aſide the liquor that runs from them. Add the remainder of the water to the raiſins that have thus been preſſed, and let it ſtand upon them one week, frequently ſtirring them as before. Then preſs off the liquor, and add it to what you firſt collected; putting both runnings together into your veſſel, together with one quart of brandy. To colour it, burn three-fourths of a pound of ſugar into a ſmall quantity of the liquor, and add this to the wine. When the liquor in the barrel has done ſinging, ſtop the veſſel cloſe, and let it ſtand till fit to be bottled. The greater the quantity which the veſſel holds, and the longer it is kept in the wood, the better will it be.

Wine-Preſs, a machine contrived to ſqueeze the juice out of grapes, and conſiſting of ſeveral pieces of timber, variouſly diſpoſed, which compoſe three bodies of timber-work, cloſely united to the axis, which ſerves as a ſwing whereby it may be moved by the vice. Of theſe there are different ſizes as well as different conſtructions; for an account of which, illuſtrated by figures, ſee Miller's Gardener's Dictionary, article *Wine Preſs*.

Spirit of Wine, or *alcohol*, a name given by chemiſts to every ardent ſpirit produced by diſtillation. See *Chemistry-Index*.

WING, that part of a bird, inſect, &c. whereby it is enabled to fly. See Bird and Ornithology.

Wings, in military affairs, are the two flanks or extremes of an army, ranged in form of a battle; being the right and left ſides thereof.

WINTER, one of the four ſeaſons or quarters of the year. See Season, &c.

Winter commences on the day when the ſun's diſtance from the zenith of the place is greateſt, and ends on the day when its diſtance is at a mean between the greateſt and leaſt.

Under the equator, the winter as well as other ſeaſons return twice every year; but all other places have only one winter in the year; which in the northern hemiſphere begins when the ſun is in the tropic of Capricorn, and in the ſouthern hemiſphere when in the tropic of Cancer; ſo that all places in the ſame hemiſphere have their winter at the ſame time.

Winter-Berry. See Physalis.

WINTERA, in botany: A genus of plants of the claſs of *polyandria*, and order of *pentagynia*; and in the natural ſyſtem arranged under the 12th order, *Holoraceæ*. The calyx is three lobed; there are ſix or twelve petals; there is no ſtyle; the fruit is a berry, which is club-ſhaped as well as the germen. There are two ſpecies; the aromatica and granadenſis.

Wintera aromatica, is one of the largeſt foreſt-trees upon Terra del Fuego; it often riſes to the height of 50 feet. Its outward bark is on the trunk grey and very little wrinkled, on the branches quite ſmooth and green. The branches do not ſpread horizontally, but are bent upwards, and form an elegant head of an oval ſhape. The leaves come out, without order, of an oval elliptic ſhape, quite entire, obtuſe, flat, ſmooth, ſhining, of a thick leathery ſubſtance, evergreen, on the upper ſide of a lively deep green colour, and of a pale bluiſh colour underneath, without any nerves, and their veins ſcarcely viſible; they are ſomewhat narrower near the footſtalks, and there their margins are bent downwards. In general, the leaves are from three to four inches long, and between one and two broad; they have very ſhort footſtalks, ſeldom half an inch long, which are ſmooth, concave on the upper ſide, and convex underneath. From the ſcars of the old footſtalks the branches are often tuberculated.

The peduncles, or footſtalks for the flowers, come out of the *axillæ foliorum*, near the extremity of the branches; they are flat, of a pale colour, twice or three times ſhorter than the leaves; now and then they ſupport only one flower, but are oftener near the top divided into three ſhort branches, each with one flower. The bracteæ are oblong, pointed, concave, entire, thick, whitiſh, and ſituated one at the baſis of each peduncle.

There is no calyx; but in its place the flower is ſurrounded with a ſpathaceous gem, of a thick leathery ſubſtance, green, but reddiſh on the ſide which has faced the ſun: before this gem burſts, it is of a round form, and its ſize is that of a ſmall pea. It burſts commonly ſo, that one ſide is higher than the other, and the ſegments are pointed. The corolla conſiſts always of ſeven petals, which are oval, obtuſe, concave, erect, white, have ſmall veins, and are of an unequal ſize, the largeſt ſcarcely four lines long; they very ſoon fade, and drop off almoſt as ſoon as the gem burſts. The filaments are from 15 to 30, and are placed on the flattened ſide of the receptacle; they are much ſhorter than the petals, and gradually decreaſe in length towards the ſides. The antheræ are large, oval, longitudinally divided into two, or as if each was made up of two oblong antheræ. The germina are from three to ſix, placed above the receptacle, turbinated, or of the ſhape of an inverted fig; flat on the inſide, and ſomewhat higher than the ſtamina; they have no ſtyles, but terminate in a ſtigma, which is divided into two or three ſmall lobes.

Dr Solander, to whom the world is indebted for the deſcription, never ſaw the fruit in its perfectly ripe ſtate; but could conclude from the unripe fruit which he ſaw in abundance, that each germen becomes a ſeparate ſeed-veſſel, of a thick fleſhy ſubſtance, and unilocular; and in each the rudiments of three, four, or five ſeeds were plainly diſcernible. See Plate DXL. where n° 1. repreſents the ſpathaceous gem, after it is burſt open. 2. The ſame. 3. The ſame (*a*) with the corolla (*b*) remaining within it. 4. One of the petals ſpread out. 5. The ſtamina (*a*) and the piſtilla (*b*) after the gem and the corolla are taken away. 6. The outſide of an anthera (*a*) with its filament (*b*). 7. The inſide of the ſame. 8. The germina (*a*) ſituated on the centre of the receptacle, after the ſtamina have been removed; the lobated ſtigma (*b*). 9. The convex or outermoſt ſide of a germen (*a*) with its ſtigma (*b*). 10. The inſide of the ſame. 11. A germen cut open longitudinally, ſo as to ſhow the rudiments of the ſeeds. 12. A germen cut through tranſverſely.

The weather is much more ſevere in the climate where theſe trees are natives than in Britain; here, therefore, it is thought they would thrive very well.

The bark of the wintera, or winter's cinnamon, brought over by the Dolphin, in reſpect to figure, exactly reſembles that which was delineated by Cluſius. The pieces are about three or four inches ſquare, of different degrees of thickneſs, from a quarter to three quarters of an inch. It is of a dark brown cinnamon colour; an aromatic ſmell, if rubbed; and of a pungent hot ſpicy taſte, which is laſting on the palate, though imparted ſlowly. It has the name of *winter's cinnamon*, from a faint reſemblance in colour and flavour to that grateful aromatic, though differing from it greatly in every other reſpect. This bark is only brought to us from the Straits of Magellan, and is the produce of the tree above deſcribed; much celebrated as an antiſcorbutic by the firſt diſcoverers, but unknown in the practice of phyſic, no quantity, except as a curioſity, having been brought to Europe till the return of the ſhips ſent out on the expeditions to the South Seas. The bark which was ſubſtituted in the room of this is the canella alba of the ſhops. See Canella.

From ſeveral experiments made by Dr Morris, the cortex magellanicus appears to be an aſtringent of a particular kind, and therefore likely to be of uſe in ſeveral manufactures. Water is the proper ſolvent of this bark; though the ſaline, gummy, and reſinous parts are ſo blended in it, as in ſaffron and ſome other vegetables, that it parts with them readily in proof and rectified ſpirits of wine, though not in ſo great a quantity.

The infuſion and decoction of this bark were of ſo grateful an aromatic bitter taſte, that it ſeems likely to be a pleaſant vehicle for ſome of the nauſeous drugs. With this view, on ſubſtituting the powder of this bark for the cardamom ſeeds in making the infuſion of ſenna, as directed in the London Diſpenſatory, the nauſeous ſmell and taſte of that excellent purgative was ſo effectually covered, as to be ſcarcely diſtinguiſhed by the niceſt palate. Tincture of rhubarb alſo prepared with this bark inſtead of cardamoms ſeemed far leſs diſagreeable.

WIRE, a piece of metal drawn through the hole of an iron into a thread of a fineneſs anſwerable to the hole it paſſed through,

Wires are frequently drawn ſo fine as to be wrought along with other threads of ſilk, wool, flax, &c.

The metals moſt commonly drawn into wire are gold, ſilver, copper, and iron. Gold-wire is made of cylindrical ingots of ſilver, covered over with a ſkin of gold, and thus drawn ſucceſſively through a vaſt number of holes, each ſmaller and ſmaller, till at laſt it is brought to a fineneſs exceeding that of a hair. That admirable ductility which makes one of the diſtinguiſhing characters of gold, is nowhere more conſpicuous than in this gilt wire. A cylinder of 48 ounces of ſilver, covered with a coat of gold, only weighing one ounce, as Dr Hally informs us, is uſually drawn into a wire, two yards of which weigh no more than one grain: whence 98 yards of the wire weigh no more than 49 grains, and one ſingle grain of gold covers the 98 yards; ſo that the ten thouſandth part of a grain is above one-eighth of an inch long.

Wire of Lapland. The inhabitants of Lapland have a ſort of ſhining ſlender ſubſtance in uſe among them on ſeveral occaſions, which is much of the thickneſs and appearance of our ſilver-wire, and is therefore called, by thoſe who do not examine its ſtructure or ſubſtance, *Lapland wire.* It is made of the ſinews of the rein-deer, which being carefully ſeparated in the eating, are, by the women, after ſoaking in water and beating, ſpun into a ſort of thread, of admirable fineneſs and ſtrength, when wrought to the ſmalleſt filaments; but when larger, is very ſtrong, and fit for the purpoſes of ſtrength and force. Their wire, as it is called, is made of the fineſt of theſe threads covered with tin. The women do this buſineſs; and the way they take is to melt a piece of tin, and placing at the edge of it a horn, with a hole through it, they draw theſe ſinewy threads, covered with the tin, through the hole, which prevents their coming out too thick covered. This drawing is performed with their teeth; and there is a ſmall piece of bone placed at the top of the hole, where the wire is made flat; ſo that we always find it rounded on all ſides but one, where it is flat.

This wire they uſe in embroidering their clothes as we do gold and ſilver; they often ſell it to ſtrangers, under the notion of its having certain magical virtues.

WISDOM, uſually denotes a higher and more refined notion of things immediately preſented to the mind, as it were, by intuition, without the aſſiſtance of ratiocination.

Sometimes the word is more immediately uſed, in a moral ſenſe, for what we call *prudence* or *diſcretion,* which conſiſts in the ſoundneſs of the judgment, and a conduct anſwerable thereto.

Wisdom of Solomon, one of the books of the Apocrypha. It abounds with Platonic language, and was probably written after the Caballiſtic philoſophy was introduced among the Jews.

WIT, is a quality of certain thoughts and expreſſions, much eaſier perceived than defined. According to Mr Locke, wit lies in the aſſemblage of ideas, and putting thoſe together with quickneſs and variety, wherein can be found any reſemblance or congruity, thereby to make up pleaſant pictures and agreeable viſions to the fancy. Mr Addiſon limited this definition conſiderably, by obſerving, that every reſemblance of ideas does not conſtitute wit, but thoſe only which produce delight and ſurpriſe. Mr Pope defined wit to be a quick conception and an eaſy delivery: while, according to a late writer, it conſiſts in an aſſimilation of diſtant ideas.

The word *wit* originally ſignified *wiſdom.* A *witte* was anciently a *wiſe man;* the *wittenagemot,* or Saxon parliament, an aſſemblage of wiſe men. So late as the reign of Elizabeth, a man of pregnant *wit,* of great *wit* was a man of vaſt *judgment.* We ſtill ſay, *in his wits, out of his wits,* for in or out of ſound mind. The word, however, is now applied in a more limited ſenſe.

Without attempting to expoſe the inaccuracy of the definitions above mentioned, or hazarding a definition of our own where ſo many eminent men have failed, we ſhall endeavour to ſhow in what true wit conſiſts.

It is evident that wit excites in the mind an agreeable ſurpriſe, and that this is owing entirely to the ſtrange aſſemblage of related ideas preſented to the mind. This end is effected, 1. By debaſing things pompous or *ſeemingly* grave; 2. By aggrandiſing things little or frivolous; 3. By ſetting ordinary objects in a particular and uncommon point of view, by means not only remote but apparently contrary. Of ſo much conſequence are ſurpriſe and novelty, that nothing is more taſteleſs, and ſometimes diſguſting, than a joke that has become ſtale by frequent repetition. For the ſame reaſon, even a pun or happy alluſion will appear excellent when thrown out extempore in converſation, which would be deemed execrable in print. In like manner, a witty repartee is infinitely more pleaſing than a witty attack: for though, in both caſes, the thing may be equally new to the reader or hearer, the effect on him is greatly injured, when there is acceſs to ſuppoſe that it may be the ſlow production of ſtudy and premeditation. This, however, holds moſt with regard to the inferior tribes of witticiſms, of which their readineſs is the beſt recommendation.

Campbel's Philoſophy of Rhetoric, vol. i.

We ſhall illuſtrate theſe obſervations by ſubjoining a ſpecimen or two of each of theſe ſorts of wit:

Of the firſt ſort, which conſiſts in the debaſement of things great and eminent, Butler, amongſt a thouſand other inſtances, hath given us thoſe which follow:

> And now had Phœbus in the lap
> Of Thetis taken out his nap:
> And, like a lobſter boil'd, the morn
> From black to red began to turn.
>
> *Hudibras, part* ii. *canto* 2.

Here the low allegorical ſtyle of the firſt couplet, and the ſimile uſed in the ſecond, afford us a juſt notion of this loweſt ſpecies, which is diſtinguiſhed by the name of the *ludicrous.* Another ſpecimen from the ſame author you have in theſe lines:

> Great on the bench, great in the ſaddle,
> That could as well bind o'er as ſwaddle,
> Mighty he was at both of theſe,
> And ſtyl'd of *war,* as well as *peace:*
> So ſome rats of amphibious nature,
> Are either for the *land* or *water.*
>
> *Ibid. part* i. *canto* 1.

In this coarſe kind of drollery, thoſe laughable tranſlations or paraphraſes of heroic and other ſerious poems, wherein the authors are ſaid to be traveſtied, chiefly abound.

The ſecond kind, conſiſting in the aggrandiſement of little things, which is by far the moſt ſplendid, and diſplays a ſoaring imagination, theſe lines of Pope will ſerve to illuſtrate:

> As Berecynthia, while her offſpring vie
> In homage to the mother of the ſky,
> Surveys around her in the bleſt abode,
> An hundred ſons, and every ſon a god:
> Not with leſs glory mighty dulneſs crown'd,
> Shall take thro' Grubſtreet her triumphant round;

And her Parnaſſus glancing o'er at once,
Behold a hundred ſons, and each a dunce.

This whole ſimilitude is ſpirited. The parent of the celeſtials is contraſted by the daughter of night and chaos; heaven by Grubſtreet; gods by dunces. Beſides the parody it contains on a beautiful paſſage in Virgil adds a particular luſtre to it. This ſpecies we may term the *thraſonical*, or the *mock-majeſtic*. It affects the moſt pompous language, and ſonorous phraſeology, as much as the other affects the reverſe, the vileſt and moſt grovelling dialect.

To this claſs alſo we muſt refer the application of grave reflections to mere trifles. For that *great* and *ſerious* are naturally aſſociated by the mind, and likewiſe little and trifling, is ſufficiently evinced by the common modes of expreſſion on theſe ſubjects uſed in every tongue. An appoſite inſtance of ſuch an application we have from Philips:

My galligaſkins, that have long withſtood
The winter's fury and encroaching froſts,
By time ſubdued, (*What will not time ſubdue!*)
An horrid chaſm diſcloſe. *Splendid Shilling.*

Of the third ſpecies of wit, which is by far the moſt multifarious, and which reſults from what may be called the queerneſs or ſingularity of the imagery, we ſhall give a few ſpecimens that will ſerve to mark ſome of its principal varieties. To illuſtrate all would be impoſſible. The firſt ſhall be where there is an apparent contrariety in the things ſhe exhibits as connected. This kind of contraſt we have in theſe lines of Garth:

Then Hydrops next appears amongſt the throng;
Bloated and big ſhe ſlowly ſails along:
But like a miſer in exceſs ſhe's poor,
And pines for thirſt amidſt her watery ſtore.
Diſpenſary.

A ſecond ſort is, where the things compared are what with dialecticians would come under the denomination of *diſparates*, being ſuch as can be ranked under no common genus. Of this we ſhall ſubjoin an example from Young:

Health chiefly keeps an Atheiſt in the dark;
A fever argues better than a *Clarke*:
Let but the logic in his pulſe decay,
The Grecian he'll renounce, and learn to pray.
Univerſal Paſſion.

A third variety in this ſpecies ſprings from confounding artfully the proper and the metaphorical ſenſe of an expreſſion. In this way, one will aſſign as a motive what is diſcovered to be perfectly abſurd, when but ever ſo little attended to; and yet, from the ordinary meaning of the words, hath a ſpecious appearance on a ſingle glance. Of this kind we have an inſtance in the ſubſequent lines:

While thus the lady talk'd, the knight
Turn'd th' outſide of his eyes to white,
As men of inward light are wont
To turn their optics in upon't.
Hudibras, part iii. *canto* 1.

For whither can they turn their eyes more properly than to the light?

A fourth variety much reſembling the former, is when the argument or compariſon (for all argument is a kind of compariſon) is founded on the ſuppoſal of corporeal or perſonal attributes in what is ſtrictly not ſuſceptible of them; as in this,

But Hudibras gave him a twitch
As quick as lightning in the breech,
Juſt in the place where honour's lodg'd,
As wiſe philoſophers have judg'd;
Becauſe a kick in that place more
Hurts honour than deep wounds before.
Ibid. part ii. *canto* 3.

The fifth, and only other variety which we ſhall mention, is that which ariſes from a relation, not in the things ſignified, but in the ſigns of all relations, no doubt the ſlighteſt. Identity here gives riſe to puns and clinches; reſemblance to quibbles, cranks, and rhimes: of theſe it is quite unneceſſary to exhibit ſpecimens.

Wit (John de), a celebrated penſioner of Holland, and one of the greateſt politicians of his time, was the ſon of Jacob de Wit, burgomaſter of Dort, and was born in 1625. He became well ſkilled in civil law, politics, mathematics, and other ſciences, and wrote a treatiſe on the Elements of Curved Lines, publiſhed by Francis Schooten. Having taken his degree of doctor of law, he travelled into foreign courts, where he became eſteemed for his genius and prudence. At his return to his native country in 1650, he became penſioner of Dort, then counſellor-penſionary of Holland, and Weſt Frieſland, intendant and regiſter of the fiefs, and keeper of the great ſeal. He was thus at the head of affairs in Holland; but his oppoſition to the re-eſtabliſhment of the office of ſtadtholder, which he thought a violation of the freedom and independence of the republic, coſt him his life, when the prince of Orange's party prevailed. He and his brother Cornelius were aſſaſſinated by the populace at the Hague in 1674, aged 47.

WITCH, a perſon guilty of witchcraft.

WITCHCRAFT, a ſupernatural power which perſons were formerly ſuppoſed to obtain the poſſeſſion of by entering into a compact with the devil. They gave themſelves up to him body and ſoul; and he engaged, that they ſhould want for nothing, and that he would avenge them upon all their enemies. As ſoon as the bargain was concluded, the devil delivered to the witch an imp, or familiar ſpirit, to be ready at a call, and do whatever it was directed. By the aſſiſtance of this imp, and the devil together, the witch, who was almoſt always an old woman, was enabled to tranſport herſelf in the air on a broomſtick or a ſpit to diſtant places to attend the meetings of the witches. At theſe meetings the devil always preſided. They were enabled alſo to transform themſelves into various ſhapes, particularly to aſſume the forms of cats and hares, in which they moſt delighted; to inflict diſeaſes on whomſoever they thought proper; and to puniſh their enemies in a variety of ways.

The belief that certain perſons were endowed with ſupernatural power; and that they were aſſiſted by inviſible ſpirits, is very ancient. The *ſagae* of the Romans ſeem rather to have been ſorcerers than witches; indeed the idea of a witch, as above deſcribed, could not have been prevalent till after the propagation of Chriſtianity, as the heathens had no knowledge of the Chriſtian *devil*.

Witchcraft was univerſally believed in Europe till the 16th century, and even maintained its ground with tolerable firmneſs till the middle of the 17th. Vaſt numbers of reputed witches were convicted and condemned to be burnt every year. The methods of diſcovering them were various. One was, to weigh the ſuppoſed criminal againſt the church bible, which, if ſhe was guilty would preponderate: another, by making her attempt to ſay the Lord's Prayer; this no witch was able to repeat entirely, but would omit ſome part or ſentence thereof. It is remarkable, that all witches did not heſitate at the ſame place; ſome leaving out one part, and ſome another. Teats, through which the imps ſucked, were indubitable marks of a witch; theſe were always raw, and alſo inſenſible; and, if ſqueezed, ſometimes yielded a drop of blood. A witch could not weep more than three tears, and that only out of the left eye. This want of tears was,

Provincial Gloſſary.

was, by the witch-finders, and even by ſome judges, conſidered as a very ſubſtantial proof of guilt. Swimming a witch was another kind of popular ordeal generally practiſed; for this ſhe was ſtripped naked, and croſs-bound, the right thumb to the left toe, and the left thumb to the right toe. Thus prepared, ſhe was thrown into a pond or river, in which, if guilty, ſhe could not ſink, for having, by her compact with the devil, renounced the benefit of the water of baptiſm, that element, in its turn, renounced her, and refuſed to receive her into its boſom. Sir Robert Filmer mentions two others by fire: the firſt, by burning the thatch of the houſe of the ſuſpected witch; the other, burning any animal ſuppoſed to be bewitched by her, as a hog or ox. Theſe, it was held, would force a witch to confeſs.

The trial by the ſtool was another method uſed for the diſcovery of witches. It was thus managed: Having taken the ſuſpected witch, ſhe was placed in the middle of a room upon a ſtool or table, croſs-legged, or in ſome other uneaſy poſture; to which if ſhe ſubmitted not, ſhe was then bound with cords: there ſhe was watched, and kept without meat or ſleep for the ſpace of 24 hours (for they ſaid, within that time they ſhould ſee her imp come and ſuck). A little hole was likewiſe made in the door for imps to come in at; and leſt it ſhould come in ſome leſs diſcernible ſhape, they that watched were taught to be ever and anon ſweeping the room, and if they ſaw any ſpiders or flies, to kill them; if they could not kill them, then they might be ſure they were imps. If witches, under examination or torture, would not confeſs, all their apparel was changed, and every hair of their body ſhaven off with a ſharp razor, leſt they ſhould ſecrete magical charms to prevent their confeſſing. Witches were moſt apt to confeſs on Fridays.

By ſuch trials as theſe, and by the accuſation of children, old women and fools, were thouſands of unhappy women condemned for witchcraft, and burnt at the ſtake. In the 18th volume of the Statiſtical Account of Scotland there is the trial of two witches, William Coke and Alinſon Dick, in Kirkaldy, in 1636. The evidence on which they were condemned, is abſolutely ridiculous: they were, however, burnt for witchcraft. The expences which the town and kirk-ſeſſion were put to on this occaſion were as follows:

In primis.—To Mr James Miller, when he went to Preſtowne for a man to try them, 47s. - -	L. 2	7
Item.—To the man of Culroſs, (the executioner), when he went away the firſt time, 12s. - -	0	12
Item.—For coals for the witches, 24s.	1	4
Item.—In purchaſing the commiſſion,	9	3
Item.—For one to go to Finmouth for the laird to ſit upon their aſſize as judge,	0	6
Item.—For harden to be jumps to them,	3	10
Item.—For making of them, - -	0	8
Summa for the kirk's part	L. 17	10 Scots.

The town's part of expences deburſed extraordinarily upon William Coke and Aliſon Dick.

In primis.—For ten loads of coals to burn them, 5 merks, - -	L. 3	6	8
Item.—For a tar barrel, 14 s. -	0	14	0
Item.—For towes, - - -	0	6	0
Item.—To him that brought the executioner,	2	18	0
Item.—To the executioner for his pains,	8	14	0
Item.—For his expences here, -	0	16	4
Carry over	L. 16	15	0
Brought over	L. 16	15	0
Item.—For one to go to Finmouth for the laird, - - -	0	6	0
Summa town part,	L. 17	1	Scots
Both,	L. 34	11	
Or	L. 2	17	7 Ster.

For a conſiderable time after the inquiſition was erected, the trials of witches (as heretics) were confined to that tribunal; but the goods of thoſe who were condemned being confiſcated to the holy office, its miniſters were ſo active in diſcovering ſorcerers, that the different governments found it neceſſary to deprive them of the cogniſance of this crime. On the continent, commiſſioners were then appointed for the diſcovery and conviction of witches, who, though leſs active than the inquiſitors, were but too zealous in proſecuting their function. In 1494, Sprenger and Inſtitor, two perſons employed in this commiſſion, publiſhed a collection of trials, moſt of which had come before themſelves, under the title of *Malleus Maleficarum:* this ſerved as a kind of inſtitute for their ſucceſſors.

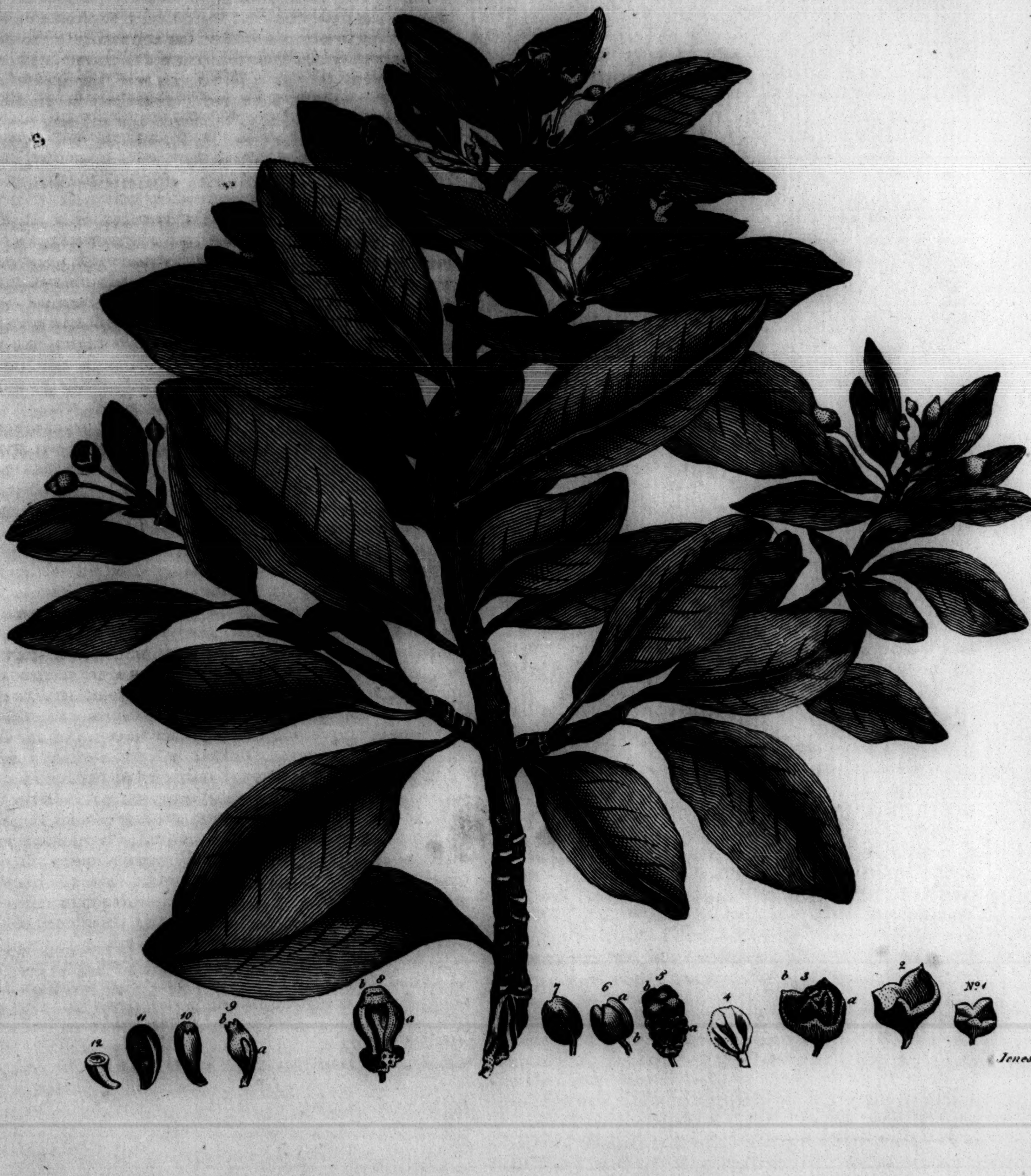
Dr Farrier, Mancheſter Tranſ. vol. iii.

The firſt writers againſt witchcraft were ſtigmatized as Atheiſts, though they only endeavoured to prove the imbecility of the perſons accuſed, and the infatuation or the knavery of their accuſers. Such were the epithets beſtowed by Dr Henry More, and even by Cudworth himſelf. Wierus, the diſciple of the celebrated Agrippa, gave riſe to the firſt great controverſy on this ſubject. His maſter had taught him humanity; and he endeavoured, but with too feeble a hand, to ſtop the bloody proceedings of the judges. Wierus appears to have been a well-diſpoſed, weak man, with extenſive reading on his ſubject, but too narow minded to comprehend it thoroughly. He involved himſelf in unſpeakable difficulties, by admitting the action of ſupernatural powers in certain diſeaſes, and in poſſeſſions, while he denied that witches had any concurrence in them. Theſe appearances (ſaid he) are illuſions of the devil, who perſuades ſimple and melancholy perſons that the miſchief he himſelf performs, is done by them, and at their pleaſure. He was weak enough to attempt the explanation of every ſtory alledged by his antagoniſts, without queſtioning the truth of the facts.

Bodinus, a French lawyer of eminence, who had aſſiſted at ſeveral trials of witches, wrote againſt Wierus, in his *Demonomania*. He urged the concurrent teſtimonies of ſufficient witneſſes, and the confeſſions of the witches themſelves, to eſtabliſh the exiſtence of ſorcery. Wierus owned that the unhappy perſons believed themſelves to be guilty of the crimes alledged againſt them, but that they were deceived by the devil. But what do you make of the witches meetings, cried Bodinus? The witches (replied his antagoniſt) are atrabilious. This explanation was ſo unſatiſfactory that Wierus paſſed for a magician, whom the devil had furniſhed with ſpecious arguments to ſave others from puniſhment. Lerchemer, Godelmann, Ewichius, Ewaldus, and ſome others followed him, notwithſtanding this ſtigma; but they were oppoſed by men of more acuteneſs and conſiſtency than themſelves; by Remigius, who had condemned ſeveral hundreds of ſorcerers to the flames; Delrio, whoſe book is a complete Corpus Magiæ; Cujas, Eraſtus, Scribonius, Camerarius, and a crowd of others.

In this country, while the belief in witchcraft was ſupported by royal authority (for James I. is univerſally known to have written on demonology) countenanced by Bacon, and generally adopted among the people, only one writer was hardy enough to oppoſe it. This was Reginald Scott, who publiſhed a collection of impoſtures detected, under the title of Diſcoveries of Witchcraft. James ordered the book to

WINTERA Aromatica. Plate DXL.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to be burnt by the common executioner, and the judges continued to burn witches as uſual. During the civil wars, upwards of eighty were hanged in Suffolk, on the accuſation of Hopkins the witch-finder. Webſter was the next writer againſt witchcraft; but he had a different fate from that of Scott, for moſt of his arguments were refuted by Glanville. This very acute writer was induced to publiſh his Philoſophical Conſiderations about Witchcraft, by the apprehenſion, that the increaſing diſbelief of witches and apparitions tended to affect the evidence of religion, and even of a Deity. In reſpect of argument, he was certainly ſuperior to his adverſaries; his reaſoning is perſpicuous, though ſometimes ſubtile, reſted on the moſt ſpecious foundations of evidences, and arranged with great ſkill.

On the continent, this controverſy ſeemed almoſt forgotten, till Bekker publiſhed his *Monde Enchantée*, in which he denied the exiſtence of witches on the Carteſian principle, that the Deity is the ſource of all action, conſequently actions ſo oppoſite to his nature and attributes cannot be ſuppoſed to exiſt. He was anſwered by Frederick Hoffman, the father of the modern theory and practice of medicine, in his diſſertation *De Diaboli Potentia in Corpora*.

The lateſt witchcraft frenzy was in New England, about 1692, when the execution of witches became a calamity more dreadful than the ſword or the peſtilence. The accuſers became ſo daring, that neither civil nor religious authority would have proved a ſecurity againſt their attacks, if all the proſecutions had not been ſuddenly dropped, and the priſoners ſet at liberty. So far did thoſe wretches proceed in abſurdity, that a dog was accuſed of throwing perſons into fits by looking at them. As ſoon as the proſecutions were ſtopped, all reports of witchcraft ceaſed.

It would be ridiculous to attempt a ſerious refutation of the exiſtence of witches; and at preſent, luckily, the taſk is unneceſſary. In this country, at leaſt, the diſcouragement long given to all ſuſpicion of witchcraft, and the repeal of the ſtatutes againſt that crime, have very much weakened, though perhaps they have not entirely eradicated, the perſuaſion. On the continent, too, it is evidently on the decline; and notwithſtanding the exertions of Dr De Haen, and of the celebrated Lavater, we have little doubt but that in a ſhort time poſterity will wonder at the credulity of their anceſtors. That there ever were witches, is an opinion that cannot for a moment be believed by a thinking man. The actions imputed to them were either abſurd or impoſſible; the witneſſes by whoſe evidence they were condemned, either weak enthuſiaſts or downright villains; and the confeſſions aſcribed to the witches themſelves, the effects of a diſordered imagination produced by cruel treatment and exceſſive watches. As to the nightly meetings, demonologiſts themſelves have been obliged to confeſs, that they were nothing elſe but uneaſy dreams, often produced by ſoporific compoſitions. The facts which have been brought forward by the advocates for witchcraft bear in their front the moſt evident marks of trick and impoſture; and this has conſtantly been found out whenever theſe facts have been properly examined. See Sorcery.

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BRITISH MUSEUM

to be burnt by the common executioner, and the judges continued to burn witches as uſual. During the civil wars, upwards of eighty were hanged in Suffolk, on the accuſation of Hopkins the witch-finder. Webſter was the next writer againſt witchcraft; but he had a different fate from that of Scott, for moſt of his arguments were refuted by Glanville. This very acute writer was induced to publiſh his Philoſophical Conſiderations about Witchcraft, by the apprehenſion, that the increaſing diſbelief of witches and apparitions tended to affect the evidence of religion, and even of a Deity. In reſpect of argument, he was certainly ſuperior to his adverſaries; his reaſoning is perſpicuous, though ſometimes ſubtile, reſted on the moſt ſpecious foundations of evidences, and arranged with great ſkill.

On the continent, this controverſy ſeemed almoſt forgotten, till Bekker publiſhed his *Monde Enchantée*, in which he denied the exiſtence of witches on the Carteſian principle, that the Deity is the ſource of all action, conſequently actions ſo oppoſite to his nature and attributes cannot be ſuppoſed to exiſt. He was anſwered by Frederick Hoffman, the father of the modern theory and practice of medicine, in his diſſertation *De Diaboli Potentia in Corpora.*

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Woad not only affords a laſting and ſubſtantial blue, which, according to the ſcale of the dyers, may be reduced into many different ſhades, but is alſo of great uſe in dyeing and fixing many other colours. But notwithſtanding this, and its being a commodity of our own, the uſe of it has very much declined ſince the introduction of indigo; for the purchaſe of which large ſums go annually out of the nation. The reaſon of this is, that indigo affords a more lively and pleaſing colour, is managed with more eaſe by the dyers, and does their buſineſs more expeditiouſly. Yet with all theſe advantages, it is univerſally acknowledged, that the colour which indigo affords is inferior to that of woad in many reſpects, and particularly in permanency; for which reaſon, they are frequently uſed in conjunction; woad to give ſolidity and ſubſtance, and indigo to give brightneſs and colour. But the worſt conſequence that has attended the uſe of indigo is, not barely leſſening the conſumption, but abating the price and depreciating the intrinſic value of woad; ſo that leſs care is taken in the management of it; to which in a great meaſure the inferiority of its colour, at leaſt in ſome places, is at preſent owing. The declenſion in its conſumption is not the caſe here only, but alſo in other countries; for it was once the great ſtaple of Languedoc, and was cultivated alſo in Normandy, and in other provinces of France; as it alſo is in Spain, Portugal, the Azores, and Canary iſlands, Switzerland, in the neighbourhood of Geneva, in different parts of Germany, and in Sweden.

An idea has been entertained, that by an alteration in the manner of curing it, the inconveniences that are ſuppoſed to attend the uſe of it might be removed, and that woad might be brought to anſwer all the purpoſes of indigo; which, if it could be accompliſhed, would be moſt certainly a great advantage, and an advantage which every true lover of his country would wiſh ſhould take place here rather that any where elſe. The author of the Natural Hiſtory of Languedoc ſuggeſts, that woad, if cured in the ſame manner as indigo, might produce as lively a colour; and adds, that from ſome experiments made by himſelf, he is convinced the method would effectually anſwer. The celebrated M. Du Hamel du Monçeau informs us, that having propoſed to Mr Fontenelle, a phyſician in Louiſiana, the cultivating the paſtel there in the manner of indigo, that gentleman acquainted him, that by treating indigo after the manner of paſtel, he had obtained a very beautiful green: which indeed is always the caſe when the indigo is only allowed to abſorb a ſmall quantity of oxygen; for it is now well known that its blue colour is owing to the abſorption of that gas.

WOAHOO, one of the Sandwich Iſlands, lying to the north-weſt of Morotoi, at the diſtance of ſeven leagues. From the appearance of the north-eaſt and north-weſt parts, it is the fineſt iſland of the group. Nothing can exceed the verdure of the hills, the variety of wood and lawn, and rich cultivated valleys, which the whole face of the country diſplays. A bay is formed by the north and weſt extremities, into which a fine river empties itſelf, through a deep valley; but as the water is brackiſh for 200 yards from the entrance, watering in it is not convenient. It contains about 60,000 inhabitants. Lieutenant Hergeſt, commander of the Dædalus ſtoreſhip, who had been ſent from England, in 1791, to New South Wales, and thence to the Southern Pacific Ocean, with a ſupply of proviſions for the Diſcovery ſloop, Captain Vancouver, then on a voyage of diſcovery, was here ſurpriſed and murdered by the natives, together with Mr Gooch, the aſtronomer. W. Long. 157. 51. N. Lat. 21. 43.

WODEN. See ODIN, and MYTHOLOGY, n° 40.

WODEVILE (Anthony), earl of Rivers, brother to the queen of Edward IV. was born in the end of 1442, or in the beginning of 1443. Though one of the moſt accompliſhed men of his age, very little is known of his private hiſtory. He was early and conſtantly employed either in the tumults of thoſe turbulent times, or in diſcharging the duties of ſome of the higheſt offices of the ſtate, with which he was inveſted. Yet he found leiſure to cultivate letters, and to be the author of works which, though of little value now, made ſome noiſe in that age, when learning was at a low ebb in England. Theſe conſiſted chiefly of tranſlations from the French; and his Lordſhip, with his printer Caxton, were the firſt Engliſh writers who had the pleaſure to ſee their works publiſhed from the preſs. This accompliſhed, brave, and amiable nobleman was treacherouſly impriſoned by Richard III. in Pomfret caſtle, where, during his confinement, he compoſed a ſhort poem, which has been preſerved by John Rous of Warwick, and breathes, ſays Dr Henry, a noble ſpirit of pious reſignation to his approaching fate. He was beheaded on the 23d of June 1483, in the 41ſt year of his age.

WOLAW, a town in Germany, in Sileſia, and capital of a duchy of the ſame name. It is ſurrounded with ſtrong walls and a moraſs, and one part of the houſes are built with ſtone. The caſtle is alſo encompaſſed with deep ditches, and the greateſt part of the inhabitants are employed in a woollen manufactory. In 1709 a proteſtant church was allowed to be built here. It is ſeated on the river Oder, 20 miles north-weſt of Breſlau, and 32 ſouth-eaſt of Glogau. E. Long. 16. 54. N. Lat. 51. 18.

WOLD, WELD, or *Dyers Weed*. See RESEDA.

WOLF, in zoology. See CANIS.

Wolf-Fiſh, or *Sea-Wolf*. See ANARCHICAS.

WOLF or *Wolf Poiſon*. See POISON.

WOLFE (Major-general James), was born at Weſterham in the county of Kent, about the beginning of the year 1726. His father was Lieutenant-general Edward Wolfe. He went into the army when very young; and applying himſelf with unwearied aſſiduity to the ſtudy of his profeſſion, ſoon became remarkable for his knowledge and his genius. He diſtinguiſhed himſelf at the battle of Lafelt when little more than 20, and received the higheſt encomiums from the commander in chief. After the peace he ſtill continued to cultivate the art of war. He contrived to introduce the greateſt regularity and the exacteſt diſcipline into his corps, and at the ſame time to preſerve the affection of every ſoldier. In 1758 he was preſent as a brigadier-general at the ſiege of Louiſbourg. He landed firſt on the iſland at the head of his diviſion; and in ſpite of the violence of the ſurf, and the force and well directed fire of the enemy, drove them from their poſt with great precipitation. The ſurrender of the town, which happened ſoon after, was in a great meaſure owing to his activity, bravery, and ſkill. The fame which he acquired during this ſiege pointed him out to Mr Pitt, who was then miniſter, as the propereſt perſon to command the army deſtined to attack Quebec. This was the moſt difficult and the moſt arduous undertaking of the whole war. Quebec was the capital of the French dominions in North America; it was well fortified, ſituated in the midſt of an hoſtile country, and defended by an army of 20,000 men, regulars and militia, beſides a conſiderable number of Indian allies. The troops deſtined for this expedition conſiſted of ten battalions, making up altogether about 7000 men. Such was the army deſtined to oppoſe three times their own number, defended by fortifications, in a country altogether unknown, and in a late ſeaſon in that climate for military operations. But this little army, ſays an officer who was preſent at that expedition, and who has been ſo obliging as to communicate all the information we deſired, was always ſanguine of ſucceſs; for they were commanded by General Wolfe, who, by a very uncommon magnanimity and nobleneſs of behaviour, had attached the troops ſo much to his perſon, and inſpired them with ſuch reſolution and ſteadineſs in the execution of their duty, that nothing ſeemed too difficult for them to accompliſh. The admirable ſkill with which his meaſures were planned, and the prudence and vigour with which they were executed, is well known. He landed his army on the northern ſhore of the river St Lawrence in ſpite of the enemy, and forced them to a battle, in which they were completely defeated. The conſequence of this battle was the reduction of Quebec, and the conqueſt of Canada. In the beginning of the battle General Wolfe was wounded in the wriſt by a muſketball: he wrapt his handkerchief round it, continued to give his orders with his uſual calmneſs and perſpicuity, and informed the ſoldiers that the advanced parties on the front had his orders to retire, and that they needed not be ſurpriſed when it happened. Towards the end of the battle he received a new wound in the breaſt; he immediately retired behind the rear-rank ſupported by a grenadier, and laid himſelf down on the ground. Soon after a ſhout was heard; and one of the officers who ſtood by him exclaimed, "See how they run!" The dying hero aſked with ſome emotion, "Who run?" "The enemy (replied the officer); they give way every where." The general then ſaid, "Pray, do one of you run to Colonel Burton, and tell him to march Webb's regiment with all ſpeed down to Charles river, to cut off the retreat of the fugitives from the bridge. Now, God be praiſed, I ſhall die happy!" He then turned on his ſide, cloſed his eyes, and expired.

The death of General Wolfe was a national loſs univerſally lamented. He inherited from nature an animating fervour of ſentiment, an intuitive perception, an extenſive capacity, and a paſſion for glory, which ſtimulated him to acquire every ſpecies of military knowledge that ſtudy could comprehend, that actual ſervice could illuſtrate and confirm. This noble warmth of diſpoſition ſeldom fails to call forth and unfold all the liberal virtues of the ſoul. Brave above all eſtimation of danger; generous, gentle, complacent, and humane; the pattern of the officer, the darling of the ſoldier. There was a ſublimity in his genius which ſoared above the pitch of ordinary minds; and had his faculties been exerciſed to their full extent by opportunity and action, had his judgment been fully matured by age and experience, he would, without doubt, have rivalled in reputation the moſt celebrated captains of antiquity. His body was brought to England, and buried with military honours in Weſtminſter abbey, where a magnificent monument is erected to his memory.

Enfield's Hiſt. of Philoſophy, vol. ii.

Wolfe (Chriſtian), a celebrated German philoſopher, was born at Breſlau in 1679. After having been well inſtructed in the rudiments of learning and ſcience in his own country, Wolfe proſecuted his ſtudies ſucceſſively in the univerſities of Jena, Hamburgh, and Leipſic. At the age of 26 he had acquired ſo much diſtinction, that he was appointed profeſſor of mathematics, and ſoon afterwards of philoſophy in general, in the univerſity of Hall. After Leibnitz had publiſhed his *Theodicea*, Wolfe, ſtruck with the novelty of the edifice which that philoſopher had raiſed, aſſiduouſly laboured in the inveſtigation of new metaphyſical truths. He alſo digeſted the Elements of Mathematics in a new method, and attempted an improvement of the art of reaſoning in a treatiſe On the Powers of the Human Underſtanding. Upon the foundation of Leibnitz's doctrine of Monads, he formed a new ſyſtem of Coſmology and Pneumatology, digeſted and demonſtrated in a mathematical method. This work, entitled Thoughts on God, the World, and the Human Soul, was publiſhed in the year 1719; to which were added, in a ſubſequent edition, Heads of Ethics and Policy.

Wolfe was now riſing towards the ſummit of philoſophical reputation, when the opinion which he entertained on the doctrine of neceſſity being deemed by his colleagues inimical to religion, and an oration which he delivered in praiſe of the morality of the Chineſe having given much offence, an accuſation of hereſy was publicly brought againſt him; and, though he attempted to juſtify himſelf in a treatiſe which he wrote on the ſubject of fatality, a royal mandate was iſſued in November 1723, requiring him to leave the Pruſſian dominions. Having been formerly invited by the landgrave of Heſſe-Caſſel to fill a profeſſor's chair in the univerſity of Caſſel, Wolfe now put himſelf under the patronage of that prince, who had the liberality to afford him a ſecure aſylum, and appointed him profeſſor of mathematics and philoſophy. The queſtion concerning the grounds of the cenſure which had been paſſed upon Wolfe was now every where freely canvaſſed; almoſt every German univerſity was inflamed with diſputes on the ſubject of liberty and neceſſity; and the names of Wolfians and Anti-Wolfians were every where heard. After an interval of nine years, the king of Pruſſia reverſed his ſentence of exile, and appointed him vice-chancellor of the univerſity of Hall; where his return was welcomed with every expreſſion of triumph. From this time he was employed in completing his Inſtitutes of Philoſophy, which he lived to accompliſh in every branch except policy. In 1745 he was created a baron by the elector of Bavaria, and ſucceeded Ludowig in the office of chancellor of the univerſity. He continued to enjoy theſe honours till the year 1754, when he expired. He poſſeſſed a clear and methodical underſtanding; which by long exerciſe in mathematical inveſtigations was particularly fitted for the employment of digeſting the ſeveral branches of knowledge into regular ſyſtems; and his fertile powers of invention enabled him to enrich almoſt every field of ſcience in which he laboured, with ſome valuable additions. The lucid order which appears in all his writings enables his reader to follow his conceptions with eaſe and certainty, through the longeſt trains of reaſoning.

WOLFEMBUTTLE, a conſiderable town of Germany, in the circle of Lower Saxony, and duchy of Brunſwick, with a caſtle where the duke of Brunſwick Wolfembuttle reſides. It is one of the ſtrongeſt places in Germany, though the fortifications want repairing in ſeveral places. There is an excellent library, kept in a building lately erected for that purpoſe, conſiſting of 116,000 printed books, and 2000 uncommon books, with a cabinet of curioſities, relating to natural hiſtory. It is ſeated on the river Ocker, five miles ſouth of Brunſwick, and 30 weſt of Halberſtadt. E. Long. 10. 42. N. Lat. 52. 18,

WOLFRAM, or TUNGSTEN. See TUNGSTEN.

WOLFRAM, in natural hiſtory and chemiſtry, the name of a peculiar mineral, lately ranged among the ſemi-metals. See MINERALOGY, p. 134, col. 2.

Cronſtadt's Mineralogy tranſlated by Magellan, vol. ii.

This mineral, which the Germans have called *wolfram* or *wolfruth*, a name tranſlated into Latin *ſpuma lupi*, or rather *lupus Jovis*, has been met with hitherto only in mines of tin; for, though many authors would make it more common, it is an error owing to their confounding ſome gloſſy iron ores with the true wolfram, as appears by the ſpecimens which are frequently found in cabinets under this name. It has been, on account of the bad effects produced by this mineral in the ſmelting of tin-ores, from which it is very difficult to ſeparate it by waſhing, becauſe of its great ſpecific weight, that the names of *ſpuma lupi*, *lupus Jovis*, and *wolfram*, have been given to it by the miners and ſmelters.

This is really a metallic ore, and contains the very ſemi-metal lately diſcovered in the tungſten; both being mineralized, or rather formed by the ſame tungſtenic acid.

1. It is of a black or brown ſhining colour, of a radiated or foliated texture, of a moderate hardneſs, and ſometimes ſo brittle as to be eaſily broken between the fingers; but it is very weighty, its ſpecific gravity being = 7,119.

2. When ſcratched it ſhows a red trace, and this diſtinguiſhes it from the tungſten, MINERALOGY, part ii. p. 73. col. 1. which is a variety of the ore of the ſame ſemi-metal.

3. It is found in ſcattered maſſes, cryſtallized into hexaedral flat priſms, coming to a point, with four ſides, and theſe points terminated obliquely.

4. Internally it is ſhining, with the luſtre almoſt of a metal.

5. When it is broken, its texture appears leafy; and the leaves are flat, but ſomewhat confuſed.

6. On ſome ſides they are unequal, and very ſeldom ſtriated.

7. It is always opaque; and when ſcraped, it yields a powder of a dark reddiſh grey.

8. The wolfram will not melt by itſelf with the blowpipe, the angles being only rounded; but,

9. Internally it preſerves its ſtructure and colour without change.

10. With microcoſmic ſalt *(phoſphate of ammoniac)* it fuſes with efferveſcence; and forms a glaſs of a pale red in the exterior flame, and much darker in the interior.

11. With borax it likewiſes efferveſces, and forms by the interior flame a glaſs of a greeniſh yellow, which by the exterior turns reddiſh.

12. Being expoſed in a crucible to a ſtrong fire for one hour, it ſwelled, became ſpongy, and of a browniſh colour; entered into a ſemi-vitrification; and was attracted by the magnet.

13. Equal parts of nitre and wolfram being put in a red-hot crucible, they detonated, or rather boiled up with a blue flame round the edges, and a nitrous vapour aroſe; the matter, when cold, on being put into water, partly diſſolved; and a few drops of acid produced a white precipitation.

14. Pounded wolfram, digeſted in a ſand-heat with a ſufficient quantity of marine acid, to the depth of the thickneſs of a finger above the matter, after one hour's boiling, the powder turned yellow; which is the ſame phenomenon as happens with the tungſtenic acid. See CHEMISTRY-*Index*.

15. It appears by the chemical analyſis of wolfram made by Meſſ. John and Fauſt de Luyart, that its contents conſiſt of 22 parts of manganeſe in the ſtate of black oxyd; 13,5 of iron, 65 of a yellow wolfranic oxyd, and of quartz and tin.

16. A good quantity of this yellow oxyd being collected, it was obſerved that it was entirely inſipid, and that its ſpecific gravity was = 6,120. It efferveſces with microcoſmic ſalt; produces a tranſparent blue colour without any ſhade of red; and efferveſces alſo with borax and with mineral alkali. This ſame matter does not diſſolve in water; but when triturated with it, forms a kind of emulſion: to which the acetous acid gives a blue colour, but does not diſſolve it. This matter, however, diſſolves completely in cauſtic vegetable alkali, both by the dry and moiſt way; and the liquor acquires a great bitterneſs. By pouring on it ſome nitrous acid a precipitate enſues, which leaves on the filtre a white ſalt; and this being well edulcorated, has a taſte at firſt ſweet, afterwards ſharp and bitter, producing a very diſagreeable ſenſation on the throat. It is in fact a true acid combined with a portion of the alkali and precipitating acid.

17. This acid melts, if alone, by the flame urged with the blow-pipe.

18. This white ſalt is a true metallic triple ſalt, as appears by putting 100 grains in a crucible with powdered charcoal; for after one hour and a half of a ſtrong fire, when cooled a button was found, which fell to powder between the fingers. Its colour was brown; and, on examining it with a magnifier, there was a congeries of metallic globules, of the bigneſs of pins heads; which, when broken, exhibit the metallic appearance of a ſteel colour in the fracture; and their ſpecific gravity was = 17,600.

19. Theſe metallic globules, melted with other metals, gold and platina excepted, afford ductile alloys with ſilver or copper; and hard ones with caſt iron, tin, antimony, biſmuth, and manganeſe.

It has been ſuppoſed that this is a new metal before unknown: That this was evinced, 1. by its ſpecific gravity, equal to 17,600; 2. by the tinges it gives to different glaſſes; 3. by its great difficulty to fuſe, which is greater than that of manganeſe; 4. by the yellow colour of its calx; 5. its alloys with other metals; 6. its inſolubility, at leaſt by a direct method, with mineral acids; 7. its eaſy ſolution in alkalis; 8. the emulſion it gives with water; 9. and by the blue colour it gives to acetous acid. We are not certain, however, how far this opinion has been corroborated by later experiments.

WOLFSPERG, a town of Germany, in Lower Carinthia, with a caſtle, on which the diſtrict about it depends, which is 20 miles in length, and 10 in breadth. It is ſeated on the river Lavand, at the foot of a mountain covered with wood, and full of wolves, from whence the town took its name. It is 36 miles eaſt of Clagenfurt. E. Long. 15. 0. N. Lat. 46. 56.

WOLGAST, a pretty conſiderable town of Germany, in the circle of Upper Saxony, and in Pomerania, capital of a territory of the ſame name, with a caſtle, and one of the beſt and largeſt harbours on the Baltic Sea. It is a well-built place, ſubject to Sweden, and ſeated on the river Pſin. E. Long. 14. 4. N. Lat. 54. 1.

WOLLASTON (William), deſcended of an ancient family in Staffordſhire, was born in 1659. He was in 1674 admitted a penſioner in Sidney college, Cambridge, where, notwithſtanding ſeveral diſadvantages, he acquired a great degree of reputation. In 1682, ſeeing no proſpect of preferment, he became aſſiſtant to the head maſter of Birmingham ſchool. Some time after, he got a ſmall lecture about two miles diſtant, but did the duty the whole Sunday; which, together with the buſineſs of a great free-ſchool for about four years, began to break his conſtitution. During this ſpace he likewiſe underwent a great deal of trouble and uneaſineſs, in order to extricate two of his brothers from ſome inconveniences, to which their own imprudence had ſubjected them. In 1688 affairs took a new turn. He found himſelf by a couſin's will intitled to a very ample eſtate; and came to London that ſame year, where he ſettled; chooſing a private, retired, and ſtudious life. Not long before his death, he publiſhed his treatiſe, intitled the Religion of Nature Delineated; a work for which ſo great a demand was made, that more than 10,000 were ſold in a very few years. He had ſcarcely completed the publication of it, when he unfortunately broke an arm; and this adding ſtrength to diſtempers that had been growing upon him for ſome time, accelerated his death; which happened upon the 29th of October 1724. He was a tender, humane, and in all reſpects worthy man; but is repreſented to have had ſomething of the iraſcible in his conſtitution and temperament. His Religion of Nature Delineated expoſed him to ſome cenſure, as if he had put a ſlight upon Chriſtianity by laying ſo much ſtreſs, as he does in this work, upon the obligations of truth, reaſon, and virtue; and by making no mention of revealed religion. But this cenſure muſt have been the offſpring of ignorance or envy, ſince it appears from the introduction to his work, that he intended to treat of revealed religion in a ſecond part, which he lived not to finiſh.

WOLSEY (Thomas), a famous cardinal and archbiſhop of York, is ſaid to have been the ſon of a butcher at Ipſwich. He ſtudied at Magdalen college, Oxford, where he became acquainted with the learned Eraſmus; and in the year 1500 became rector of Lymington in Somerſetſhire: he was afterwards made chaplain to king Henry VIII. and obtained ſeveral preferments. Having gradually acquired an entire aſcendency over the mind of Henry VIII. he ſucceſſively obtained ſeveral biſhoprics, and at length was made archbiſhop of York, lord high-chancellor of England, and prime miniſter; and was for ſeveral years the arbiter of Europe. Pope Leo X. created him cardinal in 1515, and made him *legate à latere;* and the emperor Charles V. and the French king Francis I. loaded him with favours, in order to gain him over to their intereſt: but after having firſt ſided with the emperor, he deſerted him to eſpouſe the intereſt of France. As his revenues were immenſe, his pride and oſtentation were carried to the greateſt height. He had 500 ſervants; among whom were 9 or 10 lords, 15 knights, and 40 eſquires. His ambition to be pope, his pride, his exactions, and his political delay of Henry's divorce, occaſioned his diſgrace. In the earlier part of his life he ſeems to have been licentious in his manners; for there goes a ſtory, that ſoon after his preferment to the living of Lymington in Somerſetſhire, he was put into the ſtocks by Sir Amias Paulet, a neighbouring juſtice of the peace, for getting drunk and making a riot at a fair. This treatment Wolſey did not forget when he arrived at the high ſtation of lord-chancellor of England; but ſummoned his corrector up to London, and, after a ſevere reprimand, enjoined him ſix years cloſe confinement in the Temple. Whatever may have been his faults, there can be no doubt of their having been aggravated both by the zealous reformers and by the creatures of Henry VIII. who was himſelf neither Papiſt nor Proteſtant; but there is every reaſon to believe that the cardinal was ſincere in his religion; and ſincerity, or at leaſt conſiſtency, was then a crime. Wolſey was the patron of learned men; a judge and munificent encourager of the polite arts; and ought to be conſidered as the founder of Chriſt-church college, Oxford; where, as well as in other places, many remains of his magnificent ideas in architecture ſtill exiſt. He died in 1530.

WOLVERENE, in zoology. See URSUS.

WOLVES-TEETH, of a horſe. See FARRIERY, § XXXV.

WOMAN, the female of the human ſpecies. See HOMO.

WOMB, or UTERUS. See ANATOMY, n° 108.

WOOD (Anthony), an eminent biographer and antiquarian, was the ſon of Thomas Wood, bachelor of arts and of the civil law, and was born at Oxford in 1632. He ſtudied at Merton college, and in 1655 took the degree of maſter of arts. He wrote, 1. The Hiſtory and Antiquities of the Univerſity of Oxford; which was afterwards tranſlated into Latin by Mr Waſe and Mr Peers, under the title of *Hiſtoria & Antiquitates Univerſitatis, Oxonienſis*, 2 vols folio. 2. *Athenæ Oxonienſes;* or an exact Account of all the Writers and Biſhops who have had their Education in the Univerſity of Oxford, from the Year 1500 to 1600, 2 vols folio; which was greatly enlarged in a ſecond edition publiſhed in 1721 by biſhop Tanner. Upon the firſt publication of this work the author was attacked by the univerſity, in defence of Edward earl of Clarendon, lord high-chancellor of England, and chancellor of the univerſity, and was likewiſe animadverted upon by biſhop Burnet; upon which he publiſhed a Vindication of the Hiſtoriographer of the Univerſity of Oxford. He died at Oxford of a retention of urine in 1695.

WOOD, a ſubſtance whereof the trunks and branches of trees conſiſt. It is compoſed of a number of concentric circles or zones, one of which is formed every year; conſequently their number correſponds to the age of the tree. Theſe zones vary in thickneſs according to the degree of vegetation that took place the year of their formation. They are alſo of different degrees of thickneſs in different parts, that part of the tree which is moſt expoſed to the ſun and beſt ſheltered growing faſteſt: hence in this country that part of the zone which looked towards the ſouth while the tree was growing is generally thickeſt. The innermoſt circle or zone is the one which was firſt formed, the outermoſt was formed the year before the tree was cut down. Theſe zones are at firſt very ſoft and tender, and harden by degrees as the tree becomes older: this is the reaſon that the middle of a tree is ſo often much better wood than the outſide of it.

The proper ligneous part of the wood conſiſts of longitudinal fibres, diſpoſed in faſciculi, and poſſeſſed of conſiderable hardneſs. It is this longitudinal direction of the fibres that renders it ſo much eaſier to cleave wood lengthwiſe than acroſs the tree or in any other direction. See PLANT.

Chemiſts have attempted to aſcertain the ingredients which enter into the compoſition of wood. The taſk, however, is ſo difficult, that they have by no means made the ſame progreſs that they have done in analyſing the various mineral productions of nature. When wood is diſtilled, water comes over firſt; ſoon after it begins to be impregnated with oil, then an empyreumatic oil comes over, then carbonic acid gas, then hydrogen gas, and laſtly carbonated hydrogen gas: a coal remains behind, which is compoſed of charcoal, fixed alkali, various earths, and ſometimes alſo of ſeveral neutral ſalts and metallic ſubſtances. This was once looked upon by chemiſts as a perfect analyſis, and it was ſuppoſed that all the various ſubſtances above-mentioned exiſted in plants in their proper form. But this is now known to be a miſtake: the action of the fire produces new combinations in the ultimate ingredients of the plant, and thus produces new ſubſtances; and it is only theſe that are obtained by the above proceſs. It is ſufficient however to ſhow, that wood is compoſed in a great meaſure of carbon, oxygen, and hydrogen, combined variouſly and in unknown proportions with one another; as moſt of the products of the diſtillation can be reſolved into theſe ſubſtances.

There are many varieties of wood poſſeſſed of diſtinguiſhing properties, as cedar, box, ebony, &c. See theſe articles.

For the *Method of Staining or Dyeing Wood*, ſee TURNING.

For more complete information concerning wood, ſee alſo PLANT, TREE, *STRENGTH of Materials*.

Foſſil Wood. Foſſil wood, or whole trees, or parts of them, are very frequently found buried in the earth, and that in different ſtrata; ſometimes in ſtone, but more uſually in earth; and ſometimes in ſmall pieces looſe among gravel. Theſe, according to the time they have lain in the earth, or the matter they have lain among, are found differently altered from their original ſtate; ſome of them having ſuffered very little change; and others being ſo highly impregnated with cryſtalline, ſparry, pyritical, or other extraneous matter, as to appear mere maſſes of ſtone, or lumps of the common matter of the pyrites, &c. of the dimenſions, and, more or leſs, of the internal figure of the vegetable bodies into the pores of which they have made their way.

The foſſil woods which we find at this day are, according to theſe differences, arranged by Dr Hill into three kinds; 1. The leſs altered: 2. The pyritical: and, 3. The petrified.

Of the trees, or parts of them, leſs altered from their original ſtate, the greateſt ſtore is found in digging to ſmall depths in bogs, and among what is called *peat* or *turf earth*, a ſubſtance uſed in many parts of the kingdom for fuel. In digging among this, uſually very near the ſurface, immenſe quantities of vegetable matter of various kinds are found buried; in ſome places there are whole trees ſcarce altered, except in colour; the oaks in particular being uſually turned to a jetty black; the pines and firs, which are alſo very frequent, are leſs altered, and are as inflammable as ever, and often contain between the bark and wood a black reſin. Large parts of trees have alſo been not unfrequently met with unaltered in beds of another kind, and at much greater depths, as in the ſtrata of clay and loam, among gravel, and ſometimes even in ſolid ſtone.

Beſide theſe harder parts of trees, there are frequently found alſo in the peat earth vaſt quantities of the leaves and fruit and catkins of the hazel and ſimilar trees: theſe are uſually mixed with ſedge and roots of graſs, and are ſcarce at all altered from their uſual texture. The moſt common of theſe are hazel-nuts; but there are frequently found alſo the twigs and leaves of the white poplar; and a little deeper uſually there lies a cracked and ſhattered wood, the crevices of which are full of a bituminous black matter: and among this the ſtones of plums and other ſtone-fruits are ſometimes found, but more rarely.

In this ſtate the fruits and larger parts of trees are uſually found: what we find of them more altered, are ſometimes large and long, ſometimes ſmaller and ſhorter branches of trees, ſometimes ſmall fragments of branches, and more frequently ſmall ſhapeleſs pieces of wood. The larger and longer branches are uſually found bedded in the ſtrata of ſtone, and are more or leſs altered into the nature of the ſtratum they lie in. The ſhorter and ſmaller branches are found in vaſt variety in the ſtrata of blue clay uſed for making tiles in the neighbourhood of London. Theſe are prodigiouſly plentiful in all the clay-pits of this kind, and uſually carry the whole external reſemblance of what they once were, but nothing of the inner ſtructure; their pores being wholy filled, and undiſtinguiſhably cloſed by the matter of the common pyrites, ſo as to appear mere ſimple maſſes of that matter. Theſe fall to pieces on being long expoſed to moiſture; and are ſo impregnated with vitriol that they are what is principally uſed for making the green vitriol or copperas at Deptford and other places.

The irregular maſſes or fragments of petrified wood are principally of oak, and are moſt uſually found among gravel; though ſometimes in other ſtrata. Theſe are variouſly altered by the inſinuation of cryſtalline and ſtony particles; and make a very beautiful figure when cut and poliſhed, as they uſually keep the regular grain of the wood, and ſhow exactly the ſeveral circles which mark the different years growth. Theſe, according to the different matter which has filled their pores, aſſume various colours, and the appearance of the various foſſils that have impregnated them; ſome are perfectly white, and but moderately hard; others of a browniſh black, or perfectly black, and much harder; others of a reddiſh black, others yellowiſh, and others greyiſh, and ſome of a ferruginous colour. They are of different weights alſo and hardneſſes, according to the nature and quantity of the ſtony particles they contain: of theſe ſome pieces have been found with every pore filled with pure pellucid cryſtal: and others in large maſſes, part of which is wholly petrified and ſeems mere ſtone, while the reſt is crumbly and is unaltered wood. That this alteration is made in wood, even at this time, is alſo abundantly proved by the inſtances of wood being put into the hollows of mines, as props and ſupports to the roofs, which is found after a number of years as truly petrified as that which is dug up from the natural ſtrata of the earth. In the pieces of petrified wood found in Germany, there are frequently veins of ſpar or of pure cryſtal, ſometimes of earthy ſubſtances, and often of the matter of the common pebbles: theſe fragments of wood ſometimes have the appearance of parts of the branches of trees in their natural ſtate, but more frequently they reſemble pieces of broken boards; theſe are uſually capable of a high and elegant poliſh.

Many ſubſtances, it is certain, have been preſerved in the cabinets of collectors, under the title of *petrified wood*, which have very little right to that name. But where the whole outer figure of the wood, the exact lineaments of the bark, or the fibrous and fiſtular texture of the ſtriæ, and the veſtiges of the utriculi and tracheæ or air-veſſels, are yet remaining, and the ſeveral circles yet viſible which denoted the ſeveral years growth of the tree, none can deny theſe ſubſtances to be real foſſil wood. See PETRIFACTION.

Compoſition for preſerving Wood. See CHEMISTRY, n° 621 and 700.

WOOD (*ſylva*), in geography, a multitude of trees extended over a large continued track of land, and propagated without culture. The generality of woods only conſiſt of trees of one kind.—The ancient Saxons had ſuch a veneration for woods, that they made them ſanctuaries.—It is ordained, that none ſhall deſtroy any wood, by turning it into tillage or paſture, &c. where there are two acres or more in quantity, on pain of forfeiting 40s. an acre, by 35 Henry VIII. c. 17. All woods that are felled at 14 years growth, are to be preſerved from deſtruction for eight years; and no cattle put into the ground till five years after the felling thereof, &c. 13 Eliz. c. 25. The burning of woods or underwood is declared to be felony; alſo thoſe perſons that maliciouſly cut or ſpoil timber-trees, or any fruit trees, &c. ſhall be ſent to the houſe of correction, there to be kept three months, and whipt once a month.

Wood-Cock, in ornithology. See SCOLOPAX.

Wood-Goat. See CAPRA.

Wood-Louſe. See ONISCUS.

Wood-Pecker. See PICUS.

WOODMOTE. See *Forest-Courts.*

WOODSTOCK, a town of Oxfordſhire, in England, pleaſantly ſeated on a riſing ground, and on a rivulet; a well compacted borough-town, and ſends two members to parliament; but is chiefly noted for Blenheim-houſe, a fine palace, built in memory of the victory obtained by the duke of Marlborough over the French and Bavarians in Auguſt 1704. It was erected at the public expence, and is one of the nobleſt ſeats in Europe. One of the paſſages to it is over a bridge with one arch, 190 feet in diameter, reſembling the Rialto at Venice. The gardens take up 100 acres of ground; and the offices, which are very grand, have room enough to accommodate 300 people. The apartments

ments of the place are magnificently furniſhed ; and the ſtaircaſes, ſtatues, paintings, and tapeſtry, ſurpriſingly fine. The town is about half a mile from the palace, having ſeveral good inns ; and a manufacture of ſteel chains for watches, and excellent gloves. It is 8 miles north of Oxford, and 60 weſt-north-weſt of London. W. Long. 1. 15. N. Lat. 51. 52.

WOODWARD (Dr John), was born in 1665, and educated at a country ſchool, where he learned the Latin and Greek languages, and was afterwards ſent to London, where he is ſaid to have been put apprentice to a linendraper. He was not long in that ſtation, till he became acquainted with Dr Peter Barwick, an eminent phyſician, who took him under his tuition and into his family. Here he proſecuted with great vigour and ſucceſs the ſtudy of philoſophy, anatomy, and phyſic. In 1692, Dr Stillingfleet quitting the place of profeſſor of phyſic in Greſham college, our author was choſen to ſucceed him, and the year following was elected F. R. S. In 1695 he obtained the degree of M. D. by patent from archbiſhop Tenniſon; and the ſame year he publiſhed his Eſſay toward a Natural Hiſtory of the Earth. He afterwards wrote many other pieces which have been well received by the learned world. He founded a lecture in the univerſity of Cambridge, to be read there upon his Eſſay, &c. and handſomely endowed it. He died in 1728.

WOOF, among manufacturers, the threads which the weavers ſhoot acroſs with an inſtrument called the *ſhuttle*. See CLOTH.

WOOKEY or *Okey Hole*, a remarkable cavern two miles from the city of Wells in Somerſetſhire ; for an account of which, ſee the article GROTTO.

WOOL, the covering of ſheep. See OVIS, and SHEEP.

Wool reſembles hair in a great many particulars ; but beſides its fineneſs, which conſtitutes an obvious difference, there are other particulars which may ſerve alſo to diſtinguiſh them from one another. Wool, like the hair of horſes, cattle, and moſt other animals, completes its growth in a year, and then falls off as hair does, and is ſucceeded by a freſh crop. It differs from hair, however, in the uniformity of its growth, and the regularity of its ſhedding. Every filament of wool ſeems to keep exact pace with another in the ſame part of the body of the animal ; the whole crop ſprings up at once ; the whole advances uniformly together ; the whole looſens from the ſkin nearly at the ſame period, and thus falls off if not previouſly ſhorn, leaving the animal covered with a ſhort coat of young wool, which in its turn undergoes the ſame regular mutations.

Bee, vol. xviii. p. 57.

Hairs are commonly of the ſame thickneſs in every part ; but wool conſtantly varies in thickneſs in different parts, being generally thicker at the points than at the roots. That part of the fleece of ſheep which grows during the winter is finer than what grows in ſummer. This was firſt obſerved by Dr Anderſon, the editor of the Bee, and publiſhed in his *Obſervations on the Means of exciting a Spirit of National Induſtry*.

While the wool remains in the ſtate it was firſt ſhorn off the ſheep's back, and not ſorted into its different kinds, it is called *fleece*. Each fleece conſiſts of wool of divers qualities and degrees of fineneſs, which the dealers therein take care to ſeparate. The French and Engliſh uſually ſeparate each fleece into three ſorts, *viz.* 1. Mother-wool, which is that of the back and neck. 2. The wool of the tails and legs. 3. That of the breaſt and under the belly. The Spaniards make the like diviſion into three ſorts, which they call *prime*, *ſecond*, and *third* ; and for the greater eaſe, denote each bale or pack with a capital letter, denoting the ſort. If the triage or ſeparation be well made, in 15 bales there will be 12 marked R, that is, refine, or prime ; two marked F, for fine, or ſecond ; and one S, for thirds.

The wools moſt eſteemed are the Engliſh, chiefly thoſe about Leominſter, Cotſwold, and the Iſle of weight ; the Spaniſh, principally thoſe about Segovia ; and the French, about Berry : which laſt are ſaid to have this peculiar property, that they will knot or bind with any other ſort ; whereas the reſt will only knot with their own kind.

Among the ancients, the wools of Attica, Megara, Laodicea, Apulia, and eſpecially thoſe of Tarentum, Parma, and Altino, were the moſt valued. Varro aſſures us, that the people there uſed to clothe their ſheep with ſkins, to ſecure the wool from being damaged.

Of late a great deal of attention has been paid to wool in Britain as well as ſeveral others. Several very ſpirited attempts have been made to improve it, by introducing ſuperior breeds of ſheep, and better methods of managing them. For this purpoſe has been formed the *Britiſh Wool Society*.

Britiſh Wool Society, an aſſociation formed for the purpoſe of obtaining the beſt breeds of fine-woolled ſheep, with a view of aſcertaining, by actual experiments, how far each ſpecies or variety is calculated for the climate of Great Britain ; the qualities of their wool reſpectively ; the uſes to which each kind of wool could be moſt profitably employed in different manufactures ; and the comparative value of each ſpecies of ſheep, ſo far as the ſame can be determined.

Attention had for ſome time been paid by the Highland Society to a famous breed of fine-woolled ſheep in Shetland ; but it occurred to Sir John Sinclair of Ulbſter, baronet, and to Dr James Anderſon, well known as the author of many uſeful publications, that the improvement of Britiſh wool was a matter of too much importance to be entruſted to a ſociety which is obliged to devote its attention to ſuch a variety of objects as the general improvement of the Highlands of Scotland. The latter of theſe gentlemen, therefore, in an Appendix to the Report of the Committee of the Highland Society of Scotland, for the year 1790, propoſed *the plan of a patriotic aſſociation for the improvement of Britiſh wool* ; and the former, who was convener of the committee to whom the ſubject of Shetland wool had been referred, wrote circular letters, recommending the plan. The conſequence of which was, that, on the 31ſt of January 1791, ſeveral noblemen and gentlemen of the higheſt reſpectability met in Edinburgh, and conſtituted themſelves into *a Society for the Improvement of Britiſh Wool*. Of this ſociety Sir John Sinclair was elected preſident ; after which, in an excellent ſpeech, he pointed out to the members the objects of the inſtitution, the means by which thoſe objects could be attained, and the advantages which would reſult from their united labours. This addreſs was afterwards printed by order of the ſociety.

The particular breeds of ſheep to which the ſociety propoſed to direct its attention, were ſheep for the hilly parts of Scotland ; ſheep for the plains, or the Lowland breed : and ſheep for the iſlands. They were to try experiments alſo with ſheep from foreign countries, diſtinguiſhed by any particular property.

The principal objects which the members had in view, during the firſt year of their aſſociation, were, 1. To collect ſpecimens of the beſt breeds which Great Britain at that period afforded, in order to aſcertain the degree of perfection to which ſheep had already been brought in this kingdom. 2. To procure from every country, diſtinguiſhed for the quality of its ſheep and wool, ſpecimens of the different breeds it poſſeſſed, in order to aſcertain how far the original breed, or a mixed breed from it and the native

Wool.

ſheep of the country, could thrive in Scotland. 3. To diſperſe as much as poſſible all theſe breeds, both foreign and domeſtic, over the whole kingdom, wherever proper perſons could be found to take charge of them, in order to try experiments on a more extenſive ſcale than the ſociety itſelf could do ; to ſpread information, and to excite a ſpirit for the improvement of ſheep and wool in every part of the country.

Sir John Sinclair had previouſly collected a flock, conſiſting of ſheep of the Spaniſh, Herefordſhire, Southdown, Cheviot, Lomond hills, and Shetland breeds, and of a mixed breed from theſe different ſheep. This flock amounted to 110 rams, ewes, and lambs. M. D'Aubenton, in conſequence of a correſpondence with Sir John Sinclair, ſent over to the ſociety ten rams and five ewes, of real Spaniſh breed, which had been originally intruſted to his care by the late king of France : theſe, after encountering a number of obſtacles, and after being ſtopped and threatened to be ſlaughtered at the cuſtomhouſe of Brighthelmſtone for the uſe of the poor, arrived ſafe at Leith. Lord Sheffield, at the ſame time, ſent to the ſociety four rams and ſix ewes of the Southdown and Spaniſh breeds. Mr Biſhton of Kilſall, in Shropſhire, preſented them with three Hereford rams, reckoned by many the beſt breed in England ; the ſociety at the ſame time ordered 150 ewes of the ſame breed, and two ewes of the Long Mountain breed, reckoned the beſt in Wales, to be ſent along with them. They purchaſed 57 rams and 173 ewes of the Cheviot breed, reckoned the beſt in Scotland, for the hilly parts of the country. Lord Daer ſent them 20 ewes of an excellent breed which exiſted at Mochrum in Galloway. The late earl of Oxford ſent them in a preſent three rams of the Norfolk croſſed by the Cape of Good Hope breed. Mr Iſaac Grant junior of Leghorn, in conjunction with Mr Sibbald merchant at Leith, preſented them an Apulian ram and ewe ; the ram arrived in ſafety, but the ewe unfortunately died on the paſſage. Mr Baron Seton of Preſton, in Linlithgowſhire, ſent them a ram and two ewes of a Spaniſh breed, which had been for ſome time kept in Sweden unmixed with any other. They purchaſed 100 ewes of a ſmall breed exiſting in the pariſh of Leuchars in Fife, much reſembling the Shetland. The Right Honourable William Conynghame of Ireland ſent them 11 Spaniſh rams, 7 Spaniſh ewes, 15 three-fourth breed and 16 one-half breed Spaniſh and Iriſh ewes. Lord Sheffield ſent them 8 rams and 18 ewes : and his Majeſty made them a preſent of two rams.

Thus, in the courſe of one year, the ſociety acquired by donation or purchaſe about 800 ſheep of different ſorts and ages, and many of them from foreign countries : about 500 of theſe were diſtributed over different parts of Scotland, the greater number of which were ſold to gentlemen anxious to promote the views of the ſociety, and well qualified to make experiments on the different breeds which they had obtained. The greateſt part of the remainder were taken by different gentlemen who kept them for the ſociety, and according to their directions, without any expence.

It is impoſſible to produce an inſtance of ſo much having been accompliſhed by a ſociety of private individuals in ſo ſhort a time. Nor was this all ; the ſame year Mr Andrew Kerr, a very intelligent ſheep-farmer on the borders of England, was ſent, at the expence of the ſociety, to examine the ſtate of ſheep-farming along the eaſt coaſt of Scotland and the interior parts of the Highlands. His tour was printed by order of the ſociety, and contains the firſt intimation of the poſſibility of the Cheviot breed thriving in the north of Scotland.

In the year 1792, Meſſrs Redhead, Laing, and Marſhall, were ſent by the ſociety, to make a ſurvey of the ſtate of ſheep-farming through ſome of the principal counties of England ; the reſult of which was alſo publiſhed by the ſociety, and contains more information on the ſubject of the different breeds of England than any work hitherto publiſhed ; and in 1794, Mr John Naiſmyth was ſent on a tour through the ſouthern diſtricts of Scotland, which completed the circuit of almoſt the whole kingdom.

Woolſton Woolwich.

Thus a few private individuals, unaided by the public purſe, had boldneſs enough to undertake aſcertaining the comparative value of the different kinds of ſheep in their own country, and to introduce ſome of the moſt celebrated breeds of other countries, and ſucceeded in the ſpirited attempt. It is impoſſible in this place to ſtate more minutely the various other tranſactions of the ſociety ; to enter into any detail of the premiums given by this reſpectable inſtitution for the improvement of the celebrated Shetland breed ; or to explain how, as if it were by magic, in a country where the manufacture of wool was little known, articles manufactured of that material were made, rivalling, and in ſome caſes ſurpaſſing, the moſt celebrated fabrics of other countries. A war having unfortunately ariſen, it became impoſſible to pay the ſame attention, or to carry on with the ſame ſucceſs, novel enterprizes ; even old eſtabliſhments often fall a ſacrifice amidſt the horrors of war. The utmoſt that the Britiſh Wool Society could expect to do, was to preſerve the inſtitution in ſuch a ſtate, that when peace ſhall be happily reſtored it may revive with double energy and ſpirit.

WOOLSTON (Thomas), an Engliſh divine, was born at Northampton in 1669, and educated at Cambridge. His firſt appearance in the learned world was in 1705, in a work entitled, The old Apology for the Truth of the Chriſtian Religion, againſt the Jews and Gentiles, revived. He afterwards wrote many pieces : but what made the moſt noiſe, were his Six Diſcourſes on the Miracles of Chriſt ; which occaſioned a great number of books and pamphlets upon the ſubject, and raiſed a proſecution againſt him. At his trial in Guildhall, before the lord chief-juſtice Raymond, he ſpoke ſeveral times himſelf ; and urged, that " he thought it very hard that he ſhould be tried by a ſet of men who, though otherwiſe very learned and worthy perſons, were no more judges of the ſubjects on which he wrote, than himſelf was a judge of the moſt crabbed points of the law." He was ſentenced to a year's impriſonment, and to pay a fine of 100l. He purchaſed the liberty of the rules of the King's-bench, where he continued after the expiration of the year, being unable to pay the fine. The greateſt obſtruction to his deliverance from confinement was, the obligation of giving ſecurity not to offend by any future writings, he being reſolved to write again as freely as before. Whilſt ſome ſuppoſed that this author wrote with the ſettled intention of ſubverting Chriſtianity under the pretence of defending it, others believed him diſordered in his mind ; and many circumſtances concurred which gave countenance to this opinion. He died, January 27, 1732-3, after an illneſs of four days ; and, a few minutes before his death, uttered theſe words : " This is a ſtruggle which all men muſt go through, and which I bear not only patiently, but with willingneſs." His body was interred in St George's church-yard, Southwark.

WOOLWICH, a town in Kent, with a market on Fridays, but no fair. It is ſeated on the river Thames, and of great note for its fine docks and yards, where men of war are built ; as alſo for its vaſt magazines of great guns, mortars, bombs, cannon-balls, powder, and other warlike ſtores. It has likewiſe an academy, where the mathematics are taught, and young officers inſtructed in the military art.

It

Worceſter, Worceſterſhire.

It is nine miles eaſt of London. E. Lon. 0. 10. N. Lat. 51. 30.

WORCESTER, in Latin *Wigornia*, the capital of a county of England of the ſame name, ſtands on the river Severn, but ſo low that it can hardly be ſeen till one is cloſe upon it. It is ſuppoſed to be the Branonium of Antoninus, the Branogenium of Ptolemy, and to have been built by the Romans to awe the Britons on the other ſide of the Severn. It was made an epiſcopal ſee about the year 680 by Sexulphus biſhop of the Mercians; but the preſent cathedral was begun by Wulſton in the year 1084. The town hath been ſeveral times burnt down; firſt, in 1041, by Hardicanute, who alſo maſſacred the citizens; ſecondly, not long after William Rufus's time; and a third time, when king Stephen beſieged and took it. Here, in latter times, was fought that battle, in which Charles II. with his Scots army was defeated by Cromwell. In a garden, near the ſouth gate of the city, where the action was hotteſt, the bones of the ſlain are often dug up. It had formerly ſtrong walls and a caſtle; but theſe have been demoliſhed long ago. It is now a large city, the ſtreets broad and well paved, and ſome of them very regular and well built, particularly Foregate-ſtreet; ſo that in general it is a very agreeable place. The cathedral is a ſtately edifice, and among other monuments in it are thoſe of king John, of Arthur, elder brother to Henry VIII. and of the counteſs of Saliſbury, who gave occaſion to the inſtitution of the order of the Garter. There are ſeven or eight hoſpitals in and about the city; of which that built and endowed by Robert Berkley, of Spetchley, Eſq. is a very noble one. There is a ſchool founded by Henry VIII. three other ſchools, and ſix charity ſchools. The Guildhall and the workhouſe are ſtately ſtructures. The churches, St Nicholas and All-Saints, have been lately rebuilt, and are very handſome edifices. The city carries on a great trade; for which it is chiefly indebted to its ſituation upon the Severn. A prodigious number of people are employed in and about it in the manufacture of broad-cloth and gloves. The Welch inhabit a part of it, and ſpeak their own language. Its market is well ſupplied with proviſions, corn, and cattle, and its quay is much frequented by ſhips. By a charter from James I. it is governed by a mayor, ſix aldermen, who are juſtices of the peace, and choſen out of 24 capital citizens; a ſheriff, the city being a county of itſelf, a common council, conſiſting of 48 other citizens, out of which two chamberlains are yearly choſen, a recorder, town-clerk, two coroners, a ſword-bearer, 13 conſtables, and four ſergeants at mace. Of the biſhops of this ſee, there have been, it is ſaid, one pope, four ſaints, ſeven lord high-chancellors, 11 archbiſhops, two lord treaſurers, one chancellor to the queen, one lord preſident of Wales, and one vice-preſident. The city at preſent gives title of earl and marquis to the duke of Beaufort. W. Long. 1. 55. N. Lat. 52. 10.

WORCESTER (earl of) See TIPTOFT.

WORCESTERSHIRE, a county of England, bounded by Warwickſhire on the eaſt, by Glouceſterſhire on the ſouth, by the counties of Hereford and Salop on the weſt, and on the north by Staffordſhire. According to Templeman, it is 36 miles in length, 28 in breadth, and about 130 in circumference, within which it contains ſeven hundreds, and a part of two others, 11 market towns, of which three are boroughs, one city, namely *Worceſter*, 152 pariſhes, about 540,000 acres, and 103,000 inhabitants.

This being an inland county, well cultivated, and free from lakes, marſhes, or ſtagnant waters, the air is very ſweet and wholeſome all over it. The ſoil in general is very rich, producing corn, fruit, eſpecially pears, of which they make a great deal of perry; hops and paſture. The hills are covered with ſheep, and the meadows with cattle. Hence they have wool, cloth, ſtuffs, butter, and cheeſe in abundance. They are alſo well ſupplied with fuel, either wood or coal, and ſalt from their brine pits and ſalt ſprings. Of the laſt they have not only enough for themſelves, but export large quantities by the Severn; which noble river, to the great convenience and emolument of the inhabitants, runs from north to ſouth through the very middle of the country, enriching the ſoil, and yielding it plenty of fiſh, and an eaſy expeditious conveyance of goods to and from it. The other rivers by which it is watered are the Stour, Avon, Teme, &c. It ſends nine members to parliament, viz. two for the county, two for the city of Worceſter, two for Droitwich, two for Eveſham, and one for Bewdley; and lies in the dioceſe of Worceſter, and Oxford circuit.

Word, Work.

WORD, in language, an articulate ſound deſigned to repreſent ſome idea or notion. See GRAMMAR and LANGUAGE. See alſo LOGIC, Part I. chap. 1.

WORD, or *Watch-Word*, in military affairs, is ſome peculiar word or ſentence, by which the ſoldiers know and diſtinguiſh one another in the night, &c. and by which ſpies and deſigning perſons are diſcovered. It is uſed alſo to prevent ſurpriſes. The word is given out in an army every night to the lieutenant, or major-general of the day, who gives it to the majors of the brigades, and they to the adjutants; who give it firſt to the field-officers, and afterwards to a ſergeant of each company, who carry it to the ſubalterns. In garriſons it is given after the gate is ſhut to the town major, who gives it to the adjutants, and they to the ſergeants.

WORDS of Command. See EXERCISE and MANUAL.

Signals by the Drum, made uſe of in exerciſing of the Army, inſtead of the WORD *of Command, viz.*

Signals by the Drum,	*Operations.*
A ſhort roll,	To caution.
A flam	To perform any diſtinct thing.
To arms,	To form the line or battalion.
The march,	To advance, except when intended for a ſalute.
The quick march,	To advance quick.
The point of war,	To march and charge.
The retreat,	To retreat.
Drum ceaſing,	To halt.
Two ſhort rolls,	To perform the flank firing.
The dragoon march,	To open the battalion.
The grenadier march,	To form the column.
The troop,	To double diviſions.
The long roll,	To form the ſquare.
The grenadier march,	To reduce the ſquare to the column.
The preparative,	To make ready and fire.
The general,	To ceaſe firing.
Two long rolls,	To bring or lodge the colours.

WORK, in the manege. To work a horſe, is to exerciſe him at pace, trot, or gallop, and ride him at the manege. To work a horſe upon volts, or head and haunches in or between two heels, is to paſſage him, or make him go ſidewiſe upon parallel lines.

To WORK, in ſea language, is to direct the movements of a ſhip, by adapting the ſails to the force and direction of the wind. See SEAMANSHIP.

WORK, *Carpenters, Clock, Crown, Field, Fire, Fret, Groteſque, Horn, Moſaic.* See the ſeveral articles, together with FORTIFICATION and PYROTECHNEY.

WORK-*Houſe*, a place where indigent, vagrant, and idle people, are ſet to work, and ſupplied with food and clothing.

Work-houſes are of two kinds, or at leaſt are employed for two different purpoſes. Some are uſed as priſons for vagrants, or ſturdy beggars, who are there confined, and compelled to labour for the benefit of the ſociety which maintains them; whilſt others, ſometimes called *poor-houſes*, are charitable aſylums for ſuch indigent perſons as through age or infirmity are unable to ſupport themſelves by their own labour. The former kind of work-houſe, when under proper management may be made to ſerve the beſt of purpoſes; of the latter we are acquainted with none which entirely commands our approbation.

To make confinement in a work-houſe operate to the correction of vagrants and diſorderly perſons (and if it produce not this effect it can hardly be conſidered as a beneficial inſtitution), the priſoners ſhould be ſhut up in ſeparate cells, and compelled to labour for their own ſubſiſtence. A crew of thieves and vagabonds aſſociating with each other is a hell upon earth, in which every individual is hardened in his crimes by the countenance and converſation of his companions; and wretches who, when at liberty, chooſe to beg or ſteal rather than to earn a comfortable livelihood by honeſt induſtry, will ſubmit to any puniſhment which a humane overſeer can inflict rather than work for the benefit of others. No puniſhment indeed will compel a vagrant to labour. He may aſſume the appearance of it, but he will make no progreſs; and the pretext of ſickneſs or weakneſs is ever at hand for an excuſe. Hence it is that thieves and ſtrumpets are too often diſmiſſed from work-houſes and bridewells ten times more the children of the devil than when they entered them.

To remedy theſe evils, we can think of no better method than to confine each priſoner in a cell by himſelf, and to furniſh him daily with ſuch an allowance of bread and water as may preſerve him from *immediate* death; for the only compulſion to make ſuch men work ſeriouſly is the fear of want, and the only way to reform them is to leave them to their own meditations on the conſequences of their paſt conduct. There are ſurely very few perſons, if any, whoſe averſion from labour would not be conquered by the pinchings of hunger and the certain proſpect of periſhing by famine; and it is to be hoped that there are not many ſo totally diveſted of every latent principle of virtue as not to be brought by ſuch ſolitude to a due ſenſe of their former wickedneſs. Should one or two, however, be occaſionally found ſo very obdurate as to ſuffer themſelves to periſh rather than work, their deaths would prove a ſalutary beacon to others, and their blood would be on their own heads; for we have the expreſs command of St Paul himſelf, that "if any will not work, neither ſhould he eat."

No doubt it would be proper that the meditations of vagabonds confined in a work-houſe ſhould be directed by the private admonitions of a pious and intelligent clergyman; but it is not every clergyman who is qualified to diſcharge ſuch a duty. If he be actuated by a zeal not according to knowledge, or if he have not with equal care ſtudied human nature and the word of God, his admonitions will be more likely to provoke the profane ridicule of his auditor, and harden him in his wickedneſs, than to excite in his breaſt ſuch ſorrow for his ſins as ſhall "bring forth fruits meet for repentance." To render the inſtruction of thieves and vagrants of any uſe, it muſt be accurately adapted to the caſe of each individual; and however excellent it may be in itſelf, it will not be liſtened to unleſs offered at ſeaſons of uncommon ſeriouſneſs, which the inſtructor ſhould therefore carefully obſerve.

That ſuch wholeſome ſeverity as this would often reform the inhabitants of work-houſes, appears extremely probable from the effects of a ſimilar treatment of common proſtitutes mentioned by Lord Kames in his Sketches of the Hiſtory of Man: "A number of thoſe wretches were in Edinburgh confined in a houſe of correction, on a daily allowance of threepence, of which part was embezzled by the ſervants of the houſe. Pinching hunger did not reform their manners; for being abſolutely idle, they encouraged each other in vice, waiting impatiently for the hour of deliverance. Mr Stirling the ſuperintendant, with the conſent of the magiſtrates, removed them to a clean houſe; and inſtead of money, appointed for each a pound of oat-meal daily, with ſalt, water, and fire for cooking. Relieved now from diſtreſs, they longed for comfort. What would they not give for milk or ale? Work (ſays he) will procure you plenty. To ſome who offered to ſpin, he gave flax and wheels, engaging to pay them half the price of their yarn, retaining the other half for the materials furniſhed. The ſpinners earned about ninepence weekly; a comfortable addition to what they had before. The reſt undertook to ſpin, one after another; and before the end of the firſt quarter they were all of them intent upon work. It was a branch of his plan to ſet free ſuch as merited that favour; and ſome of them appeared to be ſo thoroughly reformed as to be in no danger of a relapſe."

Work-houſes erected as charitable aſylums appear to us, in every view that we can take of them, as inſtitutions which can ſerve no good purpoſe. Economy is the great motive which inclines people to this mode of providing for the poor. There is comparatively but a very ſmall number of mankind in any country ſo aged and infirm as not to be able to contribute, in ſome degree, to their ſubſiſtence by their own labour; and in ſuch houſes it is thought that proper work may be provided for them, ſo that the public ſhall have nothing to give in charity but what the poor are abſolutely unable to procure for themſelves. It is imagined likewiſe, that numbers collected at a common table, can be maintained at leſs expence than in ſeparate houſes; and foot ſoldiers are given for an example, who could not live on their pay if they did not meſs together. But the caſes are not parallel. "Soldiers having the management of their pay, can club for a bit of meat; but as the inhabitants of a poor-houſe are maintained by the public, the ſame quantity of proviſions muſt be allotted to each. The conſequence is what might be expected: the bulk of them reſerve part of their victuals for purchaſing ale or ſpirits. It is vain to expect work from them: poor wretches void of ſhame will never work ſeriouſly, where the profit accrues to the public, not to themſelves. Hunger is the only effectual means for compelling ſuch perſons to work.*"

The poor, therefore, ſhould be ſupported in their own houſes; and to ſupport them properly, the firſt thing to be done is, to eſtimate what each can earn by his own labour; for as far only as that falls ſhort of maintenance is there room for charity. In repairing thoſe evils which ſociety did not or could not prevent, it ought to be careful not to counteract the wiſe purpoſes of nature, nor to do more than to give the poor a fair chance to work for themſelves. The preſent diſtreſs muſt be relieved, the ſick and the aged provided for; but the children muſt be inſtructed; and labour, not alms, offered to thoſe who have ſome ability to work, however ſmall that ability may be. They will be as induſtrious as poſſible, becauſe they work for themſelves; and a weekly ſum of charity under their own management will turn to better account than in a poor-houſe under the direction of mercenaries. Not a penny of it will be laid out on fermented liquors, unleſs perhaps as a medicine in ſickneſs. Nor does ſuch low fare call for pity to thoſe who can afford no better. Ale makes no part of the maintenance of thoſe, who, in many parts of

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* Kames's Sketches.

Scotland, live by the ſweat of their brows; and yet the perſon who ſhould baniſh all from a charity work-houſe, would be exclaimed againſt as hard-hearted, and even void of humanity.

That ſuch a mode of ſupporting the poor in their own houſes is practicable, will hardly admit of a diſpute; for it has been actually put in practice in the city of Hamburgh ever ſince the year 1788. At that period ſuch revenues as had till then been expended in alms by the ſeveral church-wardens, and thoſe of which the adminiſtration had been connected with the work-houſe, were united under one adminiſtration with ſuch ſums as were collected from private benevolence. The city was divided into ſixty diſtricts, containing each an equal number of poor; and over theſe 180 overſeers were appointed. Actual relief was the firſt object; but at the very moment that this proviſion was ſecured, meaſures were taken to prevent any man from receiving a ſhilling which he could have been able to earn for himſelf. By methods, which our limits will not permit us to ſtate, the overſeers were able to make a calculation tolerably exact of what each pauper wanted for bare ſubſiſtence, in addition to the fruits of his own labour. A flax-yarn-ſpinning manufacture was eſtabliſhed, in which the yarn is paid for, not by its weight, but by its meaſure. The clean flax is ſold to the poor at a low price, and a certain meaſure of yarn again bought from them at 30 *per cent.* above the uſual price; ſo that the overſeers are ſure that all the yarn ſpun by the poor will be brought into their office. Every pauper brings with him a book in which the quantity delivered is carefully noted down, which furniſhes the overſeers with a continual average of the ſtate of induſtry among their poor.

As ſoon as this inſtitution was eſtabliſhed, the overſeers went through their diſtricts, and aſked, in all ſuch manſions as could be ſuppoſed to harbour want, if the inhabitants ſtood in need of ſupport? The queſtion to all ſuch poor as wiſhed for relief, and were able to ſpin, was, Whether they did earn by their work 1s. 6d. a week? for experience had taught the inhabitants of Hamburg, that many poor live upon the ſum; and they knew enough of their poor to ſuppoſe, that 1s. 6d. avowed earning was equal to ſomething more. If the anſwer was affirmative, the pauper ſtood not in need of weekly aſſiſtance. If it was negative, work was given him, which, by being paid 30 *per cent.* above its value, afforded him 1s. 6d. a-week eaſily, if he was even an indifferent hand. The far more frequent caſes were partial inability by age, or weakneſs, or want of ſkill. For poor of the latter deſcription a ſchool was opened, and in three months time the buſineſs was eaſily learnt. During that time, the pauper got firſt 2s. a-week, and every week afterwards 2 d. leſs, till in the twelfth week he got nothing at all but his earnings, and was diſmiſſed, with a wheel and a pound of flax *gratis*.

The quantity of work which diſabled poor were capable of doing in a week was eaſily and accurately aſcertained by a week's trial in the ſpinning-ſchool. The reſult was produced weekly before appointed members of the committee; and the ſum which the poor could earn was noted down in their ſmall books. The overſeer was directed to pay them weekly what their earnings fell ſhort of 1s. 6d, in every ſuch week, when it appeared from their books that they had earned to the known extent of their abilities. From that moment applications became leſs frequent; and the committee had an infallible ſtandard for diſtinguiſhing real want: for whenever the pauper, if in health (if not, he was peculiarly provided for), had not earned what he could, then he had either been lazy, or had found more lucrative work: in either caſe, he was not entitled to relief for that week, whatever he might be for the following.

This mode of providing for the poor, which attracted the notice and obtained the eulogium of the miniſter in the Britiſh houſe of commons, has for ſix years been in Hamburgh attended with the happieſt conſequences. In the ſtreets of that city a beggar is rarely to be ſeen, whilſt thoſe, who ſtand in need of the charitable contributions of the rich, are much more comfortably, as well as at much leſs expence, maintained at home, with their children about them, than they could be in work-houſes, under the management of mercenary overſeers. For a fuller account of this judicious inſtitution, we muſt refer the reader to Vought's *Account of the Management of the Poor in Hamburgh, ſince the year* 1788, *in a letter to ſome friends of the poor in Gr. Britain.*

WATERWORKS. Under this name may be comprehended almoſt every hydraulic ſtructure or contrivance; ſuch as, canals, conduits, locks, mills, water-engines, &c. But they may be conveniently arranged under two general heads, 1*ſt*, Works which have for their object the conducting, raiſing, or otherwiſe managing, of water; and, 2*dly*. Works which derive their efficacy from the impulſe or other action of water. The *firſt* claſs comprehends the methods of ſimply conducting water in aqueducts or in pipes for the ſupply of domeſtic conſumption or the working of machinery: It comprehends alſo the methods of procuring the ſupplies neceſſary for theſe purpoſes, by means of pumps, water, or fire engines. It alſo comprehends the ſubſequent management of the water thus conducted, whether in order to make the proper diſtribution of it according to the demand, or to employ it for the purpoſe of navigation, by lockage, or other contrivances—And in the proſecution of theſe things many ſubordinate problems will occur, in which practice will derive great advantages from a ſcientific acquaintance with the ſubject. The *ſecond* claſs of water-works is of much greater variety, comprehending almoſt every kind of hydraulic machine: and would of itſelf fill volumes. Many of theſe have already occurred in various articles of this Dictionary. In deſcribing or treating them, we have tacitly referred the diſcuſſion of their general principles, in which they all reſemble each other, to ſome article where they could be taken in a connected body, ſuſceptible of general ſcientific diſcuſſion, independent of the circumſtances which of neceſſity introduced the particular modifications required by the uſes to which the ſtructures were to be applied. That part of the preſent article, therefore, which embraces theſe common principles, will chiefly relate to the theory of water-mills, or rather of water-wheels; becauſe, when the neceſſary motion is given to the axis of the water-wheel, this may be ſet to the performance of any taſk whatever.

CLASS I.

1. *Of the conducting of Water.*

THIS is undoubtedly a buſineſs of great importance, and makes a principal part of the practice of the civil engineer: It is alſo a buſineſs ſo imperfectly underſtood, that we believe that very few engineers can venture to ſay, with tolerable preciſion, what will be the quantity of water which his work will convey, or what plan and dimenſions of conduit will convey the quantity which may be propoſed. For proof of this we ſhall only refer our readers to the facts mentioned in the article RIVERS, n° 27, &c.

In that article we have given a ſort of hiſtory of the progreſs of our knowledge in hydraulics, a branch of mechanical philoſophy which ſeems to have been entirely unknown to the ancients. Even Archimedes, the author of almoſt all that we know in hydroſtatics, ſeems to have been entirely ignorant of any principles by which he could determine the motion of water. The mechanical ſcience of the ancients ſeems to have reached no farther than the doctrine of equilibrium among bodies at reſt. Guglielmini firſt ventured to conſider the motion of water in open canals and in rivers. Its motion in pipes had been partially conſidered in detached ſcraps by others, but not ſo as to make a body of doctrine. Sir Iſaac Newton firſt endeavoured to render hydraulics ſuſceptible of mathematical demonſtration: But his fundamental propoſition has not yet been freed from very ſerious objections; nor have the attempts of his ſucceſſors, ſuch as the Bernoullis, Euler, D'Alembert, and others, been much more ſucceſsful: ſo that hydraulics may ſtill be conſidered as very imperfect, and the general concluſions which we are accuſtomed to receive as fundamental propoſitions are not much better than matters of obſervation, little ſupported by principle, and therefore requiring the moſt ſcrupulous caution in the application of them to any hitherto untried caſe. When experiments are multiplied ſo as to include as great a variety of caſes as poſſible; and when theſe are cleared of extraneous circumſtances, and properly arranged, we muſt receive the concluſions drawn from them as the general laws of hydraulics. The experiments of the Abbé Boſſut, narrated in his *Hydrodynamique*, are of the greateſt value, having been made in the caſes of moſt general frequency, and being made with great care. The greateſt ſervice, however, has been done by the chevalier Buat, who ſaw the folly of attempting to deduce an accurate theory from any principles that we have as yet learned, and the neceſſity of adhering to ſuch a theory as could be deduced from experiment alone, independent of any more general principles. Such a theory muſt be a juſt one, if the experiments are really general, unaffected by the particular circumſtances of the caſe, and if the claſſes of experiment are ſufficiently comprehenſive to include all the caſes which occur in the moſt important practical queſtions. Some principle was neceſſary, however, for connecting theſe experiments. The ſufficiency of this principle was not eaſily aſcertained. M. Buat's way of eſtabliſhing this was judicious. If the principle is ill-founded, the reſults of its combination in caſes of actual experiments muſt be irregular; but if experiments, ſeemingly very unlike, and in a vaſt variety of diſſimilar caſes, give a train of reſults which is extremely regular and conſiſtent, we may preſume that the principle, which in this manner harmonizes and reconciles things ſo unlike, is founded in the nature of things; and if this principle be ſuch as is agreeable to our cleareſt notions of the internal mechaniſm of the motions of fluids, our preſumption approaches to conviction.

Proceeding in this way, the chevalier Buat has collected a prodigious number of facts, comprehending almoſt every caſe of the motion of fluids. He firſt claſſed them according to their reſemblance in ſome one particular, and obſerved the differences which accompanied their differences in other circumſtances; and by conſidering what could produce theſe differences, he obtained general rules, deduced from fact, by which theſe differences could be made to fall into a regular ſeries. He then arranged all the experiments under ſome other circumſtance of reſemblance, and purſued the ſame method; and by following this out, he has produced a general propoſition, which applies to the whole of this numerous liſt of experiments with a preciſion far exceeding our utmoſt hopes. This propoſition is contained in n° 59. of the article RIVERS, and is there offered as one of the moſt valuable reſults of modern ſcience.

We muſt, however, obſerve, that of this liſt of experiments there is a very large claſs, which is not direct, but requires a good deal of reflection to enable us to draw a confident concluſion; and this is in caſes which are very frequent and important, *viz.* where the declivity is exceedingly ſmall, as in open canals and rivers. The experiments were of the following forms: Two large ciſterns were made to communicate with each other by means of a pipe. The ſurfaces of the water in theſe ciſterns were made to differ only by a ſmall fraction of an inch: and it is ſuppoſed that the motion in the communicating pipe will be the ſame as in a very long pipe, or an open canal, having this very minute declivity. We have no difficulty in admitting the concluſion; but we have ſeen it conteſted, and it is by no means intuitive. We had hopes that ere now this important caſe would have been determined by direct experiments, which the writer of this article was commiſſioned to make by the Board for Encouraging Improvements and Manufactures in Scotland: But this has been prevented hitherto by his want of health; and we cannot expect that it will be accompliſhed before the cloſe of this Work. This, however, need not occaſion any heſitation in the adoption of M. Buat's general propoſition, becauſe the experiments which we are now criticiſing fall in preciſely with the general train of the reſt, and ſhow no *general* deviation which would indicate a fallacy in principle.

We apprehend it to be quite unneceſſary to add much to what has been already delivered on the motion of waters in an open canal. Their *general progreſſive* motion, and conſequently the quantity delivered by an aqueduct of any ſlope and dimenſion, are ſufficiently determined; and all that is wanted is the tables which we promiſed in n° 65. of the article RIVERS, by which any perſon who underſtands common arithmetic may, in five minutes time or leſs, compute the quantity of water which will be delivered by the aqueduct, canal, conduit, or pipe; for the theorem in n° 59. of this article applies to them all without diſtinction. We therefore take this opportunity of inſerting theſe tables, which have been computed on purpoſe for this Work with great labour.

Table I. *Logarithms of the Values of the Numerator of the Fraction* $\frac{307(\sqrt{d}-0{,}1)}{\sqrt{s}-1.\sqrt{s+1{,}6}}$ *for every Value of the Hydraulic mean Depth* d: *Also the Values of* $0.3\,(\sqrt{d}-0{,}1)$.

d.	Log. of $307(\sqrt{d}-0{,}1)$	$0{,}3 \times (\sqrt{d}-0{,}1)$	d.	Log. of $307(\sqrt{d}-0{,}1)$	$0{,}3 \times (\sqrt{d}-0{,}1)$	d.	Log. of $307(\sqrt{d}-0{,}1)$	$0{,}3 \times (\sqrt{d}-0{,}1)$	d.	Log. of $307(\sqrt{d}-0{,}1)$	$0{,}3 \times (\sqrt{d}-0{,}1)$
0,1	1.82208	0,06	4,9	2.81216	0,63	9,7	2.96634	0,9	54	3.34738	2,17
0,2	2.02786	0,1	5,0	2.81674	0,63	9,8	2.96865	0,91	55	3.35143	2,19
0,3	2.13753	0,13	5,1	2.82125	0,65	9,9	2.97093	0,91	56	3.35539	2,21
0,4	2.21343	0,16	5,2	2.82567	0,65	10,	2.97319	0,92	57	3.35928	2,23
0,5	2.27040	0,18	5,3	2.83000	0,66	11	2 99454	0,97	58	3.36312	2,25
0,6	2.31618	0,2	5,4	2.83222	0,67	12	3.01401	1,01	59	3.36687	2,27
0,7	2.35441	0,22	5,5	2.83840	0,67	13	3 03189	1,05	60	3.37057	2,3
0,8	2.38719	0,24	5,6	2.84248	0,68	14	3.04843	1,09	61	3.37421	2,31
0,9	2.41588	0,25	5,7	2.84648	0,68	15	3.06383	1,13	62	3,37778	2,33
1,0	2.44138	0,27	5,8	2.85043	0,69	16	3.07820	1,17	63	3.38130	2,35
1,1	2.46431	0,28	5,9	2.85431	0,69	17	3.09170	1,21	64	3.38477	2,37
1,2	2.48518	0,3	6,0	2.85812	0,7	18	3.10441	1,24	65	3.38817	2,39
1,3	2.50426	0,31	6,1	2 86185	0,7	19	3.11644	1,28	66	3.39158	2,41
1,4	2.52185	0,32	6,2	2.86554	0,71	20	3.12783	1,31	67	3.39483	2,42
1,5	2.53818	0,34	6,3	2.86916	0,72	21	3.13867	1,34	68	3.39809	2,44
1,6	2.55345	0,35	6,4	2.87271	0,73	22	3.14899	1,38	69	3.40130	2,46
1,7	2.56769	0,36	6,5	2.87622	0,73	23	3.15885	1,41	70	3.40446	2,48
1,8	2.58112	0,37	6,6	2.87966	0,74	24	3.16828	1,44	71	3.40758	2,49
1,9	2.59381	0,38	6,7	2.88306	0,75	25	3.17734	1,47	72	3.41065	2,51
2,0	2.60580	0,39	6,8	2.88641	0,75	26	3.18601	1,5	73	3.41369	2,53
2,1	2.61713	0,4	6,9	2.88971	0,76	27	3.19438	1,53	74	3.41667	2,55
2,2	2.62803	0,41	7,0	2.89296	0,76	28	3.20243	1,56	75	3.41962	2,57
2,3	2.63839	0,42	7,1	2.89614	0,77	29	3.21020	1,58	76	3.42253	2,58
2,4	2.64827	0,44	7,2	2.89930	0,77	30	3.21770	1,61	77	3.42540	2,60
2,5	2.65772	0,45	7,3	2.90241	0,78	31	3.22495	1,64	78	3.42823	2,62
2,6	2.66681	0,45	7,4	2.90549	0,78	32	3.23196	1,67	79	3.43103	2,63
2,7	2.67556	0,46	7,5	2.90851	0,79	33	3 23877	1,69	80	3.43380	2,65
2,8	2.68395	0,47	7,6	2.91150	0,79	34	3.24537	1,72	81	3.43653	2,67
2,9	2.69207	0,48	7,7	2.91445	0,8	35	3.25176	1,74	82	3.43923	2,69
3,0	2.69989	0,49	7,8	2.91734	0,8	36	3.25799	1,77	83	3.44189	2,7
3,1	2.70743	0,5	7,9	2.92022	0,81	37	3.26404	1,79	84	3.44452	2,72
3,2	2.71472	0,51	8,0	2.92305	0,82	38	3.26993	1,82	85	3.44712	2,74
3,3	2.72181	0,52	8,1	2.92584	0,82	39	3.27566	1,84	86	3.44968	2,75
3,4	2.72866	0,53	8,2	2.92860	0,83	40	3.28125	1,87	87	3.45222	2,77
3,5	2.73531	0,53	8,3	2.93133	0,83	41	3.28669	1,89	88	3.45473	2,78
3,6	2.74178	0,54	8,4	2.93403	0,84	42	3.29201	1,91	89	3.45721	2,79
3,7	2.74805	0,55	8,5	2.93670	0,84	43	3.29720	1,93	90	3.45965	2,81
3,8	2.75417	0,56	8,6	2.93933	0,85	44	3.30227	1,95	91	3.46208	2,83
3,9	2.76009	0,56	8,7	2.94192	0,85	45	3.30722	1,98	92	3.46448	2,85
4,0	2.76589	0,57	8,8	2.94449	0,86	46	3.31207	2,00	93	3.46685	2,86
4,1	2.77153	0,58	8,9	2.94703	0,86	47	3.31681	2,03	94	3.46920	2,88
4,2	2.77704	0,59	9,0	2.94954	0,87	48	3 32145	2,05	95	3.47152	2,89
4,3	2.78240	0,59	9,1	2.95202	0,87	49	3.32599	2,07	96	3 47381	2,91
4,4	2.78765	0,6	9,2	2.65447	0,88	50	3.33043	2,09	97	3.47608	2,93
4,5	2.79277	0,6	9,3	2.95690	0,88	51	3.33480	2,11	98	3.47833	2,94
4,6	2.79779	0,61	9,4	2.95930	0,89	52	3.33908	2,13	99	3.48056	2,95
4,7	2.80269	0,62	9,5	2.96167	0,89	53	3.34327	2,15	100	3.48277	2,97
4,8	2.80747	0,63	9,6	2.96402	0.9						

TABLE II. *Logarithms of the Values of the Denominator of the Fraction* $\frac{307(\sqrt{d}-0,1)}{\sqrt{s}-L\sqrt{s+1,6}}$ *for every Value of the Slope s.*

s.	Log of $\sqrt{s}-L\sqrt{s+1,6}$	s.	Log. of $\sqrt{s}-L\sqrt{s+1,6}$	s.	Log. of $\sqrt{s}-L\sqrt{s+1,6}$	s.	Log. of $\sqrt{s}-L\sqrt{s+1,6}$	s.	Log. of $\sqrt{s}-L\sqrt{s+1,6}$	s.	Log. of $\sqrt{s}-L\sqrt{s+1,6}$
1,0	9.71784	7,3	0.20651	45	0.67997	170	1.01983	800	1.39690	5200	1.83142
1,1	9.74210	7,4	0.20997	46	0.68574	180	1.03410	810	1.39985	5300	1.83575
1,2	9.76388	7,5	0.21336	47	0.69135	190	1.04751	820	1.40277	5400	1.84002
1,3	9.78376	7,6	0.21674	48	0.69688	200	1.06026	830	1.40564	5500	1.84421
1,4	9.80202	7,7	0.22109	49	0.70226	210	1.07237	840	1.40678	5600	1.84833
1,5	9.81882	7,8	0.22335	50	0.70749	220	1.08390	850	1.41128	5700	1.85237
1,6	9.83461	7,9	0.22663	51	0.71265	230	1.09489	860	1.41408	5800	1.85634
1,7	9.84930	8,0	0.22982	52	0.71767	240	1.10542	870	1.41683	5900	1.86022
1,8	9.86314	8,1	0.23297	53	0.72263	250	1.11553	880	1.41953	6000	1.86404
1,9	9.87622	8,2	0.23611	54	0.72746	260	1.12523	890	1.42220	6100	1.86778
2,0	9.88857	8,3	0.23923	55	0.73223	270	1.13453	900	1.42487	6200	1.87146
2,1	9.90031	8,4	0.24229	56	0.73695	280	1.14345	910	1.42746	6300	1.87507
2,2	9.91153	8,5	0.24532	57	0.74155	290	1.15204	920	1.43005	6400	1.87863
2,3	9.92267	8,6	0.24832	58	0.74601	300	1.16035	930	1.43263	6500	1.88213
2,4	9.93247	8,7	0.25128	59	0.75043	310	1.16838	940	1.43515	6600	1.88558
2,5	9.94231	8,8	0.25422	60	0.75481	320	1.17612	950	1.43464	6700	1.88898
2,6	9.95173	8,9	0.25709	61	0.75906	330	1.18363	960	1.44011	6800	1.89233
2,7	9.96085	9,0	0.25995	62	0.76328	340	1.19092	970	1.44254	6900	1.89564
2,8	9.96942	9,1	0.26281	63	0.76745	350	1.19803	980	1.44498	7000	1.89891
2,9	9.97818	9,2	0.26560	64	0.77151	360	1.20490	990	1.44737	7100	1.90214
3,0	9.98632	9,3	0.26839	65	0.78276	370	1.21158	1000	1.44976	7200	1.90532
3,1	9.99427	9,4	0.27116	66	0.77945	380	1.21806	—		7300	1.90845
3,2	0.00200	9,5	0.27387	67	0.78333	390	1.22435	1100	1.47223	7400	1.91154
3,3	0.00945	9,6	0.27656	68	0.78718	400	1.23048	1200	1,49269	7500	1.91458
3,4	0.01669	9,7	0.27921	69	0.79092	410	1.23647	1300	1.51148	7600	1.91757
3,5	0.02373	9,8	0.28186	70	0.79463	420	1.24232	1400	1.52885	7700	1.92052
3,6	0.03064	9,9	0.28450	71	0.79824	430	1.24805	1500	1.54497	7800	1.92344
3,7	0.03733	10	0.28709	72	0.80182	440	1.25360	1600	1.56014	7900	1.92632
3,8	0.04383	—		73	0.80536	450	1.25903	1700	1.57416	8000	1.92916
3,9	0.05015	11	0.31170	74	0.80882	460	1.26433	1800	1.58747	8100	1.93197
4,0	0.05638	12	0.33425	75	0.81231	470	1.26951	1900	1.60004	8200	1.93475
4,1	0.06245	13	0.35488	76	0.81571	480	1.27461	2000	1.61195	8300	1.93749
4,2	0.06839	14	0.37420	77	0.81908	490	1.27957	2100	1.62325	8400	1.94020
4,3	0.07412	15	0.39235	78	0.82236	500	1.28445	2200	1.63403	8500	1.94287
4,4	0.07898	16	0.40926	79	0.82562	510	1.28923	2300	1.64432	8600	1.94551
4,5	0.08533	17	0.42521	80	0.82885	520	1.29391	2400	1.65414	8700	1.94811
4,6	0.09081	18	0.44028	81	0.83206	530	1.29851	2500	1.66358	8800	1.95069
4,7	0.09615	19	0.45439	82	0.83525	540	1.30300	2600	1.67261	8900	1.95324
4,8	0.10131	20	0.46776	83	0.83835	550	1.30740	2700	1.68133	9000	1.95576
4,9	0.10644	21	0.48044	84	0.84142	560	1.31172	2800	1.68971	9100	1.95826
5,0	0.11147	22	0.49262	85	0.84442	570	1.31597	2900	1.69780	9200	1.96073
5,1	0.11635	23	0.50433	86	0.84739	580	1.32015	3000	1.70558	9300	1.96317
5,2	0.12108	24	0.51548	87	0.85034	590	1.32426	3100	1.71313	9400	1.96559
5,3	0.12595	25	0.52621	88	0.85327	600	1.32830	3200	1.72042	9500	1.96797
5,4	0.13061	26	0.53656	89	0.85618	610	1.33226	3300	1.72750	9600	1.97033
5,5	0.13519	27	0.54654	90	0.85908	620	1.33614	3400	1.73435	9700	1.97267
5,6	0.13970	28	0.55606	91	0.86189	630	1.33997	3500	1.74099	9800	1.97497
5,7	0.14410	29	0.56526	92	0.86463	640	1.34373	3600	1.74746	9900	1.97726
5,8	0.14844	30	0.57415	93	0.86741	650	1.34743	3700	1.75373	10000	1.97952
5,9	0.15274	31	0.58263	94	0.87017	660	1.35108	3800	1.75984	11000	2.00099
6,0	0.15697	32	0.59095	95	0.87286	670	1.35468	3900	1.76578	12000	2.02056
6,1	0.16113	33	0.59901	96	0.87552	680	1.35823	4000	1.77159	13000	2.03855
6,2	0.16522	34	0.60692	97	0.87818	690	1.36170	4100	1.77725	14000	2.05518
6,3	0.16927	35	0.61448	98	0.88076	700	1.36513	4200	1.78277	15000	2.07065
6,4	0.17322	36	0.62180	99	0.88338	710	1.36851	4300	1.78814	16000	2.08512
6,5	0.17713	37	0.62900	100	0.88593	720	1.37185	4400	1.79339	17000	2.09869
6,6	0.18099	38	0.63599	—		730	1.37513	4500	1.79851	18000	2.11148
6,7	0.18477	39	0.64276	110	0.91014	740	1.37839	4600	1.80352	19000	2.12357
6,8	0.18854	40	0.64933	120	0.93212	750	1.38157	4700	1.80875	20000	2.13503
6,9	0.19229	41	0.65571	130	0.95236	760	1.38471	4800	1.81321	21000	2.14594
7,0	0.19584	42	0.66200	140	0.97109	770	1.38782	4900	1.81790	22000	2.15633
7,1	0.19886	43	0.66811	150	0.98843	780	1.39089	5000	1.82249	23000	2.16624
7,2	0.20298	44	0.67413	160	0.00466	790	1.39391	5100	1.82699	24000	2.17573

Table I. conſiſts of three columns.—*Column* 1. entitled *d*, contains the hydraulic mean depths of any conduit in inches. This is ſet down for every 10th of an inch in the firſt 10 inches, that the anſwers may be more accurately obtained for pipes, the mean depth of which ſeldom exceeds three or four inches. The column is continued to 100 inches, which is fully equal to the hydraulic mean depth of any canal.

Column 2. contains the logarithms of the values of $\sqrt{d}-0{,}1$, multiplied by 307; that is, the logarithm of the numerator of the fraction $\frac{307(\sqrt{d}-0{,}1)}{\sqrt{s}-\mathrm{L}\sqrt{s+1{,}6}}$ in n° 65. of the article Rivers.

Column 3. contains the products of the values of $\sqrt{d}-0{,}1$ multiplied by 0,3.

Table II. conſiſts of two columns.—*Column* 1. entitled *s*, contains the denominator of the fraction expreſſing the ſlope or declivity of any pipe or canal; that is, the quotient of its length divided by the elevation of one extremity above the other. Thus, if a canal of one mile in length be three feet higher at one end than the other, then *s* is $\frac{5280}{3}$, = 1760.

Column 2. contains the logarithms of the denominators of the above mentioned fraction, or of the different values of the quantity $\sqrt{s-\mathrm{L}\sqrt{s+1{,}6}}$

Theſe quantities were computed true to the third decimal place. Notwithſtanding this, the laſt figure in about a dozen of the firſt logarithms of each table is not abſolutely certain to the neareſt unit. But this cannot produce an error of 1 in 100,000.

Examples of the Uſe of theſe Tables.

Example 1. Water is brought into the city of Edinburgh in ſeveral mains. One of theſe is a pipe of five inches diameter. The length of the pipe is 14,637 feet; and the reſervoir at Comiſton is 44 feet higher than the reſervoir into which it delivers the water on the Caſtle Hill. *Query*, The number of Scotch pints which this pipe ſhould deliver in a minute?

1. We have $d=\frac{5}{4}=1{,}25$ inches. The logarithm correſponding to this *d*, being nearly the mean between the logarithms correſponding to 1,2 and 1,3, is 2.49472.

2. We have $s=\frac{14637}{44}$, or 332,7. The logarithm correſponding to this in Table II. is had by taking proportional parts for the difference between the logarithms for $s=330$ and $s=340$, and is 1.18533.

3. From 2.49472
Take 1.18533
Remains 1.30939, the logarithm of 20,385 inches.

4. In column 3. of Table I. oppoſite to $d=1{,}2$ and $a=1{,}3$ are 0,3 and 0,31, of which the mean is 0,305 inches, the correction for viſcidity.

5. Therefore the velocity in inches *per* ſecond is 20,385 — 0,305, or 20,08.

6. To obtain the Scotch pints *per* minute (each containing 103,4 cubic inches), multiply the velocity by 60, and this product by 5^2, and this by 0,7854 (the area of a circle whoſe diameter is 1), and divide by 103,4. Or, by logarithms,

Add the log. of 20,08	1,30276
log. of 60″ - -	1.77815
log. of 5^2 or 25 - -	1·39794
log. of 0,7854 -	9·89509
Carry over	4·37394
Brought over	4·37394
Subtract the log. of 103,4 -	2.01451
Remains the log. of 228,8 pints -	2·35943

Example 2. The canal mentioned in the article Rivers, n° 63. was 18 feet broad at the ſurface, and 7 feet at the bottom. It was 4 feet deep, and had a declivity of 4 inches in a mile. *Query*, The mean velocity?

1. The ſlant ſide of the canal correſponding to 4 feet deep and $5\frac{1}{2}$ projection, is 6,8 feet; therefore the border touched by the water is $6{,}8+7+6{,}8=20{,}6$. The area is $4\times\frac{18+7}{2}$, = 50 ſquare feet. Therefore $d=\frac{50}{20{,}6}$, = 2,427 feet, or 29,124 inches. The logarithm correſponding to this in Table I. is 3.21113, and the correction for viſcidity from the third column of the ſame Table is 1,58.

2. The ſlope is one-third of a foot in a mile, or one foot in three miles. Therefore *s* is 15,840. The logarithm correſponding to this is 2.08280.

3. From 3.21113
Subtract 2.08280
Remains 1.12833 = log. of 13,438 inches.
Subtract for viſcidity - 1.58
Velocity *per* ſecond - 11,858

This velocity is conſiderably ſmaller than what was obſerved by Mr Watt. And indeed we obſerve, that in the very ſmall declivities of rivers and canals, the formula is a little different. We have made ſeveral compariſons with a formula which is eſſentially the ſame with Buat's, and comes nearer in theſe caſes. Inſtead of taking the hyperbolic logarithm of $\sqrt{s+1{,}6}$, multiply its common logarithm by $2\frac{1}{4}$, or multiply it by 9, and divide the product by 4; and this proceſs is vaſtly eaſier than taking the hyperbolic logarithm.

We have not, however, preſumed to calculate tables on the authority of our own obſervations, thinking too reſpectfully of this gentleman's labours and obſervations. But this ſubject will, ere long, be fully eſtabliſhed on a ſeries of obſervations on canals of various dimenſions and declivities, made by ſeveral eminent engineers during the execution of them. Fortunately Mr Buat's formula is chiefly founded on obſervations on ſmall canals; and is therefore moſt accurate in ſuch works where it is moſt neceſſary, viz. in mill courſes, and other derivations for working machinery.

We now proceed to take notice of a few circumſtances which deſerve attention, in the conſtruction of canals, in addition to thoſe delivered in the article Rivers.

When a canal or aqueduct is brought off from a baſon or larger ſtream, it ought always to be widened at the entry, if it is intended for drawing off a continued ſtream of water: For ſuch a canal has a ſlope, without which it can have no current. Suppoſe it filled to a dead level to the farther end. Take away the bar, and the water immediately begins to flow off at that end. But it is ſome time before any motion is perceived at the head of the canal, during all which time the motion of the water is augmenting in every part of the canal; conſequently the ſlope is increaſing in every part, this being the ſole cauſe of its ſtream. When the water at the entry *begins* to move, the ſlope is ſcarcely ſenſible there; but it ſenſibly ſteepens every moment with the increaſe of velocity, which at laſt attains its maximum relative to the ſlope and dimenſions of the whole canal; and this regulates the depth of water in every point down the ſtream. When all has attained a ſtate of permanency, the ſlope at the entry *remains* much greater than in any other part of the canal: for this ſlope muſt be ſuch as will produce a velocity ſufficient for ſupplying its TRAIN.

And it muſt be remembered, that the velocity which muſt be produced greatly exceeds the mean velocity correſponding to the train of the canal. Suppoſe that this is 25 inches. There muſt be a velocity of 30 inches at the ſurface, as appears by the Table in the article RIVERS, n° 80. This muſt be produced by a real fall at the entry.

In every other part the ſlope is ſufficient, if it merely ſerves to give the water (already in motion) force enough for overcoming the friction and other reſiſtances. But at the entry the water is ſtagnant, if in a baſon, or it is moving paſt laterally, if the aqueduct is derived from a river; and, having no velocity whatever in the direction of the canal, it muſt derive it from its ſlope. The water therefore which has acquired a permanent form in ſuch an aqueduct, muſt neceſſarily take that form which exactly performs the offices requiſite in its different portions. The ſurface remains horizontal in the baſon, as at KC (fig. 1.), till it comes near the entry of the canal A B, and there it acquires the form of an undulated curve CDE; and then the ſurface acquires an uniform ſlope EF, in the lower part of the canal, where the water is in train.

Plate DXLI.

If this is a drain, the diſcharge is much leſs than might be produced by the ſame bed if this ſudden ſlope could be avoided. If it is to be navigated, having only a very gentle ſlope in its whole length, this ſudden ſlope is a very great imperfection, both by diminiſhing the depth of water, which might otherwiſe be obtained along the canal, and by rendering the paſſage of boats into the baſon very difficult, and the coming out very hazardous.

All this may be avoided, and the velocity at the entry may be kept equal to that which forms the train of the canal, by the ſimple proceſs of enlarging the entry. Suppoſe that the water could accelerate along the ſlopes of the canal, as a heavy body would do on a finely poliſhed plane. If we now make the width of the entry in its different parts inverſely proportional to the fictitious velocities in thoſe parts, it is plain that the ſlope of the ſurface will be made parallel to that of the canal which is in train. This will require a form ſomewhat like a bell or ſpeaking-trumpet, as may eaſily be ſhown by a mathematical diſcuſſion. It would, however, be ſo much evaſated at the baſon as to occupy much room, and it would be very expenſive to make ſuch an excavation. But we may, at a very moderate expence of money and room, make the increaſe of velocity at the entry almoſt inſenſible. This ſhould always be done, and it is not all expence: for if it be not done, the water will undermine the banks on each ſide, becauſe it is moving very ſwiftly, and will make an excavation for itſelf, leaving all the mud in the canal below. We may obſerve this enlargement at the entry of all natural derivations from a baſon or lake. It is a very inſtructive experiment, to fill up this enlargement, continuing the parallel ſides of the drain quite to the ſide of the lake. We ſhall immediately obſerve the water grow ſhallower in the drain, and its performance will diminiſh. Suppoſing the ditch carried on with parallel ſides quite to the ſide of the baſon, if we build two walls or dykes from the extremities of thoſe ſides, bending outwards with a proper curvature (and this will often be leſs coſtly than widening the drain), the diſcharge will be greatly increaſed. We have ſeen inſtances where it was nearly doubled.

The enlargement at the mouths of rivers is generally owing to the ſame cauſe. The tide of flood up the river produces a ſuperficial ſlope oppoſite to that of the river, and this widens the mouth. This is moſt remarkable when the tides are high, and the river has little ſlope.

After this great fall at the entry of a canal, in which all the filaments are much accelerated, and the inferior ones moſt of all, things take a contrary turn. The water, by rubbing on the bottom and the ſides, is retarded; and therefore the ſection muſt, from being ſhallow, become a little deeper, and the ſurface will be convex for ſome diſtance till all comes into train. When this is eſtabliſhed, the filaments neareſt the bottom and ſide are moving ſloweſt, and the ſurface (in the middle eſpecially) retains the greateſt velocity, gliding over the reſt. The velocity in the canal, and the depth of the ſection, adjuſt themſelves in ſuch a manner that the difference between the ſurface of the baſon and the ſurface of the uniform ſection of the canal correſponds exactly to the velocity. Thus, if this be obſerved to be two feet in a ſecond, the difference of height will be $\frac{3}{16}$ths of an inch.

All the practical queſtions that are of conſiderable importance reſpecting the motion of water in aqueducts, may be eaſily, though not elegantly, ſolved by means of the tables.

But it is to be remembered, that theſe tables relate only to uniform motion, that is, to water that is in train, and where the velocity ſuffers no change by lengthening the conduit, provided the ſlope remain the ſame. It is much more difficult to determine what will be the velocity, &c. in a canal of which nothing is given but the form, and ſlope, and depth of the entry, without ſaying how deep the water runs in it. And it is here that the common doctrines of hydraulics are moſt in fault, and unable to teach us how deep the water will run in a canal, though the depth of the baſon at the entry be perfectly known. Between the part of the canal which is in train and the baſon, there is an interval where the water is in a ſtate of acceleration, and is afterwards retarded.

The determination of the motions in this interval is exceedingly difficult, even in a rectangular canal. It was one great aim of Mr Buat's experiments to aſcertain this by meaſuring accurately the depth of the water. But he found that when the ſlope was but a very few inches in the whole length of his canal, it was not in train for want of greater length; and when the ſlope was ſtill leſs, the ſmall fractions of an inch, by which he was to judge of the variations of depth, could not be meaſured with ſufficient accuracy. It would be a moſt deſirable point to determine the length of a canal, whoſe ſlope and other dimenſions are given, which will bring it into train; and what is the ratio which will then obtain between the depth at the entry and the depth which will be maintained. Till this be done, the engineer cannot aſcertain by a direct proceſs what quantity of water will be drawn off from a reſervoir by a given canal. But as yet this is out of our reach. Experiments, however, are in view which will promote the inveſtigation.

But this and ſimilar queſtions are of ſuch importance, that we cannot be ſaid to have improved hydraulics, unleſs we can give a tolerably preciſe anſwer. This we can do by a ſort of retrograde proceſs, proceeding on the principles of uniform motion eſtabliſhed by the Chevalier Buat. We may ſuppoſe a train maintained in the canal, and then examine whether this train *can* be produced by any fall that is poſſible at the entry. If it can, we may be certain that it is ſo produced, and our problem is ſolved.

We ſhall now point out the methods of anſwering ſome chief queſtions of this kind.

Queſt. 1. Given the ſlope *s* and the breadth *w* of a canal, and the height H of the ſurface of the water in the baſon above the bottom of the entry, to find the depth *h* and velocity V of the ſtream, and the quantity of water Q which is diſcharged?

The chief difficulty is to find the depth of the ſtream where it is in train. For this end, we may ſimplify the hydraulic theorem of uniform motion in nº 59 of the article River; making $V=\frac{\sqrt{Ngd}}{\sqrt{S}}$, where g is the velocity (in inches) acquired in a ſecond by falling, d is the hydraulic mean depth, and $\sqrt{S}$ ſtands for $\sqrt{S}-L\sqrt{S+1,6}$. N is a number to be fixed by experiment (ſee River, nº 53.) depending on the contraction or obſtruction ſuſtained at the entry of the canal, and it may in moſt common caſes be taken $=244$; ſo that $\sqrt{Ng}$ may be ſomewhat leſs than 307. To find it, we may begin by taking for our depth of ſtream a quantity h, ſomewhat ſmaller than H the height of the ſurface of the baſon above the bottom of the canal. With this depth, and the known width w of the canal, we can find the hydraulic depth d (River, nº 48). Then with $\sqrt{d}$ and the ſlope find V by the Table: make this $V=\frac{\sqrt{Ngd.}}{\sqrt{S}}$ This gives $\sqrt{Ng}=\frac{V\sqrt{S}}{\sqrt{d}}$. This value of N$g$ is ſufficiently exact; for a ſmall error of depth hardly affects the hydraulic mean depth.

After this preparation, the expreſſion of the mean velocity in the canal will be $\frac{\sqrt{Ng}\sqrt{\frac{wh}{w+2h}}}{\sqrt{S}}$. The height which will produce this velocity is $\frac{Ng}{2GS}\left(\frac{wh}{w+2h}\right)$. Now this is the ſlope at the entry of the canal which produces the velocity that is afterwards maintained againſt the obſtructions by the ſlope of the canal. It is therefore $=H-h$. Hence we deduce

$$h=\frac{-\left(w\left(\frac{Ng}{2GS}+1\right)-2H\right)}{4}+\frac{\sqrt{8Hw+\left(w\left(\frac{Ng}{2GS}+1\right)-2H\right)^2}}{4}.$$

If there be no contraction at the entry, $g=G$ and $\frac{9}{2G}=\frac{1}{2}$.

Having thus obtained the depth h of the ſtream, we obtain the quantity of water by combining this with the width w and the velocity V.

But as this was but an approximation, it is neceſſary to examine whether the velocity V be poſſible. This is very eaſy. It muſt be produced by the fall $H-h$. We ſhall have no occaſion for any correction of our firſt aſſumption, if h has not been extravagantly erroneous, becauſe a ſmall miſtake in h produces almoſt the ſame variation in d. The teſt of accuracy, however, is, that h, together with the height which will produce the velocity V, muſt make up the whole height H. Aſſuming h too ſmall leaves $H-h$ too great, and will give a ſmall velocity V, which requires a ſmall value of $H-h$. The error of $H-h$ therefore is always greater than the error we have committed in our firſt aſſumption. Therefore when this error of $H-h$ is but a trifle, ſuch as one-fourth of an inch, we may reſt ſatisfied with our anſwer.

Perhaps the eaſieſt proceſs may be the following: Suppoſe the whole ſtream in train to have the depth H. The velocity V obtained for this depth and ſlope by the Table requires a certain productive height u. Make $\sqrt{H+u}:H=H:h$, and h will be exceedingly near the truth. The reaſon is obvious.

Queſt. 2. Given the diſcharge (or quantity to be furniſhed in a ſecond) Q. the height H of the baſon above the bottom of the canal, and the ſlope, to find the dimenſions of the canal?

Let x and y be the depth and mean width. It is plain that the equation $\frac{Q}{xy}=\sqrt{2G}\ \sqrt{H-x}$ will give a value of y in terms of x. Compare this with the value of y obtained from the equation $\frac{Q}{xy}=\frac{\sqrt{Ng}}{\sqrt{S}}\sqrt{\frac{xy}{y+2x}}$. This will give an equation containing only x and known quantities. But it will be very complicated, and we muſt have recourſe to an approximation. This will be beſt underſtood in the form of an example.

Suppoſe the depth at the entry to be 18 inches, and the ſlope $\frac{1}{1000}$. Let 1200 cubic feet of water *per* minute be the quantity of water to be drawn off, for working machinery or any other purpoſe; and let the canal be ſuppoſed of the beſt form, recommended in nº 69. of the article River, where the baſe of the ſloping ſide is $\frac{4}{3}$ds of the height.

The ſlighteſt conſideration will ſhow us that if $\frac{V^2}{744}$ be taken for the height producing the velocity, it cannot exceed 3 inches, nor be leſs than 1. Suppoſe it $=2$, and therefore the depth of the ſtream in the canal to be 16 inches; find the mean width of the canal by the equation $w=\frac{Q}{h(\sqrt{d}-0,1)\left(\frac{307}{\sqrt{S}}-0,3\right)}$, in which Q is 20 cubic feet (the 60th part of 1200), $\sqrt{S}$ is $=28,153$, $=\sqrt{1000}-L\sqrt{1000+1,6}$, and $h=16$. This gives $w=5,52$ feet. The ſection $n=7,36$ feet, and $V=32,6$ inches. This requires a fall of 1,52 inches inſtead of 2 inches. Take this from 18, and there remains 16,48, which we ſhall find not to differ $\frac{1}{10}$th of an inch from the exact depth which the water will acquire and maintain. We may therefore be ſatisfied with aſſuming 5,36 feet as the mean width, and 3,53 feet for the width at the bottom.

This approximation proceeds on this conſideration, that when the width diminiſhes by a ſmall quantity, and in the ſame proportion that the depth increaſes, the hydraulic mean depth remains the ſame, and therefore the velocity alſo remains, and the quantity diſcharged changes in the exact proportion of the ſection. Any minute error which may reſult from this ſuppoſition, may be corrected by increaſing the fall producing the velocity in the proportion of the firſt hydraulic mean depth to the mean depth correſponding to the new dimenſions found for the canal. It will now become 1,53, and V will be 32,72, and the depth will be 16,47. The quantity diſcharged being divided by V, will give the ſection $=7,335$ feet, from which, and the new depth, we obtain 5,344 for the width.

This and the foregoing are the moſt common queſtions propoſed to an engineer. We aſſerted with ſome confidence that few of the profeſſion are able to anſwer them with tolerable preciſion. We cannot offend the profeſſional gentlemen by this, when we inform them, that the Academy of Sciences at Paris were occupied during ſeveral months with an examination of a plan propoſed by M. Parcieux, for bringing the waters of the Yvette into Paris; and after the moſt mature conſideration, gave in a report of the quantity of water which M. De Parcieux's aqueduct would yield, and that their report has been found erroneous in the proportion of at leaſt 2 to 5: For the waters have been brought in, and exceed the report in this proportion. Indeed long after the giving in the report, M. Perronet, the moſt celebrated engineer in France, affirmed that the dimenſions propoſed were much greater than were neceſſary, and ſaid, that an aqueduct of $5\frac{1}{2}$ feet wide, and $3\frac{1}{2}$ deep, with a ſlope of 15 inches in a thouſand fathoms, would have a velocity of 12 or 13 inches *per* ſecond, which would bring in all the water furniſhed by the propoſed ſources. The great diminution of expence occaſioned by the alteration encouraged the community to undertake the work. It was accordingly begun, and a part executed. The water was found to run with a velocity of near 19 inches when it was $3\frac{1}{2}$ feet deep. M. Perronet founded his computation on his own experience alone, acknowledging that he had no theory to inſtruct him. The work was carried no farther, it being found that the city could be ſupplied at a much ſmaller expence by ſteam engines erected by Boulton and Watt. But the facts which occurred in the partial execution of the aqueduct are very valuable. If M. Perronet's aqueduct be examined by our general formula, s will be found $= \frac{1}{4800}$, and $d = 1872$, from which we deduce the velocity $= 18\frac{1}{3}$, agreeing with the obſervation with aſtoniſhing preciſion.

The experiments at Turin by Michælotti on canals were very numerous, but complicated with many circumſtances which would render the diſcuſſion too long for this place. When cleared of theſe circumſtances, which we have done with ſcrupulous care, they are alſo abundantly conformable to our theory of the uniform motion of running waters. But to return to our ſubject:

Should it be required to bring off at once from the baſon a mill courſe, having a determined velocity for driving an under-ſhot wheel, the problem becomes eaſier, becauſe the velocity and ſlope combined determine the hydraulic mean depth at once; and the depth of the ſtream will be had by means of the height which muſt be taken for the whole depth at the entry, in order to produce the required velocity.

In like manner, having given the quantity to be diſcharged, and the velocity and the depth at the entry, we can find the other dimenſions of the channel; and the mean depth being found, we can determine the ſlope.

When the ſlope of a canal is very ſmall, ſo that the depth of the uniform ſtream differs but a little from that at the entry, the quantity diſcharged is but ſmall. But a great velocity, requiring a great fall at the entry, produces a great diminution of depth, and therefore it may not compenſate for this diminution, and the quantity diſcharged may be ſmaller. Improbable as this may appear, it is not demonſtrably falſe; and hence we may ſee the propriety of the following

Queſtion 3. Given the depth H at the entry of a rectangular canal, and alſo its width w, required the ſlope, depth, and velocity, which will produce the greateſt poſſible diſcharge?

Let x be the unknown depth of the ſtream. $H - x$ is the productive fall, and the velocity is $\sqrt{2G}\sqrt{H-x}$. This multiplied by $w\,x$ will give the quantity diſcharged. Therefore $w\,x\sqrt{2G}\sqrt{H-x}$ muſt be made a maximum. The common proceſs for this will give the equation $2H = 3x$, or $x = \frac{2}{3}H$. The mean velocity will be $\sqrt{2G}\sqrt{\frac{1}{3}H}$; the ſection will be $\frac{2}{3}w\,H$, and the diſcharge $= \frac{2}{3}\sqrt{2G}\,w\,H\sqrt{\frac{1}{3}H}$, and $d = \dfrac{\frac{2}{3}w\,H}{w + \frac{4}{3}H}$. With theſe data the ſlope is eaſily had by the formula for uniform motion.

If the canal is of the trapezoidal form, the inveſtigation is more troubleſome, and requires the reſolution of a cubic equation.

It may appear ſtrange that increaſing the ſlope of a canal beyond the quantity determined by this problem can diminiſh the quantity of water conveyed. But one of theſe two things muſt happen; either the motion will not acquire uniformity in ſuch a canal for want of length, or the diſcharge muſt diminiſh. Suppoſing, however, that it could augment, we can judge how far this can go. Let us take the extreme caſe, by making the canal vertical. In this caſe it becomes a ſimple weir or waſteboard. Now the diſcharge of a waſteboard is $\frac{2}{3}\sqrt{2G}\,w$. $(b^{\frac{3}{2}} - (\frac{1}{2}b)^{\frac{3}{2}}$. The maximum determined by the preceding problem is to that of the waſteboard of the ſame dimenſions as $H\sqrt{\frac{1}{3}H} : H^{\frac{3}{2}} - (\frac{1}{2}H)^{\frac{3}{2}}$, or as $H\sqrt{\frac{1}{3}H} : H\sqrt{H} - \frac{1}{2}H\sqrt{\frac{1}{2}H}$, $= 5773 : 6465$, nearly $= 9 : 10$.

Having given the dimenſions and ſlope of a canal, we can diſcover the relation between its expenditure and the time; or we can tell how much it will ſink the ſurface of a pond in 24 hours, and the gradual progreſs of this effect; and this might be made the ſubject of a particular problem. But it is complicated and difficult. In caſes where this is an intereſting object, we may ſolve the queſtion with ſufficient accuracy, by calculating the expenditure at the beginning, ſuppoſing the baſon kept full. Then, from the known area of the pond, we can tell in what time this expenditure will ſink an inch; do the ſame on the ſuppoſition that the water is one-third lower, and that it is two-thirds lower (noticing the contraction of the ſurface of the pond occaſioned by this abſtraction of its waters. Thus we ſhall obtain three rates of diminution, from which we can eaſily deduce the deſired relation between the expenditure and the time.

Aqueducts derived from a baſon or river are commonly furniſhed with a ſluice at the entry. This changes exceedingly the ſtate of things. The ſlope of the canal may be preciſely ſuch as will maintain the mean velocity of the water which paſſes under the ſluice; in which caſe the depth of the ſtream is equal to that of the ſluice, and the velocity is produced at once by the head of water above it. But if the ſlope is leſs than this, the velocity of the iſſuing water is diminiſhed, and the water muſt riſe in the canal. This muſt check the efflux at the ſluice, and the water will be as it were ſtagnant above what comes through below it. It is extremely difficult to determine at what preciſe ſlope the water will begin to check the efflux. The contraction at the lower edge of the board hinders the water from attaining at once the whole depth which it acquires afterwards, when its velocity diminiſhes by the obſtructions. While the regorging which theſe obſtructions occaſion does not reach back to the ſluice, the efflux is not affected by it.—Even when it does reach to the ſluice, there will be a leſs depth immediately behind it than farther down the canal, where it is in train; becauſe the ſwift moving water which is next the bottom drags with it the regorged water which lies on it: but the canal muſt be rapid to make this difference of depth ſenſible. In ordinary canals, with moderate ſlopes and velocities, the velocity at the ſluice may be ſafely taken as if it were that which correſponds to the difference of depths above and below the ſluice, where both are in train.

Let therefore H be the depth above the ſluice, and h the depth in the canal. Let e be the elevation of the ſluice above the ſole, and let b be its breadth. The diſcharge will be $e\,b\,\sqrt{H-h}\,\sqrt{2\,G}$ for the ſluice, and $w\,h\,\frac{\sqrt{Ng}}{\sqrt{s}}\sqrt{\frac{w\,h}{w+2\,h}}$ for the canal. Theſe muſt be the ſame. This gives the equation $e\,b\,\sqrt{H-h}\,\sqrt{2\,G} = w\,h\,\frac{\sqrt{Ng}}{\sqrt{s}}\sqrt{\frac{w\,h}{w+2h}}$ containing the ſolution of all the queſtions which can be propoſed. The only uncertainty is in the quantity G, which expreſſes the velocity competent to the paſſage of the water through the orifice, circumſtanced as it is, namely, ſubjected to contraction. This may be regulated by a proper form given to the entry into this orifice. The contraction may be almoſt annihilated by making the maſonry of a cycloidal form on both ſides, and alſo at the lower edge of the ſluice-board, ſo as to give the orifice a form reſembling fig. 5. D, in the article Rivers. If the ſluice is thin in the face of a baſon, the contraction will reduce 2 G to 296. If the ſluice be as wide as the canal, 2 G will be nearly 500.

Queſtion 4. Given the head of water in the baſon H, the breadth *b*, and elevation *e* of the ſluice, and the breadth *w* and ſlope *s* of the canal, to find the depth *h* of the ſtream, the velocity, and the diſcharge?

We muſt (as in *Queſtion* 2.) make a firſt ſuppoſition for *h*, in order to find the proper value of *d*. Then the equation $e\,b\,\sqrt{H-h}\,\sqrt{2\,G} = w\,h\,\frac{\sqrt{Ng}}{\sqrt{s}}$ gives $h = \frac{G\,e^2\,b^2\,s}{w^2\,N\,g\,d} + \sqrt{\frac{G\,e^2\,b^2\,s\,H}{w^2\,N\,g\,d} + \left(\frac{G\,e^2\,b^2\,s}{w^2\,N\,g\,d}\right)^2}$. If this value ſhall differ conſiderably from the one which we aſſumed in order to begin the computation, make uſe of it for obtaining a new value of *d*, and repeat the operation. We ſhall rarely be obliged to perform a third operation.

The following is of frequent uſe:

Queſtion 5. Given the dimenſions and the ſlope, with the velocity and diſcharge of a river in its ordinary ſtate, required the area or ſection of the ſluice which will raiſe the waters to a certain height, ſtill allowing the ſame quantity of water to paſs through? Such an operation may render the river navigable for ſmall craft or rafts above the ſluice.

The problem is reduced to the determination of the ſize of orifice which will diſcharge this water with a velocity competent to the height to which the river is to be raiſed; only we muſt take into conſideration the velocity of the water above the ſluice, conſidering it as produced by a fall which makes a part of the height productive of the whole velocity at the ſluice. Therefore H, in our inveſtigation, muſt conſiſt of the height to which we mean to raiſe the waters, and the height which will produce the velocity with which the waters approach the ſluice: *h*, or the depth of the ſtream, is the ordinary depth of the river. Then (uſing the former ſymbols) we have $e\,b\ \frac{w\,h\,\sqrt{N\,g\,d},}{\sqrt{2\,G\,s\,(H-h)}}, = \frac{Q}{\sqrt{2\,G\,(H-h)}}.$

If the area of the ſluice is known, and we would learn the height to which it will raiſe the river, we have $H-h = \frac{Q^2}{2\,G\,e^2\,b^2}$ for the expreſſion of the riſe of the water above its ordinary level. But from this we muſt take the height which would produce the velocity of the river; ſo that if the ſluice were as wide as the river, and were raiſed to the ordinary ſurface of the water, $\frac{Q^2}{2\,G\,e^2\,b^2}$, which expreſſes the height that produces the velocity under the ſluice, muſt be equal to the depth of the river, and $H-h$ will be $=0$.

The performance of aqueduct drains is a very important thing, and merits our attention in this place. While the art of managing waters, and of conducting them ſo as to anſwer our demands, renders us very important ſervice by embelliſhing our habitations, or promoting our commercial intercourſe, the art of draining creates as it were new riches, fertilizing tracts of bog or marſh, which was not only uſeleſs, but hurtful by its unwholeſome exhalations, and converting them into rich paſtures and gay meadows. A wild country, occupied by marſhes which are inacceſſible to herds or flocks, and ſerve only for the haunts of waterfowls, or the retreat of a few poor fiſhermen, when once it is freed from the waters in which it is drowned, opens its lap to receive the moſt precious ſeeds, is ſoon clothed in the richeſt garb, gives life and abundance to numerous herds, and never fails to become the delight of the induſtrious cultivator who has enfranchiſed it, and is attached to it by the labour which it coſt him. In return, it procures him abundance, and ſupplies him with the means of daily augmenting its fertility. No ſpecies of agriculture exhibits ſuch long, continued, and progreſſive improvement. New families flock to the ſpot, and there multiply; and there nature ſeems the more eager to repay their labours, in proportion as ſhe has been obliged, againſt her will, to keep her treaſures locked up for a longer time, chilled by the waters. The countries newly inhabited by the human race, as is a great part of America, eſpecially to the ſouthward, are ſtill covered to a great extent with marſhes and lakes; and they would long remain in this condition, if population, daily making new advances, did not increaſe induſtry, by multiplying the cultivating hands, at the ſame time that it increaſes their wants. The Author of this beautiful world has at the beginning formed the great maſſes of mountain, has ſcooped out the dales and ſloping hills, has traced out the courſes, and even formed the beds of the rivers: but he has left to man the care of making his place of abode, and the field which muſt feed him, dry and comfortable. For this taſk is not beyond his powers, as the others are. Nay, by having this given to him in charge, he is richly repaid for his labour by the very ſtate in which he finds thoſe countries into which he penetrates for the firſt time. Being covered with lakes and foreſts, the juices of the ſoil are kept for him as it were in reſerve. The air, the burning heat of the ſun, and the continual waſhing of rains, would have combined to expend and diſſipate their vegetative powers, had the fields been expoſed in the ſame degree to their action as in the inhabited and cultivated countries, the moſt fertile moulds of which are long ſince lodged in the bottom of the ocean. All this would have been completely loſt through the whole extent of South America, had it not been protected by the foreſts which man muſt cut down, by the rank herbage which he muſt burn, and by the marſh and bog which he muſt deſtroy by draining. Let not ungrateful man complain of this. It is his duty to take on himſelf the taſk of opening up treaſures, preſerved on purpoſe for him with ſo much judgment and care. If he has diſcernment and ſenſibility, he will even thank the Author of all good, who has thus huſbanded them for his uſe. He will co-operate with his beneficent views, and will be careful not to proceed by wantonly ſnatching at preſent and partial good, and by picking out what is moſt eaſily got at, regardleſs of him who

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who is to come afterwards to uncover and extract the remaining riches of the ground. A wiſe adminiſtration of ſuch a country will think it their duty to leave a juſt ſhare of this inheritance to their deſcendants, who are entitled to expect it as the laſt legatees. National plans of cultivation ſhould be formed on this principle, that the ſteps taken by the preſent cultivators for realizing part of the riches of the infant country ſhall not obſtruct the works which will afterwards be neceſſary for alſo obtaining the remainder. This is carefully attended to in Holland and in China. No man is allowed to conduct the drains, by which he recovers a piece of marſh, in ſuch a way as to render it much more difficult for a neighbour, or even for his own ſucceſſor, to drain another piece, although it may at preſent be quite inacceſſible. There remains in the middle of the moſt cultivated countries many marſhes, which induſtry has not yet attempted to drain, and where the legiſlature has not been at pains to prevent many little abuſes which have produced elevations in the beds of rivers, and rendered the complete draining of ſome ſpots impoſſible. Adminiſtration ſhould attend to ſuch things, becauſe their conſequences are great. The ſciences and arts, by which alone theſe difficult and coſtly jobs can be performed, ſhould be protected, encouraged, and cheriſhed. It is only from ſcience that we can obtain principles to direct theſe arts. The problem of draining canals is one of the moſt important, and yet has hardly ever occupied the attention of the hydraulic ſpeculatiſt. We apprehend that Mr Buat's theory will throw great light on it; and regret that the very limited condition of our preſent Work will hardly afford room for a ſlight ſketch of what may be done on the ſubject. We ſhall, however, attempt it by a general problem, which will involve moſt of the chief circumſtances which occur in works of that kind.

Queſt. 6. Let the hollow ground A (fig. 2.) be inundated by rains or ſprings, and have no outlet but the canal AB, by which it diſcharges its water into the neighbouring river BCDE, and that its ſurface is nearly on a level with that of the river at B. It can only drain when the river ſinks in the droughts of ſummer; and even if it could then drain completely, the putrid marſh would only be an infecting neighbour. It may be propoſed to drain it by one or more canals; and it is required to determine their lengths and other dimenſions, ſo as to produce the beſt effects?

It is evident that there are many circumſtances to determine the choice, and many conditions to be attended to.

If the canals AC, AD, AE, are reſpectively equal to the portions BC, BD, BE, of the river, and have the ſame ſlopes, they will have the ſame diſcharge: but they are not for this reaſon equivalent. The long canal AE may drain the marſh completely, while the ſhort one AC will only do it in part; becauſe the difference of level between A and C is but inconſiderable. Alſo the freſhes of the river may totally obſtruct the operation of AC, while the canal AE cannot be hurt by them, E being ſo much lower than C. Therefore the canal muſt be carried ſo far down the river, that no freſhes there ſhall ever raiſe the waters in the canal ſo high as to reduce the ſlope in the upper part of it to ſuch a level that the current ſhall not be ſufficient to carry off the ordinary produce of water in the marſh.

Still the problem is indeterminate, admitting many ſolutions. This requiſite diſcharge may be accompliſhed by a ſhort but wide canal, or by a longer and narrower. Let us firſt ſee what ſolution can be made, ſo as to accompliſh our purpoſe in the moſt economical manner, that is, by means of the ſmalleſt equation.—We ſhall give the ſolution in the form of an example.

Suppoſe that the daily produce of rains and ſprings raiſes the water $1\frac{1}{2}$ inch on an area of a ſquare league, which gives about 120,000 cubic fathoms of water. Let the bottom of the baſon be three feet below the ſurface of the freſhes in the river at B in winter. Alſo, that the ſlope of the river is 2 inches in 100 fathoms, or $\frac{1}{3600}$dth, and that the canal is to be 6 feet deep.

The canal being ſuppoſed nearly parallel to the river, it muſt be at leaſt 1800 fathoms long before it can be admitted into the river, otherwiſe the bottom of the bog will be lower than the mouth of the canal; and even then a hundred or two more fathoms added to this will give it ſo little ſlope, that an immenſe breadth will be neceſſary to make the diſcharge with ſo ſmall a velocity. On the other hand, if the ſlope of the canal be made nearly equal to that of the river, an extravagant length will be neceſſary before its admiſſion into the river, and many obſtacles may then intervene. And even then it muſt have a breadth of 13 feet, as may eaſily be calculated by the general hydraulic theorem. By receding from each of theſe extremes, we ſhall diminiſh the expence of excavation. Therefore,

Let x and y be the breadth and length, and b the depth (6 feet), of the canal. Let q be the depth of the bog below the ſurface of the river, oppoſite to the baſon, D the diſcharge in a ſecond, and $\frac{1}{a}$ the ſlope of the river. We muſt make $b\,x\,y$ a minimum, or $x\dot{y} + y\dot{x} = 0$.

The general formula gives the velocity

$V = \frac{\sqrt{ng}\,(\sqrt{d} - 0{,}1)}{\sqrt{s} - \mathrm{L}\,\sqrt{s + 1{,}6}} - 0{,}3\,(\sqrt{d} - 0{,}1)$. This would give x and y; but the logarithmic term renders it very complicated. We may make uſe of the ſimple form $V = \frac{\sqrt{Ngd}}{\sqrt{S}}$, making $\sqrt{Ng}$ nearly $2yb$. This will be ſufficiently exact for all caſes which do not deviate far from this, becauſe the velocities are very nearly in the ſubduplicate ratio of the ſlopes.

To introduce theſe data into the equation, recollect that $V = \frac{D}{bx}$; $d = \frac{bx}{x + 2b}$. As to S, recollect that the canal being ſuppoſed of nearly equal length with the river, $\frac{y}{a}$ will expreſs the whole difference of height, and $\frac{y}{a} - q$ is the difference of height for the canal. This quantity being divided by y, gives the value of $\frac{1}{S} = \frac{\frac{y}{a} - q}{y}$. Therefore the equation for the canal becomes $\sqrt{Ng}\,\sqrt{\frac{bx}{x + 2b}}\,\sqrt{\frac{\frac{y}{a} - q}{y}}$. Hence we deduce $y = \frac{Ngqb^3x^3}{\frac{Ngb^3x^3}{a} - D^2\,(x + 2b)}$

and $\dot{y} = \frac{3\,Ngqb^3x^2\dot{x}}{\frac{Ngb^3x^3}{a} - D^2\,(x + 2b)}$

$\frac{Ngqb^3x^3\,\dot{x}\,\left(\frac{3\,Ngb^3x^2}{a} - D^2\right)}{\left(\frac{Ngb^3x^3}{a} - D^2\,(x + 2b)\right)^2}$. If we ſubſtitute theſe values in the equation $y\dot{x} + x\,\dot{} = 0$, and reduce it, we obtain finally,

$$\frac{Ngb^3x^3}{aD^2} - 3x = 8b.$$

If we reſolve this equation by making $Ng = (296)^2$, or 87616 inches; $b = 72$, $\frac{1}{a} = \frac{1}{5000}$, and $D = 518400$, we obtain $x = 392$ inches, or 32 feet 8 inches, and $\frac{D}{bx}$ or $V = 18{,}36$ inches. Now, putting theſe values in the exact formula for the velocity, we obtain the ſlope of the canal, which is $\frac{1}{11664}$, nearly 0,62 inches in 100 fathoms.

Let l be the length of the canal in fathoms. As the river has 2 inches fall in 100 fathoms, the whole fall is $\frac{2l}{100}$, and that of the canal is $\frac{062\,l}{100}$. The difference of theſe two muſt be 3 feet, which is the difference between the river and the entry of the canal. We have therefore $\left(\frac{2-0{,}62}{100}\right)l = 36$ inches. Hence $l = 2604$ fathoms; and this multiplied by the ſection of the canal gives 14177 cubic fathoms of earth to be removed.

This may ſurely be done, in moſt caſes, for eight ſhillings each cubic fathom, which does not amount to 6000l. a very moderate ſum for completely draining of nine ſquare miles of country.

In order to judge of the importance of this problem, we have added two other canals, one longer and the other ſhorter, having their widths and ſlopes ſo adjuſted as to enſure the ſame performance.

Width.	Velocity.	Slope.	Length.	Excavation.
Feet.	*Inches.*			
42	14,28	$\frac{1}{18788}$	2221	15547
$32\frac{2}{3}$	18,36	$\frac{1}{11664}$	2604	14177
21	28,57	$\frac{1}{4761}$	7381	25833

We have conſidered this important problem in its moſt ſimple ſtate. If the baſon is far from the river, ſo that the drains are not nearly parallel to it, and therefore have leſs ſlope attainable in their courſe, it is more difficult. Perhaps the beſt method is to try two very extreme caſes and a middle one, and then a fourth, nearer to that extreme which differs leaſt from the middle one in the quantity of excavation. This will point out on which ſide the minimum of excavation lies, and alſo the law by which it diminiſhes and afterwards increaſes. Then draw a line, on which ſet off from one end the lengths of the canals. At each length erect an ordinate repreſenting the excavation; and draw a regular curve through the extremities of the ordinates. From that point of the curve which is neareſt to the baſe line, draw another ordinate to the baſe. This will point out the beſt length of the canal with ſufficient accuracy. The length will determine the ſlope, and this will give the width, by means of the general theorem. *N. B.* Theſe draining canals muſt always come off from the baſon with evaſated entries. This will prevent the loſs of much fall at the entry.

Two canals may ſometimes be neceſſary. In this caſe expence may frequently be ſaved, by making one canal flow into the other. This, however, muſt be at ſuch a diſtance from the baſon, that the ſwell produced in the other by this addition may not reach back to the immediate neighbourhood of the baſon, otherwiſe it would impede the performance of both. For this purpoſe, recourſe muſt be had to the problem iii. in n° 104. of the article RIVER. We muſt here obſerve, that in this reſpect canals differ exceedingly from rivers: rivers enlarge their beds, ſo as always to convey every increaſe of waters; but a canal may be gorged through its whole length, and will then greatly diminiſh its diſcharge. In order that the lower extremity of a canal may convey the waters of an equal canal admitted into it, their junction muſt be ſo far from the baſon, that the ſwell occaſioned by raiſing its waters nearly ½ more (viz. in the ſubduplicate ratio of 1 to 2) may not reach back to the baſon.

This obſervation points out another method of economy. Inſtead of one wide canal, we may make a narrower one of the whole length, and another narrow one reaching part of the way, and communicating with the long canal at a proper diſtance from the baſon. But the lower extremity will now be too ſhallow to convey the waters of both. Therefore raiſe its banks by uſing the earth taken from its bed, which muſt at any rate be diſpoſed of. Thus the waters will be conveyed, and the expence, even of the lower part of the long canal, will ſcarcely be increaſed.

Theſe obſervations muſt ſuffice for an account of the management of open canals; and we proceed to the conſideration of the conduct of water in pipes.

THIS is much more ſimple and regular, and the general theorem requires very trifling modifications for adapting it to the caſes or queſtions that occur in the practice of the civil engineer. Pipes are always made round, and therefore d is always $\frac{1}{4}$th of the diameter. The velocity of water in a pipe which is in train, is $= V, = \frac{307(\sqrt{d}-0{,}1)}{\sqrt{s}-L\sqrt{s+1{,}6}} - 0{,}3(\sqrt{d}-0{,}1)$ or $= (\sqrt{d}-0{,}1)\left(\frac{307}{\sqrt{s}-L\sqrt{s+1{,}6}} - 0{,}3\right)$.

The chief queſtions are the following:

Queſt. 1. Given the height H of the reſervoir above the place of delivery, and the diameter and length of the pipe, to find the quantity of water diſcharged in a ſecond?

Let L be the length, and h the fall which would produce the velocity with which the water enters the pipe, and actually flows in it, after overcoming all obſtructions. This may be expreſſed in terms of the velocity by $\frac{V^2}{2G}$, G denoting the acceleration of gravity, correſponding to the manner of entry. When no methods are adopted for facilitating the entry of the water, by a bell-ſhaped funnel or otherwiſe, 2G may be aſſumed as = 500 inches, or 42 feet, according as we meaſure the velocity in inches or feet. The ſlope is $\frac{1}{s}, = \frac{H-\frac{V^2}{2G}}{L}$, which muſt be put into the general formula. This would make it very complicated. We may ſimplify it by the conſideration that the velocity is very ſmall in compariſon of that ariſing from the height H: conſequently h is very ſmall. Alſo, in the ſame pipe, the reſiſtances are nearly in the duplicate ratio of the velocities when theſe are ſmall, and when they differ little among themſelves. Therefore make $b = \frac{L}{b}$, taking b by gueſs, a very little leſs than H. Then compute the mean velocity v correſponding to theſe data, or take it from the table. If $b + \frac{v^2}{2G}$ be $= H$, we have found the mean velocity $V = v$. If not, make the following proportion:

$b : \frac{v^2}{2G} = H - \frac{V^2}{2G} : \frac{V^2}{2G}$, which is the ſame with this $b + \frac{v^2}{2G} : v^2 = H : V^2$, and V^2 is $= \frac{v^2 H}{b+\frac{v^2}{2G}}, = \frac{v^2 H}{\frac{2Gb+v^2}{2G}}, = \frac{v^2 . 2GH}{v^2+2Gb}$.

If the pipe has any bendings, they muſt be calculated for in the manner mentioned in the article River, n° 101; and the head of water neceſſary for overcoming this additional reſiſtance being called $\frac{V^2}{m}$, the laſt proportion muſt be changed for

$$b+v^2\left(\frac{1}{2G}+\frac{1}{m}\right):v^2=H:V^2.$$

Queſt. 2d. Given the height of the reſervoir, the length of the pipe, and the quantity of water which is to be drawn off in a ſecond, to find the diameter of the pipe which will draw it off?

Let d be conſidered as $=\frac{1}{4}$th of the diameter, and let $1:c$ repreſent the ratio of the diameter of a circle to its circumference. The ſection of the pipe is $4\,c\,d^2$. Let the quantity of water *per* ſecond be Q; then $\frac{Q}{4\,c\,d^2}$ is the mean velocity. Divide the length of the pipe by the height of the reſervoir above the place of delivery, diminiſhed by a very ſmall quantity, and call the quotient S. Conſider this as the ſlope of the conduit; the general formula now becomes.

$$\frac{Q}{4\ {}^{4}}=\frac{307\,(\surd d-0,1)}{\surd s-L\surd s+1,06}-0,3\,(\surd d-0,1),$$

or $\frac{d\,Q}{4\,c\,d^2}=\frac{(307(\surd d-0,1)}{\surd S}-0,3\,(\surd\ d-0,1)$. We may neglect the laſt term in every caſe of civil practice, and alſo the ſmall quantity 0,1. This gives the very ſimple formula.

$$\frac{Q}{4\,cd^2}=\frac{307\surd d}{\surd S}$$

from which we readily deduce

$$d=\overline{\frac{Q\surd S}{4\,c\times 307}}\Big|^{\frac{2}{5}}=\overline{\frac{Q\,S\surd}{3858}}\Big|^{\frac{2}{5}}$$

This proceſs gives the diameter ſomewhat too ſmall. But we eaſily rectify this error by computing the quantity delivered by the pipe, which will differ a little from the quantity propoſed. Then obſerving, by this equation, that two pipes having the ſame length and the ſame ſlope give quantities of water, of which the ſquares are nearly as the 5th powers of the diameter, we form a new diameter in this proportion, which will be almoſt perfectly exact.

It may be obſerved that the height aſſumed for determining the ſlope in theſe two queſtions will ſeldom differ more than an inch or two from the whole height of the reſervoir above the place of delivery; for in conduits of a few hundred feet long the velocity ſeldom exceeds four feet *per* ſecond, which requires only a head of 3 inches.

As no inconvenience worth minding reſults from making the pipes a tenth of an inch or ſo wider than is barely ſufficient, and as this generally is more than the error ariſing from even a very erroneous aſſumption of *b*, the anſwer firſt obtained may be augmented by one or two tenths of an inch, and then we may be confident that our conduit will draw off the intended quantity of water.

We preſume that every perſon who aſſumes the name of engineer knows how to reduce the quantity of water meaſured in gallons, pints, or other denominations, to cubic-inches, and can calculate the gallons, &c. furniſhed by a pipe of known diameter, moving with a velocity that is meaſured in inches *per* ſecond. We farther ſuppoſe that all care is taken in the conſtruction of the conduit, to avoid obſtructions occaſioned by lumps of ſolder hanging in the inſide of the pipes; and, particularly, that all the cocks and plugs by the way have waterways equal to the ſection of the pipe. Undertakers are moſt tempted to fail here, by making the cocks too ſmall, becauſe large cocks are very coſtly. But the employer ſhould be ſcrupulouſly attentive to this; becauſe a ſimple contraction of this kind may be the throwing away of many hundred pounds in a wide pipe, which yields no more water than can paſs through the ſmall cock.

The chief obſtructions ariſe from the depoſition of ſand or mud in the lower parts of pipes, or the collection of air in the upper parts of their bendings. The velocity being always very moderate, ſuch depoſitions of heavy matters are unavoidable. The utmoſt care ſhould therefore be taken to have the water freed from all ſuch things at its entry by proper filtration; and there ought to be cleanſing plugs at the lower parts of the bendings, or rather a very little way beyond them. When theſe are opened, the water iſſues with greater velocity, and carries the depoſitions with it.

It is much more difficult to get rid of the air which choaks the pipes by lodging in their upper parts. This is ſometimes taken in along with the water at the reſervoir, when the entry of the pipe is too near the ſurface. This ſhould be carefully avoided, and it coſts no trouble to do ſo. If the entry of the pipe is two feet under the ſurface, no air can ever get in. Floats ſhould be placed above the entries, having lids hanging from them, which will ſhut the pipe before the water runs too low.

But air is alſo diſengaged from ſpring-water by merely paſſing along the pipe. When pipes are ſupplied by an engine, air is very often drawn in by the pumps in a diſengaged ſtate. It is alſo diſengaged from its ſtate of chemical union, when the pumps have a ſuction-pipe of 10 or 12 feet, which is very common. In whatever way it is introduced, it collects in all the upper part of bendings, and choaks the paſſage, ſo that ſometimes not a drop of water is delivered. Our cocks ſhould be placed there, which ſhould be opened frequently by perſons who have this in charge. Deſaguliers deſcribes a contrivance to be placed on all ſuch eminences, which does this of itſelf. It is a pipe with a cock, terminating in a ſmall ciſtern. The key of the cock has a hollow ball of copper at the end of a lever. When there is no air in the main pipe, water comes out by this diſcharger, fills the ciſtern, raiſes the ball, and thus ſhuts the cock. But when the bend of the main contains air, it riſes into the ciſtern, and occupies the upper part of it. Thus the floating ball falls down, the cock opens and lets out the air, and the ciſtern again filling with water, the ball riſes, and the cock is again ſhut.

A very neat contrivance for this purpoſe was invented by the late profeſſor Ruſſel of Edinburgh. The cylindrical pipe BCDE (fig. 3.), at the upper part of a bending of the main, is ſcrewed on, the upper end of which is a flat plate perforated with a ſmall hole F. This pipe contains a hollow copper cylinder G, to the upper part of which is faſtened a piece of ſoft leather H. When there is air in the pipe, it comes out by the hole A, and occupies the diſcharger, and then eſcapes through the hole F. The water follows, and, riſing in the diſcharger, lifts up the hollow cylinder G, cauſing the leather H to apply itſelf to the plate CD, and ſhut the hole. Thus the air is diſcharged without the ſmalleſt loſs of water.

It is of the moſt material conſequence that there be no contraction in any part of a conduit. This is evident; but it is alſo prudent to avoid all unneceſſary enlargements. For, when the conduit is full of water moving along it, the velocity in every ſection is inverſely proportional to the area of the ſection: it is therefore diminiſhed wherever the pipe is enlarged; but it muſt again be increaſed where the pipe contracts. This cannot be without expending force in the acceleration. This conſumes part of the impelling power, whether this be a head of water, or the force of an engine. See what is ſaid on this ſubject in the article Pumps, n° 83, &c. Nothing is gained by any enlargement; and every contraction, by requiring an augmentation of velocity, employs a part of the impelling force preciſely equal to the weight of a column of water whoſe baſe is the contracted paſſage, and whoſe height is the fall which would produce a velocity equal to this augmentation. This point ſeems to have been quite overlooked by engineers of the firſt eminence, and has in many inſtances greatly diminiſhed the performance of their beſt works. It is no leſs detrimental in open canals; becauſe at every contraction a ſmall fall is required for reſtoring the velocity loſt in the enlargement of the canal, by which the general ſlope and velocity are diminiſhed. Another point which muſt be attended to in the conducting of water is, that the motion ſhould not be ſubſultory, but continuous. When water is to be driven along a main by the ſtrokes of a reciprocating engine, it ſhould be forced into an air-box, the ſpring of which may preſerve it in motion along the whole ſubſequent main. If the water is brought to reſt at every ſucceſſive ſtroke of the piſton, the whole maſs muſt again be put in motion through the whole length of the main. This requires the ſame uſeleſs expenditure of power as to communicate this motion to as much dead matter; and this is over and above the force which may be neceſſary for raiſing the water to a certain height; which is the only circumſtance that enters into the calculation of the power of the pump-engine.

An air-box removes this imperfection, becauſe it keeps up the motion during the returning ſtroke of the piſton. The compreſſion of the air by the active ſtroke of the piſton muſt be ſuch as to continue the impulſe in oppoſition to the contrary preſſure of the water (if it is to be raiſed to ſome height), and in oppoſition to the friction or other reſiſtances which ariſe from the motion that the water really acquires. Indeed a very conſiderable force is employed here alſo in changing the motion of the water, which is forced out of the capacious air-box into the narrow pipe; and when this change of motion is not judiciouſly managed, the expenditure of power may be as great as if all were brought to reſt and again put into motion. It may even be greater, by cauſing the water to move in the oppoſite direction to its former motion. Of ſuch conſequence is it to have all theſe circumſtances ſcientifically conſidered. It is in ſuch particulars, unheeded by the ordinary herd of engineers or pump-makers, that the ſuperiority of an intelligent practitioner is to be ſeen.

Another material point in the conduit of water in pipes is the diſtribution of it to the different perſons who have occaſion for it. This is rarely done from the riſing main. It is uſual to ſend the whole into a ciſtern, from which it is aſterwards conducted to different places in ſeparate pipes. Till the diſcovery of the general theorem by the chevalier Buat, this has been done with great inaccuracy. Engineers think that the different purchaſers from water-works receive in proportion to their reſpective bargains when they give them pipes whoſe areas are proportional to theſe payments. But we now ſee, that when theſe pipes are of any conſiderable length, the waters of a larger pipe run with a greater velocity than thoſe of a ſmaller pipe having the ſame ſlope. A pipe of two inches diameter will give much more water than four pipes of one inch diameter; it will give as much as five and a half ſuch pipes, or more; becauſe the ſquares of the diſcharges are very nearly as the fifth powers of the diameters. This point ought therefore to be carefully conſidered in the bargains made with the proprietors of water-works, and the payments made in this proportion. Perhaps the moſt unexceptionable method would be to make a double diſtribution. Let the water be firſt let off in its proper proportions into a ſecond ſeries of ſmall ciſterns, and let each have a pipe which will convey the whole water that is diſcharged into it. The firſt diſtribution may be made entirely by pipes of one inch in diameter; this would leave nothing to the calculation of the diſtributor, for every man would pay in proportion to the number of ſuch pipes which run into his own ciſtern.

In many caſes, however, water is diſtributed by pipes derived from a main. And here another circumſtance comes into action. When water is paſſing along a pipe, its preſſure on the ſides of the pipe is diminiſhed by its velocity; and if a pipe is now derived from it, the quantity drawn off is alſo diminiſhed in the ſubduplicate ratio of the preſſures. If the preſſure is reduced to $\frac{1}{4}$th, $\frac{1}{9}$th, $\frac{1}{16}$th, &c. the diſcharge from the lateral pipe is reduced to $\frac{1}{2}$, $\frac{1}{3}$d, $\frac{1}{4}$th, &c.

It is therefore of great importance to determine, what this diminution of preſſure is which ariſes from the motion along the main.

It is plain that if the water ſuffered no reſiſtance in the main, its velocity would be that with which it entered, and it would paſs along without exerting any preſſure. If the pipe were ſhut at the end, the preſſure on the ſides would be the full preſſure of the head of water. If the head of water remain the ſame, and the end of the tube be contracted, but not ſtopped entirely, the velocity in the pipe is diminiſhed. If we would have the velocity in the pipe with this contracted mouth augmented to what it was before the contraction was made, we muſt employ the preſſure of a piſton, or of a head of water. This is propagated through the fluid, and thus a preſſure is immediately excited on the ſides of the pipe. New obſtructions of any kind, ariſing from friction or any other cauſe, produce a diminution of velocity in the pipe. But when the natural velocity is checked, the particles react on what obſtructs their motion; and this action is uniformly propagated through a perfect fluid in every direction. The reſiſtance therefore which we thus aſcribe to friction, produces the ſame lateral preſſure which a contraction of the orifice, which equally diminiſhes the velocity in the pipe, would do. Indeed this is demonſtrable from any diſtinct notions that we can form of theſe obſtructions. They proceed from the want of perfect ſmoothneſs, which obliges the particles next the ſides to move in undulated lines. This excites tranſverſe forces in the ſame manner as any conſtrained curvilineal motion. A particle in its undulated path tends to eſcape from it, and acts on the lateral particles in the ſame manner that it would do if moving ſingly in a capillary tube having the ſame undulations; it would preſs on the concave ſide of every ſuch undulation. Thus a preſſure is exerted among the particles, which is propagated to the ſides of the pipe; or the diminution of velocity may ariſe from a viſcidity or want of perfect fluidity. This obliges the particle immediately preſſed to drag along with it another particle which is withheld by adheſion to the ſides. This requires additional preſſure from a piſton, or an additional head of water; and this preſſure alſo is propagated to the ſides of the pipe.

Hence it ſhould follow, that the preſſure which water in motion exerts on the ſides of its conduit is equal to that which is competent to the head of water which impels it into the pipe, diminiſhed by the head of water competent to the actual velocity with which it moves along the pipe. Let H repreſent the head of water which impels it into the entry of the pipe, and b the head which would produce the actual velocity; then $H-b$ is the column which would produce the preſſure exerted on its ſides.

This is abundantly verified by very ſimple experiments.

Let an upright pipe be inſerted into the ſide of the main pipe. When the water runs out by the mouth of the main, it will riſe in this branch till the weight of the column balances the preſſure that ſupports it; and if we then aſcertain the velocity of the iſſuing water by means of the quantity diſcharged, and compute the head or height neceſſary for producing this velocity, and ſubtract this from the height of water above the entry of the main, we ſhall find the height in the branch preciſely equal to their difference. Our readers may ſee this by examining the experiments related by Graveſande, and ſtill better by conſulting the experiments narrated by Boſſut, § 558, which are detailed with great minuteneſs; the reſults correſponded accurately with this propoſition. The experiments indeed were not heights of water ſupported by this preſſure, but water expelled by it through the ſame orifice. Indeed the truth of the propoſition appears in every way we can conſider the motion of water. And as it is of the firſt importance in the practice of conducting water (for reaſons which will preſently appear), it merits a particular attention. When an inclined tube is in train, the accelerating power of the water (or its weight diminiſhed in the proportion of the length of the oblique column to its vertical height, or its weight multiplied by the fraction $\frac{1}{s}$, which expreſſes the ſlope), is in equilibrio with the obſtructions; and therefore it exerts no preſſure on the pipe but what ariſes from its weight alone. Any part of it would continue to ſlide down the inclined plane with a conſtant velocity, though detached from what follows it. It therefore derives no preſſure from the head of water which impelled it into the pipe. The ſame muſt be ſaid of a horizontal pipe infinitely ſmooth, or oppoſing no reſiſtance. The water would move in this pipe with the full velocity due to the head of water which impels it into the entry. But when the pipe oppoſes an obſtruction, the head of water is greater than that which would impel it into the pipe with the velocity that it actually has in it; and this additional preſſure is propagated along the pipe, where it is balanced by the actual reſiſtance, and therefore excites a *quaqua verſum* preſſure on the pipe. In ſhort, whatever part of the head of water in the reſervoir, or of the preſſure which impels it along the tube, is not employed in producing velocity, is employed in acting againſt ſome obſtruction, and excites (by the reacton of this obſtruction) an equal preſſure on the tube. The rule therefore is general, but is ſubject to ſome modifications which deſerve our attention.

In the ſimply inclined pipe BC (fig. 4.), the preſſure on any point S is equal to that of the head AB of water which impels the water into the pipe wanting; or *minus* that of the head of water which would communicate to it the velocity with which it actually moves. This we ſhall call x, and conſider it as the weight of a column of water whoſe length alſo is x. In like manner H may be the column AB, which impels the water into the pipe, and would communicate a certain velocity; and b may repreſent the column which would communicate the actual velocity. We have therefore $x = \mathrm{H} - b$.

In the pipe HIKL, the preſſure at the point I is $\mathrm{AH} - b - \mathrm{IO}, = \mathrm{H} - b - \mathrm{IO}$; and the preſſure at K is $\mathrm{H} - b + \mathrm{PK}$.

And in the pipe DEFG, the preſſure on E is $= \mathrm{AR} - b - \mathrm{EM}. = \mathrm{H} - b - \mathrm{EM}$; and the preſſure at F is $\mathrm{H} - b + \mathrm{FN}$.

We muſt carefully diſtinguiſh this preſſure on any ſquare inch of the pipe from the obſtruction or reſiſtance which that inch actually exerts, and which is part of the cauſe of this preſſure. The preſſure is (by the laws of hydroſtatics) the ſame with that exerted on the water by a ſquare inch of the piſton or forcing head of water. This muſt balance the united obſtructions of the whole pipe, in as far as they are not balanced by the relative weight of the water in an incloſed pipe. Whatever be the inclination of a pipe, and the velocity of the water in it, there is a certain part of this reſiſtance which may not be balanced by the tendency which the water has to ſlide along it, provided the pipe be long enough; or if the pipe is too ſhort, the tendency down the pipe may more than balance all the reſiſtances that obtain below. In the firſt caſe, this overplus muſt be balanced by an additional head of water; and in the latter caſe the pipe is not in train, and the water will accelerate. There is ſomething in the mechaniſm of theſe motions which makes a certain length of pipe neceſſary for bringing it into train; a certain portion of the ſurface which acts in concert in obſtructing the motion. We do not completely underſtand this circumſtance, but we can form a pretty diſtinct notion of its mode of acting. The film of water contiguous to the pipe is withheld by the obſtruction, but glides along; the film immediately within this is withheld by the outer film, but glides through it: and thus all the concentric films glide within thoſe around them, ſomewhat like the ſliding tubes of a ſpy-glaſs, when we draw it out by taking hold of the end of the innermoſt. Thus the ſecond film paſſes beyond the firſt or outermoſt, and becomes the outermoſt, and rubs along the tube. The third does the ſame in its turn; and thus the central filaments come at laſt to the outſide, and all ſuſtain their greateſt poſſible obſtruction. When this is accompliſhed, the pipe is in train. This requires a certain length, which we cannot determine by theory. We ſee however that pipes of greater diameter muſt require a greater length, and this in a proportion which is probably that of the number of filaments, or the ſquare of the diameter. Buat found this ſuppoſition agree well enough with his experiments. A pipe of one inch in diameter ſuſtained no change of velocity by gradually ſhortening it till he reduced it to ſix feet, and then it diſcharged a little more water. A pipe of two inches diameter gave a ſenſible augmentation of velocity when ſhortened to 25 feet. He therefore ſays, that the ſquare of the diameter in inches, multiplied by 72, will expreſs (in inches) the length neceſſary for putting any pipe in train.

The reſiſtance exerted by a ſquare inch of the pipe makes but a ſmall part of the preſſure which the whole reſiſtances occaſion to be exerted there before they can be overcome. The reſiſtance may be repreſented by $\frac{d}{s}$, when d is the hydraulic depth ($\frac{1}{4}$th of the diameter), and s the length of a column whoſe vertical height is one inch, and it is the relative weight of a column of water whoſe baſe is a ſquare inch, and height is d. For the reſiſtance of any length s of pipe which is in train, is equal to the tendency of the water to ſlide down (being balanced by it); that is, is equal to the weight of this column multiplied by $\frac{1}{s}$. The magnitude of this column is had by multiplying its length by its ſection. The ſection is the product of the border b or circumference, multiplied by the mean depth d, or it is $b\,d$. This, multiplied by the length, is $b\,d\,s$; and this multiplied by the ſlope $\frac{1}{s}$ is $b\,d$, the relative weight of the column whoſe length is s. The relative weight of one inch is therefore $\frac{b\,d}{s}$; and this is in equilibrio with the reſiſtance of a ring of the pipe one inch broad. This, when unfolded, is a parallelogram b inches in length. One inch of this therefore

fore is $\frac{d}{s}$, the relative weight of a column of water having *d* for its height and a ſquare inch for its baſe. Suppoſe the pipe four inches in diameter, and the ſlope = 253, the reſiſtance is one grain; for an inch of water weighs 253 grains.

This knowledge of the preſſure of water in motion is of great importance. In the management of rivers and canals it inſtructs us concerning the damages which they produce in their beds by tearing up the ſoil; it informs us of the ſtrength which we muſt give to the banks: but it is of more conſequence in the management of cloſe conduits. By this we muſt regulate the ſtrength of our pipes; by this alſo we muſt aſcertain the quantities of water which may be drawn off by lateral branches from any main conduit.

With reſpect to the firſt of theſe objects, where ſecurity is our ſole concern, it is proper to conſider the preſſure in the moſt unfavourable circumſtances, viz. when the end of the main is ſhut. The caſe is not unfrequent. Nay, when the water is in motion, its velocity in a conduit ſeldom exceeds a very few feet in a ſecond. Eight feet *per* ſecond requires only one foot of water to produce it. We ſhould therefore eſtimate the ſtrain on all conduits by the whole height of the reſervoir.

In order to adjuſt the ſtrength of a pipe to the ſtrain, we may conceive it as conſiſting of two half cylinders of inſuperable ſtrength, joined along the two ſeams, where the ſtrength is the ſame with the ordinary ſtrength of the materials of which it is made. The inſide preſſure tends to burſt the pipe by tearing open theſe ſeams, and each of them ſuſtains half of the ſtrain. The ſtrain on an inch of theſe two ſeams is equal to the weight of a column of water whoſe height is the depth of the ſeam below the ſurface of the reſervoir, and whoſe baſe is an inch broad and a diameter of the pipe in length. This follows from the common principles of hydroſtatics.

Suppoſe the pipe to be of lead, one foot in diameter and 100 feet under the ſurface of the reſervoir. Water weighs $62\frac{1}{2}$ pounds *per* foot. The baſe of our column is therefore $\frac{1}{12}$th of a foot, and the tendency to burſt the pipe is $100 \times 62\frac{1}{2} \times \frac{1}{12}$th $= \frac{6250}{12}, = 521$ pounds nearly. Therefore an inch of one ſeam is ſtrained by $260\frac{1}{2}$ pounds. A rod of lead one inch ſquare is pulled aſunder by 860 pounds (ſee *Strength of Materials*, n° 40). Therefore, if the thickneſs of the ſeam is $= \frac{260}{860}$ inches, or $\frac{1}{3}$d of an inch, it will juſt withſtand this ſtrain. But we muſt make it much ſtronger than this, eſpecially if the pipe leads from an engine which ſends the water along it by ſtarts. Belidor and Deſaguiliers have given tables of the thickneſs and weights of pipes which experience has found ſufficient for the different materials and depths. Deſaguiliers ſays, that a leaden pipe of $\frac{3}{4}$ths of an inch in thickneſs is ſtrong enough for a height of 140 feet and diameter of 7 inches. From this we may calculate all others. Belidor ſays, that a leaden pipe 12 inches diameter and 60 feet deep ſhould be half an inch thick: but theſe things will be more properly computed by means of the liſt given in n° 40 of the article *Strength of Materials*.

The application which we are moſt anxious to make of the knowledge of the preſſure of moving waters is the derivation from a main conduit by lateral branches. This occurs very frequently in the diſtribution of waters among the inhabitants of towns; and it is ſo imperfectly underſtood by the greateſt part of thoſe who take the name of engineers, that individuals have no ſecurity that they ſhall get even one half of the water they bargain and pay for; yet this may be as accurately aſcertained as any other problem in hydraulics by means of our general theorem. The caſe therefore merits our particular attention.

It appears to be determined already, when we have aſcertained the preſſures by which the water is impelled into theſe lateral pipes, eſpecially after we have ſaid that the experiments of Boſſut on the actual diſcharges from a lateral pipe fully confirm the theoretical doctrine. But much remains to be conſidered. We have ſeen that there is a vaſt difference between the diſcharge made through a hole, or even through a ſhort pipe, and the diſcharge from the far end of a pipe derived from a main conduit. And even when this has been aſcertained by our new theory, the diſcharge thus modified will be found conſiderably different from the real ſtate of things: For when water is flowing along a main with a known velocity, and therefore exerting a known preſſure on the circle which we propoſe for the entry of a branch, if we inſert a branch there water will go along it; but this will generally make a conſiderable change in the motion along the main, and therefore in the preſſure which is to expel the water. It alſo makes a conſiderable change in the whole quantity which paſſes along the anterior part of the main, and a ſtill greater change on what moves along that part of it which lies beyond the branch: it therefore affects the quantity neceſſary for the whole ſupply, the force that is required for propelling it, and the quantity delivered by other branches. This part therefore of the management of water in conduits is of conſiderable importance and intricacy. We can propoſe in this place nothing more than a ſolution of ſuch leading queſtions as involve the chief circumſtances, recommending to our readers the peruſal of original works on this ſubject. M. Boſſut's experiments are fully competent to the eſtabliſhment of the fundamental principle. The hole through which the lateral diſcharges were made was but a few feet from the reſervoir. The pipe was ſucceſſively lengthened, by which the reſiſtances were increaſed, and the velocity diminiſhed. But this did not affect the lateral diſcharges, except by affecting the preſſures: and the diſcharges from the end of the main were ſuppoſed to be the ſame as when the lateral pipe was not inſerted. Although this was not ſtrictly true, the difference was inſenſible, becauſe the lateral pipe had but about the 18th part of the area of the main.

Suppoſe that the diſcharge from the reſervoir remains the ſame after the derivation of this branch, then the motion of the water all the way to the inſertion of the branch is the ſame as before; but, beyond this, the diſcharge is diminiſhed by all that is diſcharged by the branch, with the head x equivalent to the preſſure on the ſide. The diſcharge by the lower end of the main being diminiſhed, the velocity and reſiſtance in it are alſo diminiſhed. Therefore the difference between x and the head employed to overcome the friction in this ſecond caſe, would be a needleſs or inefficient part of the whole load at the entry, which is impoſſible; for every force produces an effect, or it is deſtroyed by ſome reaction. The effect of the forcing head of water is to produce the greateſt diſcharge correſponding to the obſtructions; and thus the diſcharge from the reſervoir, or the ſupply to the main, muſt be augmented by the inſertion of the branch, if the forcing head of water remains the ſame. A greater portion therefore of the forcing head was employed in producing a greater diſcharge at the entry of the main, and the remainder, leſs than x, produced the preſſure on the ſides. This head was the one competent to the obſtructions reſulting from the velocity beyond the inſertion of the branch; and this velocity, diminiſhed by the diſcharge already made, was leſs than that at the entry, and even than that of the main without a branch. This will appear more diſtinctly by putting the caſe into the form of an equation. Therefore let $H-x$ be the height due to the velocity at the entry, of which the effect obtains only horizontally. The head x is the only one which acts on the ſides of the tube, tending to produce the diſcharge by the branch, at the ſame time that it muſt overcome the obſtructions beyond the branch. If the orifice did not exiſt and if the force producing the velocity on a ſhort tube be repreſented by 2 G, and the ſection of the main by A, the ſupply at the entry of the main would be $A\sqrt{2G}\sqrt{H-x}$; and if the orifice had no influence on the value of x, the diſcharge by the orifice would be $D\sqrt{\frac{x}{H}}$, D being its diſcharge by means of the head H, when the end of the main is ſhut; for the diſcharges are in the ſubduplicate ratio of the heads of water by which they are expelled; and therefore $\sqrt{H} : \sqrt{x} = D : D\sqrt{\frac{x}{H}}(=\delta)$. But we have ſeen that x muſt diminiſh; and we know that the obſtructions are nearly as the ſquare roots of the velocities, when theſe do not differ much among themſelves. Therefore calling y the preſſure or head which balances the reſiſtances of the main without a branch, while x is the head neceſſary for the main with a branch, we may inſtitute this proportion $y : H-y = x : \frac{x(H-y)}{y}$; and this 4th term will expreſs the head producing the velocity in the main beyond the branch (as $H-y$ would have done in a main without a branch). This velocity beyond the branch will be $\sqrt{2G}\sqrt{\frac{x(H-y)}{y}}$, and the diſcharge at the end will be $A\sqrt{2G}\sqrt{\frac{x(H-y)}{y}}$. If to this we add the diſcharge of the branch, the ſum will be the whole diſcharge, and therefore the whole ſupply. Therefore we have the following equation, $A\sqrt{2G}\sqrt{H-y} = A\sqrt{2G}\sqrt{\frac{x(H-y)}{y}} + D\sqrt{\frac{x}{H}}$. From this we deduce the value of $x = \frac{2GHA^2}{\left(A\sqrt{2G}\sqrt{\frac{H-y}{y}}+\frac{D}{\sqrt{H}}\right)^2 + 2GA^2}$. This value of x being ſubſtituted in the equation of the diſcharge δ of the branch, which was $= D\sqrt{\frac{x}{H}}$, will give the diſcharges required, and they will differ ſo much the more from the diſcharges calculated according to the ſimple theory, as the velocity in the main is greater. By the ſimple theory, we mean the ſuppoſition that the lateral diſcharges are ſuch as would be produced by the head $H-h$, where H is the height of the reſervoir, and h the head due to the actual velocity in the main.

And thus it appears that the proportion of the diſcharge by a lateral pipe from a main that is ſhut at the far end, and the diſcharge from a main that is open, depends not only on the preſſures, but alſo on the ſize of the lateral pipe, and its diſtance from the reſervoir. When it is large, it greatly alters the train of the main, under the ſame head, by altering the diſcharge at its extremity, and the velocity in it beyond the branch; and if it be near the reſervoir, it greatly alters the train, becauſe the diminiſhed velocity takes place through a greater extent, and there is a greater diminution of the reſiſtances.

When the branch is taken off at a conſiderable diſtance from the reſervoir, the problem becomes more complicated, and the head x is reſolved into two parts; one of which balances the reſiſtance in the firſt part of the main, and the other balances the reſiſtances beyond the lateral pipe, with a velocity diminiſhed by the diſcharge from the branch.—A branch at the end of the main produces very little change in the train of the pipe.

When the lateral diſcharge is great, the train may be ſo altered, that the remaining part of the main will not run full, and then the branch will not yield the ſame quantity. The velocity in a very long horizontal tube may be ſo ſmall (by a ſmall head of water and great obſtructions in a very long tube) that it will juſt run full. An orifice made in its upperſide will yield nothing; and yet a ſmall tube inſerted into it will carry a column almoſt as high as the reſervoir. So that we cannot judge in all caſes of the preſſures by the diſcharges, and *vice verſa*.

If there be an inclined tube, having a head greater than what is competent to the velocity, we may bring it into train by an opening on its upper ſide near the reſervoir. This will yield ſome water, and the velocity will diminiſh in the tube till it is in train. If we ſhould now enlarge the hole, it will yield no more water than before.

And thus we have pointed out the chief circumſtances which affect theſe lateral diſcharges. The diſcharges are afterwards modified by the conduits in which they are conveyed to their places of deſtination. Theſe being generally of ſmall dimenſions, for the ſake of economy, the velocity is much diminiſhed. But, at the ſame time, it approaches nearer to that which the ſame conduit would bring directly from the reſervoir, becauſe its ſmall velocity will produce a leſs change in the train of the main conduit.

We ſhould now treat of jets of water, which ſtill make an ornament in the magnificent pleaſure grounds of the wealthy. Some of theſe are indeed grand objects, ſuch as the two at Peterhoff in Ruſſia, which ſpout about 60 feet high a column of nine inches diameter, which falls again, and ſhakes the ground with its blow. Even a ſpout of an inch or two inches diameter, lancing to the height of 150 feet, is a gay object, and greatly enlivens a pleaſure-ground; eſpecially when the changes of a gentle breeze bend the jet to one ſide. But we have no room left for treating this ſubject, which is of ſome nicety; and muſt conclude this article which a very ſhort account of the management of water as an active power for impelling machinery.

II. *Of Machinery drawn by Water.*

This is a very comprehenſive article, including almoſt every poſſible ſpecies of mill. It is no leſs important, and it is therefore matter of regret, that we cannot enter into the detail which it deſerves. The mere deſcription of the immenſe variety of mills which are in general uſe, would fill volumes, and a ſcientific deſcription of their principles and maxims of conſtruction would almoſt form a complete body of mechanical ſcience. But this is far beyond the limits of a Work like ours. Many of theſe machines have been already deſcribed under their proper names, or under the articles which give an account of their manufactures; and for others we muſt refer our readers to the original works, where they are deſcribed in minute detail. The great academical collection *Des Arts et Metiers*, publiſhed at Paris in many folio volumes, contains a deſcription of the peculiar machinery of many mills; and the volumes of the *Encyclopédie Methodique*, which particularly relate to the mechanic arts, already contain many more. All that we can do in this place is, to conſider the chief circumſtances that are common to all water-mills; and from which all muſt derive their efficacy. Theſe circumſtances are to be found in the manner of employing water as an acting power, and moſt of them are comprehended in the conſtruction of water-wheels. When we have explained the principles and the maxims of conſtruction of a water-wheel, every reader converſant in mechanics knows, that the axis of this wheel may be employed to tranſmit the force impreſſed on it to any ſpecies of machinery. Therefore nothing ſubſequent to this can with propriety be conſidered as *water-works*.

Water-wheels are of two kinds, diſtinguiſhed by the manner in which water is made an impelling power, viz. by its weight, or by its impulſe. This requires a very different form and manner of adaptation; and this forms an oſtenſible diſtinction, ſufficiently obvious to give a name to each claſs. When water is made to act by its weight, it is delivered from the ſpout as high on the wheel as poſſible, that it may continue long to preſs it down: but when it is made to ſtrike the wheel, it is delivered as low as poſſible, that it may have previouſly acquired a great velocity. And thus the wheels are ſaid to be OVERSHOT or UNDERSHOT.

Of Overſhot Wheels.

THIS is nothing but a frame of open buckets, ſo diſpoſed round the rim of a wheel as to receive the water delivered from a ſpout; ſo that one ſide of the wheel is loaded with water, while the other is empty. The conſequence muſt be, that the loaded ſide muſt deſcend. By this motion the water runs out of the lower buckets, while the empty buckets of the riſing ſide of the wheel come under the ſpout in their turn, and are filled with water.

If it were poſſible to conſtruct the buckets in ſuch a manner as to remain completely filled with water till they come to the very bottom of the wheel, the preſſure with which the water urges the wheel round its axis would be the ſame as if the extremity of the horizontal radius were continually loaded with a quantity of water ſufficient to fill a ſquare pipe, whoſe ſection is equal to that of the bucket, and whoſe length is the diameter of the wheel. For let the buckets BD and EF (fig. 5.) be compared together, the arches DB and EF are equal. The mechanical energy of the water contained in the bucket EF, or the preſſure with which its weight urges the wheel, is the ſame as if all this water were hung on that point T of the horizontal arm CF, where it is cut by the vertical or plumb line BT. This is plain from the moſt elementary principles of mechanics. Therefore the effect of the bucket BD is to that of the bucket EF as CT to CF or CB. Draw the horizontal lines PB*bb*, QD*dd*. It is plain, that if BD is taken very ſmall, ſo that it may be conſidered as a ſtraight line, BD : BO = CB : BP, and EF : *bd* = CF : CT, and EF × CT = *bd* × CF. Therefore if the priſm of water, whoſe vertical ſection is *bbdd*, were hung on at F, its force to urge the wheel round would be the ſame as that of the water lying in the bucket BD. The ſame may be ſaid of every bucket; and the effective preſſure of the whole ring of water A*f*HKFI, in its natural ſituation, is the ſame with the pillar of water *abba* hung on at F. And the effect of any portion BF of this ring is the ſame with that of the correſponding portion *b*F*fb* of the vertical pillar. We do not take into account the ſmall difference which ariſes from the depth B or F*f*, becauſe we may ſuppoſe the circle deſcribed through the centres of gravity of the buckets. And in the farther proſecution of this ſubject, we ſhall take ſimilar liberties, with the view of ſimplifying the ſubject, and ſaving time to the reader.

But ſuch a ſtate of the wheel is impoſſible. The bucket at the very top of the wheel may be completely filled with water; but when it comes into the oblique poſition BD, a part of the water muſt run over the outer edge *d*, and the bucket will only retain the quantity ZBD*d*; and if the buckets are formed by partitions directed to the axis of the wheel, the whole water muſt be run out by the time that they deſcend to the level of the axis. To prevent this many contrivances have been adopted. The wheel has been ſurrounded with a hoop or ſweep, conſiſting of a circular board, which comes almoſt into contact with the rim of the wheel, and terminates at H, where the water is allowed to run off. But unleſs the work is executed with uncommon accuracy, the wheel made exactly round, and the ſweep exactly fitting it, a great quantity of water eſcapes between them; and there is a very ſenſible obſtruction to the motion of ſuch a wheel, from ſomething like friction between the water and the ſweep. Froſt alſo effectually ſtops the motion of ſuch a wheel. Sweeps have therefore been generally laid aſide, although there are ſituations where they might be uſed with good effect.

Mill-wrights have turned their whole attention to the giving a form to the buckets which ſhall enable them to retain the water along a great portion of the circumference of the wheel. It would be endleſs to deſcribe all theſe contrivances; and we ſhall therefore content ourſelves with one or two of the moſt approved. The intelligent reader will readily ſee that many of the circumſtances which concur in producing the ultimate effect (ſuch as the facility with which the water is received into the buckets, the place which it is to occupy during the progreſs of the bucket from the top to the bottom of the wheel, the readineſs with which they are evacuated, or the chance that the water has of being dragged beyond the bottom of the wheel by its adheſion, &c. &c.) are ſuch as do not admit of preciſe calculation or reaſoning about their merits; and that this or that form can ſeldom be evidently demonſtrated to be the very beſt poſſible. But, at the ſame time, he will ſee the general reaſons of preference, and his attention will be directed to circumſtances which muſt be attended to, in order to have a good bucketed wheel.

Fig. 6. is the outline of a wheel having 40 buckets. The ring of board contained between the concentric circles QDS and PAR, making the ends of the buckets, is called the SHROUDING, in the language of the art, and QP is called the *depth of ſhrouding*. The inner circle PAR is called the SOLE of the wheel, and uſually conſiſts of boards nailed to ſtrong wooden rings of compaſs timber of conſiderable ſcantling, firmly united with the ARMS or radii. The partitions, which determine the form of the buckets, conſiſt of three different planes or boards AB, BC, CD, which are variouſly named by different artiſts. We have heard them named the START or SHOULDER, the ARM, and the WREST (probably for wriſt, on account of a reſemblance of the whole line to the human arm); B is alſo called the ELBOW. Fig. 7. repreſents a ſmall portion of the ſame bucketing on a larger ſcale, that the proportions of the parts may be more diſtinctly ſeen. AG, the ſole of one bucket, is made about $\frac{1}{5}$th more than the depth GH of the ſhrouding. The ſtart AB is $\frac{1}{2}$ of AI. The plane BC is ſo inclined to AB that it would paſs through H; but it is made to terminate in C, in ſuch a manner that FC is $\frac{5}{6}$ths of GH or AI. Then CD is ſo placed that HD is about $\frac{1}{5}$th of IH.

By this conſtruction, it follows that the area FABC is very nearly equal to DABC; ſo that the water which will fill the ſpace FABC will all be contained in the bucket when it ſhall come into ſuch a poſition that AD is a horizontal line; and the line AB will then make an angle of nearly 35° with the vertical, or the bucket will be 35° from the perpendicular. If the bucket deſcend ſo much lower that one half of the water runs out, the line AB will make an angle of 25°, or 24° nearly, with the vertical. Therefore

fore the wheel, filled to the degree now mentioned, will *begin* to loſe water at about $\frac{1}{8}$th of the diameter from the bottom, and *half of the water will be diſcharged* from the loweſt bucket, about $\frac{1}{12}$th of the diameter farther down. Theſe ſituations of the diſcharging bucket are marked at T and V in fig. 6. Had a greater proportion of the buckets been filled with water when they were under the ſpout, the diſcharge would have begun at a greater height from the bottom, and we ſhould loſe a greater portion of the whole fall of water. The loſs by the preſent conſtruction is leſs than $\frac{1}{10}$th (ſuppoſing the water to be delivered into the wheel at the very top), and may be eſtimated at about $\frac{1}{11}$; for the loſs is the verſed ſine of the angle which the radius of the bucket makes with the vertical. The verſed ſine of 35° is nearly $\frac{1}{5}$th of the radius (being 0,18085), or $\frac{1}{10}$th of the diameter. It is evident, that if only $\frac{1}{2}$ of this water were ſupplied to each bucket as it paſſes the ſpout, it would have been retained for 10° more of a revolution, and the loſs of fall would have been only about $\frac{1}{18}$th.

Theſe obſervations ſerve to ſhow, in general, that an advantage is gained by having the buckets ſo capacious that the quantity of water which each can receive as it paſſes the ſpout may not nearly fill it. This may be accompliſhed by making them of a ſufficient length, that is, by making the wheel ſufficiently broad between the two ſhroudings. Economy is the only objection to this practice, and it is generally very ill placed. When the work to be performed by the wheel is great, the addition of power gained by a greater breadth will ſoon compenſate for the additional expence.

The third plane CD is not very frequent; and millwrights generally content themſelves with continuing the board all the way from the elbow B to the outer edge of the wheel at H; and AB is generally no more than $\frac{1}{3}$d of the depth AI. But CD is a very evident improvement, cauſing the wheel to retain a very ſenſible addition to the water. Some indeed make this addition more conſiderable, by bringing BC more outward, ſo as to meet the rim of the wheel at H, for inſtance, and making HD coincide with the rim. But this makes the entry of the water ſomewhat more difficult during the very ſhort time that the opening of the bucket paſſes the ſpout. To facilitate this as much as poſſible, the water ſhould get a direction from the ſpout, ſuch as will ſend it into the buckets in the moſt perfect manner. This may be obtained by delivering the water through an aperture that is divided by thin plates of board or metal, placed in the proper poſition, as we have repreſented in fig. 6. The form of bucket laſt mentioned, having the wreſt concentric with the rim, is unfavourable to the ready admiſſion of the water; whereas an oblique wreſt conducts the water which has miſſed one bucket into the next below.

The mechanical conſideration of this ſubject alſo ſhows us, that a deep ſhrouding, in order to make a capacious bucket, is not a good method: it does not make the buckets retain their water any longer; and it diminiſhes the effective fall of water; for the water received at the top of the wheel immediately falls to the bottom of the bucket, and thus ſhortens the fictitious pillar of water, which we ſhowed to be the meaſure of the effective or uſeful preſſure on the wheel: and this concurs with our former reaſons for recommending as great a breadth of the wheel, and length of buckets, as economical conſiderations will permit.

A bucket wheel has been executed lately by Mr Robert Burns, at the cotton mills of Houſton, Burns, and Co. at Cartſide in Renfrewſhire, of a conſtruction entirely new, but founded on a good principle, which is ſuſceptible of great extenſion. It is repreſented in fig. 8. The bucket conſiſts of a ſtart AB, an arm BC, and a wreſt CD, concentric with the rim. But the bucket is alſo divided by a partition LM, concentric with the ſole and rim, and ſo placed as to make the inner and outer portions of nearly equal capacity. It is evident, without any farther reaſoning about it, that this partition will enable the bucket to retain its water much longer. When they are filled $\frac{1}{3}$d, they retain the whole water at 18° from the bottom; and they retain $\frac{1}{2}$ at 11°. They do not admit the water quite ſo freely as buckets of the common conſtruction; but by means of the contrivance mentioned a little ago for the ſpout (alſo the invention of Mr Burns, and furniſhed with a race-work, which raiſed or depreſſed it as the ſupply of water varied, ſo as at all times to employ the whole fall of the water), it is found, that a ſlow moving wheel allows one half of the water to get into the inner buckets, eſpecially if the partition do not altogether reach the radius drawn through the lip D of the outer bucket.

This is a very great improvement of the bucket-wheel; and when the wheel is made of a liberal breadth, ſo that the water may be very ſhallow in the buckets, it ſeems to carry the performance as far as it can go. Mr Burns made the firſt trial on a wheel of 24 feet diameter; and its performance is manifeſtly ſuperior to that of the wheel which it replaced, and which was a very good one. It has alſo another valuable property: When the ſupply of water is very ſcanty, a proper adjuſtment of the apparatus in the ſpout will direct almoſt the whole of the water into the outer buckets; which, by placing it at a greater diſtance from the axis, makes a very ſenſible addition to its mechanical energy.

We ſaid that this principle is ſuſceptible of conſiderable extenſion; and it is evident that two partitions will increaſe the effect, and that it will increaſe with the number of partitions: ſo that when the practice now begun, of making water-wheels of iron, ſhall become general, and therefore very thin partitions are uſed, their number may be greatly increaſed without any inconvenience: and it is obvious, that this ſeries of partitions muſt greatly contribute to the ſtiffneſs and general firmneſs of the whole wheel.

There frequently occurs a difficulty in the making of bucket-wheels, when the half-taught mill-wright attempts to retain the water a long time in the buckets. The water gets into them with a difficulty which he cannot account for, and ſpills all about, even when the buckets are not moving away from the ſpout. This ariſes from the air, which muſt find its way out to admit the water, but is obſtructed by the entering water, and occaſions a great ſputtering at the entry. This may be entirely prevented by making the ſpout conſiderably narrower than the wheel. This will leave room at the two ends of the buckets for the eſcape of the air. This obſtruction is vaſtly greater than one would imagine; for the water drags along with it a great quantity of air, as is evident in the *Water-blaſt* deſcribed by many authors.

There is another and very ſerious obſtruction to the motion of an overſhot or bucketed wheel. When it moves in back-water, it is not only reſiſted by the water, when it moves more ſlowly than the wheel, which is very frequently the caſe, but it lifts a great deal in the riſing buckets. In ſome particular ſtates of back-water, the deſcending bucket fills itſelf completely with water; and, in other caſes, it contains a very conſiderable quantity, and air of common denſity; while in ſome rarer caſes it contains leſs water, with air in a condenſed ſtate. In the firſt caſe, the riſing bucket muſt come up filled with water, which it cannot drop till its mouth get out of the water. In the ſecond caſe, part of the water goes out before this; but the air rarefies, and therefore there is ſtill ſome water dragged or lifted up by the wheel, by ſuction as it is uſually called. In the laſt caſe there is no ſuch back load on the riſing ſide of the wheel, but (which is as detrimental to its performance) the deſcending ſide is employed in condenſing air; and although this air aids the aſcent of the riſing ſide, it does not aid it ſo much as it impedes the deſcending ſide, being (by the form of the bucket) nearer to the vertical line drawn thro' the axis.

All this may be completely prevented by a few holes made in the ſturt of each bucket. Air being at leaſt 800 times rarer than water, will eſcape through a hole almoſt 30 times faſter with the ſame preſſure. Very moderate holes will therefore ſuffice for this purpoſe: and the ſmall quantity of water which theſe holes diſcharge during the deſcent of the buckets, produces a loſs which is altogether inſignificant. The water which runs out of one runs into another, ſo that there is only the loſs of one bucket. We have ſeen a wheel of only 14 feet diameter working in nearly three feet of back-water. It laboured prodigiouſly, and brought up a great load of water, which fell from it in abrupt daſhes, which rendered the motion very hobbling. When three holes of an inch diameter were made in each bucket (12 feet long), the wheel laboured no more, there was no more plunging of water from its riſing ſide, and its power on the machinery was increaſed more than ¼th.

Theſe practical obſervations may contain information that is new even to ſeveral experienced mill-wrights. To perſons leſs informed they cannot fail of being uſeful. We now proceed to conſider the action of water thus lying in the buckets of a wheel: and to aſcertain its energy as it may be modified by different circumſtances of fall, velocity, &c.

With reſpect to variations in the fall, there can be little room for diſcuſſion. Since the active preſſure is meaſured by the pillar of water reaching from the horizontal plane where it is delivered on the wheel, to the horizontal plane where it is ſpilled by the wheel, it is evident that it muſt be proportional to this pillar, and therefore we muſt deliver it as high and retain it as long as poſſible.

This maxim obliges us, in the firſt place, to uſe a wheel whoſe diameter is equal to the whole fall. We ſhall not gain any thing by employing a larger wheel; for although we ſhould gain by uſing only that part of the circumference where the weight will act more perpendicularly to the radius, we ſhall loſe more by the neceſſity of diſcharging the water at a greater height from the bottom: For we muſt ſuppoſe the buckets of both the wheels equally well conſtructed; in which caſe, the heights above the bottom, where they will diſcharge the water, will increaſe in the proportion of the diameter of the wheel. Now, that we ſhall loſe more by this than we gain by a more direct application of the weight, is plain, without any further reaſoning, by taking the extreme caſe, and ſuppoſing our wheel enlarged to ſuch a ſize, that the uſeleſs part below is equal to our whole fall. In this caſe the water will be ſpilled from the buckets as ſoon as it is delivered into them. All intermediate caſes, therefore, partake of the imperfection of this.

When our fall is exceedingly great, a wheel of an equal diameter becomes enormouſly big and expenſive, and is of itſelf an unmanageable load. We have ſeen wheels of 58 feet diameter, however, which worked extremely well; but they are of very difficult conſtruction, and extremely apt to warp and go out of ſhape by their weight. In caſes like this, where we are unwilling to loſe any part of the force of a ſmall ſtream, the beſt form of a bucket-wheel is an inverted chain-pump. Inſtead of employing a chain-pump of the beſt conſtruction, ABCDEA (fig. 9.) to raiſe water through the upright pipe CB, by means of a force applied to the upper wheel A, let the water be delivered from a ſpout F, into the upper part of the pipe BC, and it will preſs down the plugs in the lower and narrower bored part of it with the full weight of the column, and eſcape at the dead level of C. This weight will urge round the wheel A without any defalcation; and this is the moſt powerful manner that any fall of water whatever can be applied, and exceeds the moſt perfect overſhot wheel. But though it excels all chains of buckets in economy and in effect, it has all the other imperfections of this kind of machinery. Though the chain of plugs be of great ſtrength, it has ſo much motion in its joints that it needs frequent repairs; and when it breaks, it is generally in the neighbourhood of A, on the loaded ſide, and all comes down with a great craſh. There is alſo a loſs of power by the immerſion of ſo many plugs and chains in the water; for there can be no doubt but that if the plugs were big enough and little enough, they would buoy and even draw up the plugs in the narrow part at C. They muſt therefore diminiſh, in all other caſes, the force with which this plug is preſſed down.

The velocity of an overſhot wheel is a matter of very great nicety; and authors, both ſpeculative and practical, have entertained different, nay oppoſite, opinions on the ſubject. Mr Belidor, whom the engineers of Europe have long been accuſtomed to regard as ſacred authority, maintains, that there is a certain velocity related to that obtainable by the whole fall, which will procure to an overſhot wheel the greateſt performance. Deſaguilliers, Smeaton, Lambert, Des Parceux, and others, maintain, that there is no ſuch relation, and that the performance of an overſhot-wheel will be the greater, as it moves more ſlowly by an increaſe of its load of work. Belidor maintains, that the active power of water lying in a bucket-wheel of any diameter is equal to that of the impulſe of the ſame water on the floats of an underſhot wheel, when the water iſſues from a ſluice in the bottom of the dam. The other writers whom we have named aſſert, that the energy of an underſhot-wheel is but one-half of that of an overſhot, actuated by the ſame quantity of water falling from the ſame height.

To a manufacturing country like Britain, which derives the aſtoniſhing ſuperiority, by which it more than compenſates for the impediments of heavy taxes and luxurious living chiefly from its machinery, in which it leaves all Europe far behind, the deciſion of this queſtion, in ſuch a manner as ſhall leave no doubt or miſconception in the mind even of an unlettered artiſt, muſt be conſidered as a material ſervice; and we think that this is eaſily attainable.

When any machine moves uniformly, the accelerating force or preſſure actually exerted on the impelled point of the machine is in equilibrio with all the reſiſtances which are exerted at the working point with thoſe ariſing from friction, and thoſe that are excited in different parts of the machine by their mutual actions. This is an inconteſtable truth; and though little attended to by the mechanicians, is the foundation of all practical knowledge of machines. Therefore, when an overſhot-wheel moves uniformly, with *any velocity whatever*, the water is acting with its whole weight: for gravity would accelerate its deſcent, if not completely balanced by ſome reaction; and in this balance gravity and the reacting part of the machine exert equal and oppoſite preſſures, and thus produce the uniform motion of the machine. We are thus particular on this point, becauſe we obſerve mechanicians of the firſt name employing a mode of reaſoning on the queſtion now before us which is ſpecious, and appears to prove the concluſion which they draw; but is nevertheleſs contrary to true mechanical principles. They aſſert, that the ſlower a heavy body is deſcending (ſuppoſe in a ſcale ſuſpended from an axis in peritrochea), the more does it preſs on the ſcale, and the more does it urge the machine round; and therefore the ſlower an overſhot wheel turns, the greater is the force with which the water urges it round, and the more work will be done. It is very true that the machine is more forcibly impelled, and that more work is done: but this is not becauſe a pound of water preſſes more ſtrongly, but becauſe there is more water preſſing on the wheel; for the ſpout ſupplies at the ſame rate, and each bucket receives more water as it paſſes by it.

Let us therefore examine this queſtion by the unqueſtionable principles of mechanics.

Let the overſhot-wheel A f H (fig. 5.) receive the water from a ſpout at the very top of the wheel; and, in order that the wheel may not be retarded by dragging into motion the water ſimply laid into the uppermoſt bucket at A, let it be received at B, with the velocity (directed in a tangent to the wheel) acquired by the head of water AP. This velocity, therefore, muſt be equal to that of the rim of the wheel. Let this be v, or let the wheel and the water move over v inches in a ſecond. Let the buckets be of ſuch dimenſions, that all the water which each receives as it paſſes the ſpout is retained till it comes to the poſition R, where it is diſcharged at once. It is plain that, in place of the ſeparate quantities of water lying in each bucket, we may ſubſtitute a continued ring of water, equal to their ſum, and uniformly diſtributed in the ſpace BER $\rho f \beta$. This conſtitutes a ring of uniform thickneſs. Let the area of its croſs ſection β B or F f be called a. We have already demonſtrated, that the mechanical energy with which this water on the circumference of the wheel urges it round, is the ſame with what would be exerted by the pillar $b\,r\,r\,b$ preſſing on F f, or acting by the lever CF. The weight of this pillar may be expreſſed by $a \times b\,r$, or $a \times \text{PS}$; and if we call the radius CF of the wheel R, the momentum or mechanical energy of this weight will be repreſented by $a \times \text{PS} \times \text{R}$.

Now, let us ſuppoſe that this wheel is employed to raiſe a weight W, which is ſuſpended by a rope wound round the axis of the wheel. Let r be the radius of this axle. Then $\text{W} \times r$ is the momentum of the work. Let the weight riſe with the velocity u when the rim of the wheel turns with the velocity v, that is, let it riſe u inches in a ſecond.

Since a perfect equilibrium obtains between the power and the work when the motion is uniform, we muſt have $\text{W} \times r = a \times \text{PS} \times \text{R}$. But it is evident that $\text{R} : r = v : u$ Therefore $\text{W} \times u = a \times v \times \text{PS}$.

Now the performance of the machine is undoubtedly meaſured by the weight and the height to which it is raiſed in a ſecond, or by $\text{W} \times u$. Therefore the machine is in its beſt poſſible ſtate when $a \times v \times \text{PS}$ is a maximum. But it is plain that $a \times v$ is an invariable quantity; for it is the cubic inches of water which the ſpout ſupplies in a ſecond. If the wheel moves faſt, little water lies in each bucket, and a is ſmall. When v is ſmall, a is great, for the oppoſite reaſon; but $a \times v$ remains the ſame. Therefore we muſt make PS a maximum, that is, we muſt deliver the water as high up as poſſible. But this diminiſhes AP, and this diminiſhes the velocity of the wheel: and as this has no limit, the propoſition is demonſtrated; and an overſhot-wheel does the more work as it moves ſloweſt.

Convincing as this diſcuſſion muſt be to any mechanician, we are anxious to impreſs the ſame maxim on the minds of practical men, unaccuſtomed to mathematical reaſoning of any kind. We therefore beg indulgence for adding a popular view of the queſtion, which requires no ſuch inveſtigation.

We may reaſon in this way: Suppoſe a wheel having 30 buckets; and that ſix cubic feet of water are delivered in a ſecond on the top of the wheel, and diſcharged without any loſs by the way at a certain height from the bottom of the wheel. Let this be the caſe, whatever is the rate of the wheel's motion; the buckets being of a ſufficient capacity to hold all the water which falls into them. Let this wheel be employed to raiſe a weight of any kind, ſuppoſe water in a chain of 30 buckets, to the ſame height, and with the ſame velocity. Suppoſe, farther, that when the load on the riſing ſide of the machine is one-half of that on the wheel, the wheel makes four turns in a minute, or one turn in 15 ſeconds. During this time 90 cubic feet of water have flowed into the 30 buckets, and each has received three cubic feet. Then each of the riſing buckets contains $1\frac{1}{2}$ feet; and 45 cubic feet are delivered into the upper ciſtern during one turn of the wheel, and 180 cubic feet in one minute.

Now, ſuppoſe the machine ſo loaded, by making the riſing buckets more capacious, that it makes only two turns in a minute, or one turn in 30 ſeconds. Then each deſcending bucket muſt contain ſix cubic feet of water. If each bucket of the riſing ſide contained three cubic feet, the motion of the machine would be the ſame as before. This is a point which no mechanician will controvert. When two pounds are ſuſpended to one end of a ſtring which paſſes over a pulley, and one pound to the other end, the deſcent of the two pound will be the ſame with that of a four pounds weight, which is employed in the ſame manner to draw up two pounds. Our machine would therefore continue to make four turns in the minute, and would deliver 90 cubic feet during each turn, and 360 in a minute. But, by ſuppoſition, it is making but two turns in a minute: this muſt proceed from a greater load than three cubic feet of water in each riſing bucket. The machine muſt therefore be raiſing *more* than 90 feet of water during one turn of the wheel, and *more* than 180 in the minute.

Thus it appears, that if the machine is turning twice as ſlow as before, there is *more than twice the former quantity* in the riſing buckets, and more will be raiſed in a minute by the ſame expenditure of power. In like manner, if the machine go three times as ſlow, there muſt be *more than three times* the former quantity of water in the riſing buckets, and more work will be done.

But we may go farther, and aſſert, that the *more* we retard the machine, by loading it with more work of a ſimilar kind, the greater will be its performance. This does not immediately appear from the preſent diſcuſſion: But let us call the firſt quantity of water in the riſing bucket A; the water raiſed by four turns in a minute will be $4 \times 30 \times \text{A}, = 120\,\text{A}$. The quantity in this bucket, when the machine goes twice as ſlow, has been ſhown to be greater than 2 A (call it $2\,\text{A} \times x$); the water raiſed by two turns in a minute will be $2 \times 30 \times \overline{2\,\text{A} + x} = 120\,\text{A} + 60\,x$. Now, let the machine go four times as ſlow, making but one turn in a minute, the riſing bucket muſt now contain more than twice $2\,\text{A} + x$, or more than $4\,\text{A} + 2\,x$; call it $4\,\text{A} + 2\,x + y$. The work done by one turn in a minute will now be $30 \times \overline{4\,\text{A} + 2\,x + y} = 120\,\text{A} + 60\,x + 30\,y$.

By ſuch an induction of the work, done with any rates of motion we chooſe, it is evident that the performance of the

Water-works.

the machine increaſes with every diminution of its velocity that is produced by the mere addition of a ſimilar load of work, or that it does the more work the ſlower it goes.

We have ſuppoſed the machine to be in its ſtate of permanent uniform motion. If we conſider it only in the beginning of its motion, the reſult is ſtill more in favour of ſlow motion: For, at the firſt action of the moving power, the inertia of the machine itſelf conſumes part of it, and it acquires its permanent ſpeed by degrees; during which, the reſiſtances ariſing from the work, friction, &c. increaſe, till they exactly balance the preſſure of the water; and after this the machine accelerates no more. Now the greater the power and the reſiſtance ariſing from the work are, in proportion to the inertia of the machine, the ſooner will all arrive at its ſtate of permanent velocity.

There is another circumſtance which impairs the performance of an overſhot-wheel moving with a great velocity, *viz.* the effects of the centrifugal force on the water in the buckets. Our mill-wrights know well enough, that too great velocity will throw the water out of the buckets; but few, if any, know exactly the diminution of power produced by this cauſe. The following very ſimple conſtruction will determine this: Let AOB (fig. 10.) be an overſhot wheel, of which AB is the upright diameter, and C is the centre. Make CF the length of a pendulum, which will make two vibrations during one turn of the wheel. Draw FE to the elbow of any of the buckets. The water in this bucket, inſtead of having its ſurface horizontal, as NO, will have it in the direction *n* O perpendicular to FE very nearly.

For the time of falling along half of FC is to that of two vibrations of this pendulum, or to the time of a revolution of the wheel as the radius of a circle is to its circumference: and it is well known, that the time of moving along half of AC, by the uniform action of the centrifugal force, is to that of a revolution as the radius of a circle to its circumference. Therefore the time of deſcribing $\frac{1}{2}$ of AC by the centrifugal force, is equal to the time of deſcribing $\frac{1}{2}$ of FC by gravity. Theſe ſpaces, being ſimilarly deſcribed in equal times, are proportional to the accelerating forces. Therefore $\frac{1}{2}$ FC : $\frac{1}{2}$ AC, or FC : AC = gravity : centrifugal force. Complete the parallelogram FCEK. A particle at E is urged by its weight in the direction KE, with a force which may be expreſſed by FC or KE; and it is urged by the centrifugal force in the direction CE, with a force = AC or CE. By their combined action it is urged in the direction FE. Therefore, as the ſurface of ſtanding water is always at right angles to the action of gravity, that is, to the plum-line, ſo the ſurface of the water in the revolving bucket is perpendicular to the action of the combined force FE.

Let NEO be the poſition of the bucket, which juſt holds all the water which it received as it paſſed the ſpout when not affected by the centrifugal force; and let NDO be its poſition when it would be empty. Let the vertical lines through D and E cut the circle deſcribed round C with the radius CF in the points H and I. Draw HC, IC, cutting the circle AOB in L and M. Make the arch $\delta'\delta$ equal to AL, and the arch $\epsilon'\epsilon$ equal to AM: Then Cδ and Cϵ will be the poſitions of the bucket on the revolving wheel, correſponding to CDO and CEO on the wheel at reſt. Water will begin to run out at ϵ, and it will be all gone at δ.—The demonſtration is evident.

The force which now urges the wheel is ſtill the weight *really* in the buckets: For though the water is urged in the direction and with the force FE, one of its conſtituents, CE, has no tendency to impel the wheel; and KE is the only impelling force.

It is but of late years that mills have been conſtructed or attended to with that accuracy and ſcientific ſkill which are neceſſary for deducing confidential concluſions from any experiments that can be made with them; and it is therefore no matter of wonder that the opinions of mill-wrights have been ſo different on this ſubject. There is a natural wiſh to ſee a machine moving briſkly; it has the appearance of activity: but a very ſlow motion always looks as if the machine were overloaded. For this reaſon mill-wrights have always yielded ſlowly and with ſome reluctance, to the repeated advices of the mathematicians: but they have yielded; and we ſee them adopting maxims of conſtruction more agreeable to ſound theory; making their wheels of great breadth, and loading them with a great deal of work. Mr Euler ſays, that the performance of the beſt mill cannot exceed that of the worſt above $\frac{1}{5}$th: but we have ſeen a ſtream of water completely expended in driving a ſmall flax mill, which now drives a cotton mill of 4000 ſpindles, with all its carding, roving, and drawing machinery, beſides the lathes and other engines of the ſmith and carpenters workſhops, exerting a force not leſs than ten times what ſufficed for the flax-mill.

The above diſcuſſion only demonſtrates in general the advantage of ſlow motion; but does not point out in any degree the relation between the rate of motion and the work performed, nor even the principles on which it depends. Yet this is a ſubject fit for mathematical inveſtigation; and we would proſecute it in this place, if it were neceſſary for the improvement of practical mechanics. But we have ſeen that there is not, in the nature of things, a maximum of performance attached to any particular rate of motion which ſhould therefore be preferred. For this reaſon we omit this diſcuſſion of mere ſpeculative curioſity. It is very intricate: For we muſt not now expreſs the preſſure on the wheel by a *conſtant* pillar of water incumbent on the extremity of the horizontal arm, as we did before when we ſuppoſed the buckets completely filled; nor by a ſmaller *conſtant* pillar, correſponding to a ſmaller but equal quantity lying in every bucket. Each different velocity puts a different quantity of water into the bucket as it paſſes the ſpout; and this occaſions a difference in the place where the diſcharge is begun and completed. This circumſtance is ſome obſtacle to the advantages of very ſlow motions, becauſe it brings on the diſcharge ſooner. All this may indeed be expreſſed by a ſimple equation of eaſy management; but the whole proceſs of the mechanical diſcuſſion is both intricate and tedious, and the reſults are ſo much diverſified by the forms of the buckets, that they do not afford any rule of ſufficient generality to reward our trouble. The curious reader may ſee a very full inveſtigation of this ſubject in two diſſertations by Elvius in the Swediſh Tranſactions, and in the *Hydrodynamique* of Profeſſor Karſtner of Gottingen; who has abridged theſe Diſſertations of Elvius, and conſiderably improved the whole inveſtigation, and has added ſome compariſons of his deductions with the actual performance of ſome great works. Theſe compariſons, however, are not very ſatisfactory. There is alſo a valuable paper on this ſubject by Mr Lambert, in the Memoirs of the Academy of Berlin for the year 1775. From theſe diſſertations, and from the *Hydrodynamique* of the Abbé Boſſut, the reader will get all that theory can teach of the relation between the preſſures of the power and work on the machine and the rates of its motion. The practical reader may reſt with confidence on the ſimple demonſtration we have given, that the performance is improved by diminiſhing the velocity.

All we have to do, therefore, is to load the machine, and thus to diminiſh its ſpeed, unleſs other phyſical circumſtances throw obſtacles in the way: but there are ſuch obſtacles.

ſtacles. In all machines there are little inequalities of action that are unavoidable. In the action of a wheel and pinion, though made with the utmoſt judgment and care, there are ſuch inequalities. Theſe increaſe by the changes of form occaſioned by the wearing of the machine—much greater irregularities ariſe from the ſubſultory motions of cranks, ſtampers, and other parts which move unequally or reciprocally. A machine may be ſo loaded as juſt to be in equilibrio with its work, in the favourable poſition of its parts. When this changes into one leſs favourable, the machine may ſtop; if not, it at leaſt ſtaggers, hobbles, or works unequally. The rubbing parts bear long on each other, with enormous preſſures, and cut deep, and increaſe friction. Such ſlow motions muſt therefore be avoided. A little more velocity enables the machine to get over thoſe increaſed reſiſtances by its inertia, or the great quantity of motion inherent in it. Great machines poſſeſs this advantage in a ſuperior degree, and will therefore work ſteadily with a ſmaller velocity. Theſe circumſtances are hardly ſuſceptible of mathematical diſcuſſion, and our beſt reliance is on well directed experience.

For this purpoſe, the reader will do well to peruſe with care the excellent paper by Mr Smeaton in the Philoſophical Transactions for 1759. This diſſertation contains a numerous liſt of experiments, moſt judiciouſly contrived by him, and executed with the accuracy and attention, to the moſt important circumſtances, which is to be obſerved in all that gentleman's performances.

It is true, theſe experiments were made with ſmall models; and we muſt not, without great caution, transfer the reſults of ſuch experiments to large works. But we may ſafely transfer the *laws* of variation which reſult from a variation of circumſtances, although we muſt not adopt the abſolute quantities of the variations themſelves. Mr Smeaton was fully aware of the limitations to which concluſions drawn from experiments on models are ſubject, and has made the applications with his uſual ſagacity.

His general inference is, that, in ſmaller works, the rim of the overſhot-wheel ſhould not have a greater velocity than three feet in a ſecond; but that larger mills may be allowed a greater velocity than this. When every thing is executed in the beſt manner, he ſays that the work performed will amount to fully two-thirds of the power expended; that is, that three cubic feet of water deſcending from any height will raiſe two to the ſame height. See ſome farther account of this diſſertation under the word MECHANICS, ſect. 5.

It is not very eaſy to compare theſe deductions with obſervations on larger works; becauſe there are few caſes where we have good meaſures of the reſiſtances oppoſed by the work performed by the machine. Mills employed for pumping water afford the beſt opportunities. But the inertia of their working gear diminiſhes their uſeful performance very ſenſibly; becauſe their great beams, pump-rods, &c. have a reciprocating motion, which muſt be deſtroyed, and produced anew in every ſtroke. We have examined ſome machines of this kind which are eſteemed good ones; and we find few of them whoſe performance exceeds one half of the power expended.

By comparing other mills with theſe, we get the beſt information of their reſiſtances. The compariſon with mills worked by Watt and Boulton's ſteam engines is perhaps a better meaſure of the reſiſtances oppoſed by different kinds of work, becauſe their power is very diſtinctly known. We have been informed by one of the moſt eminent engineers, that a ton and half of water *per* minute falling one foot will grind and dreſs one buſhel of wheat *per* hour. This is equivalent to 9 tons falling 10 feet.

If an overſhot-wheel oppoſed no reſiſtance, and only one bucket were filled, the wheel would acquire the velocity due to a fall through the whole height. But when it is in this ſtate of accelerated motion, if another bucket of water is delivered into it, its motion muſt be checked at the firſt, by the neceſſity of dragging forward this water. If the buckets fill in ſucceſſion as they paſs the ſpout the velocity acquired by an unreſiſting wheel is but half of that which one bucket would give. In all caſes, therefore, the velocity is diminiſhed by the inertia of the entering water when it is ſimply laid into the upper buckets. The performance will therefore be improved by delivering the water on the wheel with that velocity with which the wheel is really moving. And as we cannot give the direction of a tangent to the wheel, the velocity with which it is delivered on the wheel muſt be ſo much greater than the intended velocity of the rim, that it ſhall be preciſely equal to it when it is eſtimated in the direction of the tangent. Three or four inches of fall are ſufficient for this purpoſe: and it ſhould never be neglected, for it has a very ſenſible influence on the performance. But it is highly improper to give it more than this, with the view of impelling the wheel by its ſtroke. For even although it were proper to employ part of the fall in this way (which we ſhall preſently ſee to be very improper), we cannot procure this impulſe; becauſe the water falls among other water, or it ſtrikes the boards of the wheel with ſuch obliquity that it cannot produce any ſenſible effect.

It is a much debated queſtion among mill-wrights, Whether the diameter of the wheel ſhould be ſuch as that the water will be delivered at the top of the wheel? or larger, ſo that the water is received at ſome diſtance from the top, where it will act more perpendicularly to the arm? We apprehend that the obſervations formerly made will decide in favour of the firſt practice. The ſpace below, where the water is diſcharged from the wheel, being proportional to the diameter of the wheel, there is an undoubted loſs of fall attending a large wheel; and this is not compenſated by delivering the water at a greater diſtance from the perpendicular. We ſhould therefore recommend the uſe of the whole deſcending ſide, and make the diameter of the wheel no greater than the fall, till it is ſo much reduced that the centrifugal force begins to produce a ſenſible effect. Since the rim can hardly have a ſmaller velocity than three feet *per* ſecond, it is evident that a ſmall wheel muſt revolve more rapidly. This made it proper to inſert the determination that we have given, of the loſs of power produced by the centrifugal force. But even with this in view, we ſhould employ much ſmaller wheels than are generally done on ſmall falls. Indeed the loſs of water at the bottom may be diminiſhed, by nicely fitting the arch which ſurrounds the wheel, ſo as not to allow the water to eſcape by the ſides or bottom. While this improvement remains in good order, and the wheel entire, it produces a very ſenſible effect; but the paſſage widens continually by the wearing of the wheel. A bit of ſtick or ſtone falling in about the wheel tears off part of the ſhrouding or bucket, and froſty weather frequently binds all faſt. It therefore ſeldom anſwers expectations. We have nothing to add on this caſe to what we have already extracted from Mr Smeaton's Diſſertation on the Subject of Breaſt or half Overſhot Wheels.

There is another form of wheel by which water is made to act on a machine by its weight, which merits conſideration. This is known in Britain by the name of *Barker's mill*, and has been deſcribed by Deſaguilliers, vol. ii. p. 460. It conſiſts of an upright pipe or trunk AB (fig. 11), communicating with two horizontal branches BC, B*c*, which have a hole C *c* near their ends, opening in oppoſite directions, at right angles to their lengths. Suppoſe water to be poured in at the top from the ſpout F, it will run out by the holes C and *c* with the velocity correſponding to the depth of theſe holes under the ſurface. The conſequence of this muſt be, that the arms will be preſſed backwards; for there is no ſolid ſurface at the hole C, on which the lateral preſſure of the water can be exerted, while it acts with its full force on the oppoſite ſide of the arm. This unbalanced preſſure is equal to the weight of a column having the orifice for its baſe, and twice the depth under the ſurface of the water in the trunk for its height. This meaſure of the height may ſeem odd, becauſe if the orifice were ſhut, the preſſure on it is the weight of a column reaching from the ſurface. But when it is open, the water iſſues with nearly the velocity acquired by falling from the ſurface, and the quantity of motion produced is that of a column of twice this length, moving with this velocity. This is actually produced by the preſſure of the fluid, and muſt therefore be accompanied by an equal reaction.

Now ſuppoſe this apparatus ſet on the pivot E, and to have a ſpindle AD above the trunk, furniſhed with a cylindrical bobbin D, having a rope wound round it, and paſſing over a pulley G. A weight W may be ſuſpended there, which may balance this backward preſſure. If the weight be too ſmall for this purpoſe, the retrograde motion of the arms will wind up the cord, and raiſe the weight; and thus we obtain an acting machine, employing the preſſure of the water, and applicable to any purpoſe. A runner millſtone may be put on the top of the ſpindle; and we ſhould then produce a flour mill of the utmoſt ſimplicity, having neither wheel nor pinion, and ſubject to hardly any wear. It is ſomewhat ſurpriſing, that although this was invented at the beginning of this century, and appears to have ſuch advantage in point of ſimplicity, it has not come into uſe. So little has Dr Deſaguilliers's account been attended to (although it is mentioned by him as an excellent machine, and as highly inſtructive to the hydrauliſt), that the ſame invention was again brought forward by a German profeſſor (Segner) as his own, and has been honoured by a ſeries of elaborate diſquiſitions concerning its theory and performance by Euler and by John Bernoulli. Euler's Diſſertations are to be found in the Memoirs of the Academy of Berlin, 1751, &c. and in the *Nov. Comment. Petropol.* tom. vi. Bernoulli's are at the end of his Hydraulics. Both theſe authors agree in ſaying, that this machine excels all other methods of employing the force of water. Simple as it appears, its true theory, and the beſt form of conſtruction, are moſt abſtruſe and delicate ſubjects; and it is not eaſy to give ſuch an account of its principles as will be underſtood by an ordinary reader.

We ſee, in general, that the machine muſt preſs backwards; and little inveſtigation ſuffices for underſtanding the intenſity of this preſſure, when the machine is at reſt. But when it is allowed to run backwards, withdrawing itſelf from the preſſure, the intenſity of it is diminiſhed; and if no other circumſtances intervened, it might not be difficult to ſay what particular preſſure correſponded to any rate of motion. Accordingly, Deſaguilliers, preſuming on the ſimplicity of the machine, affirms the preſſure to be the weight of a column, which would produce a velocity of efflux equal to the difference of the velocity of the fluid and of the machine; and hence he deduces, that its performance will be the greateſt poſſible, when its retrograde velocity is one-third of the velocity acquired by falling from the ſurface, in which caſe, it will raiſe $\frac{8}{27}$ths of the water expended to the ſame height, which is double of the performance of a mill acted on by the impulſe of water.

But this is a very imperfect account of the operation. When the machine (conſtructed exactly as we have deſcribed) moves round, the water which iſſues deſcends in the vertical trunk, and then, moving along the horizontal arms, partakes of this circular motion. This excites a centrifugal force, which is exerted againſt the ends of the arms by the intervention of the fluid. The whole fluid is ſubjected to this preſſure (increaſing for every ſection acroſs the arm in the proportion of its diſtance from the axis), and every particle is preſſed with the accumulated centrifugal forces of all the ſections that are nearer to the axis. Every ſection therefore ſuſtains an actual preſſure proportional to the ſquare of its diſtance from the axis. This increaſes the velocity of efflux, and this increaſes the velocity of revolution; and this mutual co-operation would ſeem to terminate in an infinite velocity of both motions. But, on the other hand, the circular motion muſt be given anew to every particle of water as it enters the horizontal arm. This can be done only by the motion already in the arm, and at its expence. Thus there muſt be a velocity which cannot be overpaſſed even by an unloaded machine. But it is alſo plain, that by making the horizontal arm very capacious, the motion of the water from the axis to the jet may be made very ſlow, and much of this diminution of circular motion prevented. Accordingly, Euler has recommended a form by which this is done in the moſt eminent degree. His machine conſiſts of a hollow conoidal ring, of which fig. 12. is a ſection. The part AH*ha* is a ſort of funnel baſon, which receives the water from the ſpout F; not in the direction pointing towards the axis, but in the direction, and with the preciſe velocity of its motion. This prevents any retardation by dragging forward the water. The water then paſſes down between the outer conoid AC*ca* and the inner conoid HG*gh* along ſpiral channels formed by partitions ſoldered to both conoids. The curves of theſe channels are determined by a theory which aims at the annihilation of all unneceſſary and improper motions of the water, but which is too abſtruſe to find a place here. The water thus conducted arrives at the bottom CG, *cg*. On the outer circumference of this bottom are arranged a number of ſpouts (one for each channel), which are all directed one way in tangents to the circumference.

Plate DXLII.

Adopting the common theory of the reaction of fluids, this ſhould be a very powerful machine, and ſhould raiſe $\frac{8}{27}$ths of the water expended. But if we admit the reaction to be equal to the force of the iſſuing fluid (and we do not ſee how this can be refuſed), the machine muſt be nearly twice as powerful. We therefore repeat our wonder, that it has not been brought into uſe. But it appears that no trial has been made even of a model; ſo that we have no experiments to encourage an engineer to repeat the trial. Even the late author Profeſſor Segner has not related any thing of this kind in his *Exercitationes Hydraulicæ*, where he particularly deſcribes the machine. This remiſſneſs probably has proceeded from fixing the attention on Euler's improved conſtruction. It is plain that this muſt be a moſt cumbrous maſs, even in a ſmall ſize, requiring a prodigious veſſel, and carrying an unwieldy load. If we examine the theory which recommends this conſtruction, we find that the advantages, tho' real and ſenſible, bear but a ſmall proportion to the whole performance of the ſimple machine as invented by Dr Barker. It is therefore to be regretted, that engineers have not attempted to realiſe the firſt project. We beg leave to recommend it, with an additional argument taken from an addition made to it by Mr Mathon de la Cour, in Rozier's *Journal de Phyſique*, January and Auguſt 1775. This gentleman brings down a large pipe FEH (fig. 13.) from a reſervoir, bends it upward at H, and introduces it into two horizontal arms DA, DB, which have an upright ſpindle DK, carrying

ing a millſtone in the ſtyle of Dr Barker's mill. The ingenious mechanician will have no difficulty of contriving a method of joining theſe pipes, ſo as to permit a free circular motion without loſing much water. The operation of the machine in this form is evident. The water, preſſed by the column FG, flows out at the holes A and B, and the unbalanced preſſure on the oppoſite ſides of the arms forces them round. The compendiouſneſs and other advantages of this conſtruction are moſt ſtriking, allowing us to make uſe of the greateſt fall without any increaſe of the ſize of the machine. It undoubtedly enables us to employ a ſtream of water too ſcanty to be employed in any other form. The author gives the dimenſions of an engine which he had ſeen at Bourg Argental. AB is 92 inches, and its diameter 3 inches; the diameter of each orifice is $1\frac{1}{6}$; FG is 21 feet; the pipe D was fitted into C by grinding; and the internal diameter of D is 2 inches.

When the machine was performing no work, or was unloaded, and emitted water by one hole only, it made 115 turns in a minute. This gives a velocity of 46 feet *per* ſecond for the hole. This is a curious fact: For the water would iſſue from this hole at reſt with the velocity of $37\frac{1}{6}$. This great velocity (which was much leſs than the velocity with which the water actually quitted the pipe) was undoubtedly produced by the prodigious centrifugal force, which was nearly 17 times the weight of the water in the orifice.

The empty machine weighed 80 pounds, and its weight was half ſupported by the upper preſſure of the water, ſo that the friction of the pivots was much diminiſhed. It is a pity that the author has given no account of any work done by the machine. Indeed it was only working ventilators for a large hall. His theory by no means embraces all its principles, nor is it well-founded.

We think that the free motion round the neck of the feeding pipe, without any loſs of water or any conſiderable friction, may be obtained in the following manner: AB (fig. 14.) repreſents a portion of the revolving horizontal pipe, and CE*ec* part of the feeding pipe. The neck of the firſt is turned truly cylindrical, ſo as to turn eaſily, but without ſhake, in the collar C*c* of the feeding-pipe, and each has a ſhoulder which may ſupport the other. That the friction of this joint may not be great, and the pipes deſtroy each other by wearing, the horizontal pipe has an iron ſpindle EF, fixed exactly in the axis of the joint, and reſting with its pivot F in a ſtep of hard ſteel, fixed to the iron bar GH, which goes acroſs the feeding-pipe, and is firmly ſupported in it. This pipe is made bell-ſhaped, widening below. A collar or hoſe of thin leather is fitted to the inſide of this pipe, and is repreſented (in ſection) by LKM*nkl*. This is kept in its place by means of a metal or wooden ring N*n*, thin at the upper edge, and taper ſhaped. This is drawn in above the leather, and ſtretches it, and cauſes it to apply to the ſide of the pipe all around. There can be no leakage at this joint, becauſe the water will preſs the leather to the ſmooth metal pipe; nor can there be any ſenſible friction, becauſe the water gets at the edge of the leather, and the whole unbalanced preſſure is at the ſmall crevice, between the two metal ſhoulders. Theſe ſhoulders need not touch, ſo that the friction muſt be inſenſible. We imagine that this method of tightening a turning joint may be uſed with great advantage in many caſes.

We have only farther to obſerve on this engine, that any imperfection by which the paſſage of the water is diminiſhed or obſtructed produces a ſaving of water which is in exact proportion to the diminution of effect. The only inaccuracy that is not thus compenſated is when the jets are not at right angles to the arms.

We repeat our wiſhes, that engineers would endeavour to bring this machine into uſe, ſeeing many ſituations where it may be employed to great advantage. Suppoſe, for inſtance, a ſmall ſupply of water from a great height applied in this manner to a centrifugal pump, or to a hair belt paſſing over a pulley, and dipping in the water of a deep well. This would be a hydraulic machine exceeding all others in ſimplicity and durability, though inferior in effect to ſome other conſtructions.

2. *Of Underſhot Wheels.*

All wheels go by this name where the motion of the water is quicker than that of the partitions or boards of the wheel, and it therefore impels them. Theſe are called the *float-boards*, or *floats*, of an underſhot wheel. The water, running in a mill-row, with a velocity derived from a head of water, or from a declivity of channel, ſtrikes on theſe floats, and occaſions, by its deflections ſidewiſe and upwards, a preſſure on the floats ſufficient for impelling the wheel.

There are few points of practical mechanics that have been more conſidered than the action of water on the floats of a wheel; hardly a book of mechanics being ſilent on the ſubject. But the generality of them, at leaſt ſuch as are intelligible to perſons who are not very much converſant in dynamical and mathematical diſcuſſion, have hardly done any thing more than copied the earlieſt deductions from the ſimple theory of the reſiſtance of fluids. The conſequence has been, that our practical knowledge is very imperfect; and it is ſtill chiefly from experience that we muſt learn the performance of underſhot wheels. Unfortunately this ſtops their improvement; becauſe thoſe who have the only opportunities of making the experiments are not ſufficiently acquainted with the principles of hydraulics, and are apt to aſcribe differences in their performance to trifling noſtrums in their conſtruction, or in the manner of applying the impulſe of the water.

We have ſaid ſo much on the imperfection of our theories of the impulſe of fluids in the article Resistance *of Fluids*, that we need not repeat here the defects of the common explanations of the motions of underſhot wheels. The part of this theory of the impulſe of fluids which agrees beſt with obſervation is, *that the impulſe is in the duplicate proportion of the velocity with which the water ſtrikes the float.* That is, if v be the velocity of the ſtream, and u the velocity of the float, we ſhall have F, the impulſe on the float when held faſt to its impulſe f on the float moving with the velocity u, as v^2 to $\overline{v-u}^2$, and $f = F \times \frac{\overline{v-u}^2}{v^2}$.

This is the preſſure acting on the float, and urging the wheel round its axis. The wheel muſt yield to this motion, if the reſiſtance of the work does not exert a ſuperior preſſure on the float in the oppoſite direction. By yielding, the float withdraws from the impulſe, and this is therefore diminiſhed. The wheel accelerates, the reſiſtances increaſe, and the impulſes diminiſh, till they become an exact balance for the reſiſtances. The motion now remains uniform, and the momentum of impulſe is equal to that of reſiſtance. The performance of the mill therefore is determined by this; and, whatever be the conſtruction of the mill, its performance is beſt when the momentum of impulſe is greateſt. This is had by multiplying the preſſure on the float by its velocity. Therefore the momentum will be expreſſed by $F \times \frac{\overline{v-u}^2}{v^2} \times u$. But ſince F and v^2 are conſtant quantities, the momentum will be proportional to $u \times \overline{v-u}^2$. Let x repreſent the relative velocity. Then $v-x$ will be $= u$, and the momentum will be proportional to $\overline{v-x} \times x^2$, and will be a maximum when $\overline{v-x} \times x^2$ is a maximum, or when $v x^2 - x^3$ is a maximum. This will be diſcovered by making its fluxion $= 0$. That is,

$$2 v x x - 3 x^2 x = 0.$$

and $$2 v x - 3 x^2 = 0$$

or $$2 v - 3 x = 0$$

and $2 v = 3 x$, and $x = \frac{2}{3} v$; and therefore $v-x$, or $u, = \frac{1}{3} v$. That is, the velocity of the float muſt be one third of the velocity of the ſtream. It only remains to ſay what is the abſolute preſſure on the float thus circumſtanced. Let the velocity v be ſuppoſed to ariſe from the preſſure of a head of water h. The common theory teaches that the impulſe on a given ſurface S at reſt is equal to the weight of a column h S; put this in place of F, and $\frac{4}{9} v^2$ in place of $\overline{v-u}^2$ and $\frac{1}{3} v$ for u. This gives us S $h \times \frac{4}{27} v$ for the momentum. Now the power expended is S h v, or the column S h moving with the velocity v. Therefore the greateſt performance of an underſhot wheel is equivalent to raiſing $\frac{4}{27}$ of the water that drives it to the ſame height.

But this is too ſmall an eſtimation; for the preſſure exerted on a plane ſurface, ſituated as the float of a mill-wheel, is conſiderably greater than the weight of the column S h. This is nearly the preſſure on a ſurface wholly immerſed in the fluid. But when a ſmall vein ſtrikes a larger plane, ſo as to be deflected on all ſides in a thin ſheet, the impulſe is almoſt double of this. This is in ſome meaſure the caſe in a mill wheel. When the ſtream ſtrikes it, it is heaped up along its face, and falls back again—and during this motion it is acting with a hydroſtatic preſſure on it. When the wheel dips into an open river, this accumulation is leſs remarkable, becauſe much eſcapes laterally. But in a mill courſe it may be conſiderable.

We have conſidered only the action on one float, but ſeveral generally act at once. The impulſe on moſt of them muſt be oblique, and is therefore leſs than when the ſame ſtream impinges perpendicularly; and this diminution of impulſe is, by the common theory, in the proportion of the ſine of the obliquity. For this reaſon it is maintained, that the impulſe of the whole ſtream on the loweſt float board, which is perpendicular to the ſtream, is equal to the ſum of the impulſes made on all the floats which then dip into the water; or that the impulſe on any oblique float is preciſely equal to the impulſe which that part of the ſtream would have made on the loweſt float board had it not been interrupted. Therefore it has been recommended to make ſuch a number of floatboards, that when one of them is at the bottom of the wheel, and perpendicular to the ſtream, the next in ſucceſſion ſhould be juſt entering into the water. But ſince the impulſe on a float by no means annihilates all the motion of the water, and it bends round it and hits the one behind with its remaining force, there muſt be ſome advantage gained by employing a greater number of floats than this rule will permit. This is abundantly confirmed by the experiments of Smeaton and Boſſut. Mr Boſſut formed three or four ſuppoſitions of the number of floats, and calculated the impulſe on each; according to the obſervations made in a courſe of experiments made by the Academy of Sciences, and inſerted by us in the article *Resistance of Fluids*; and when he ſummed them up and compared the reſults with his exriments, he found the agreement very ſatisfactory. He deduces a general rule, that if the velocity of the wheel is $\frac{1}{3}$d of that of the ſtream, and if 72 degrees of the circumference are immerſed in the ſtream, the wheel ſhould have 36 floats. Each will dip $\frac{1}{5}$th of the radius. The velocity being ſtill ſuppoſed the ſame, there ſhould be more or fewer floats according as the arch is leſs or greater than 72 degrees.

Such is the theory, and ſuch are the circumſtances which it leaves undetermined. The accumulation of the water on a floatboard, and the force with which it may ſtill ſtrike another, are too intricate to be aſſigned with any tolerable preciſion; For ſuch reaſons we muſt acknowledge that the theory of underſhot wheels is ſtill very imperfect, and that recourſe muſt be had to experience for their improvement. We therefore ſtrongly recommend the peruſal of Mr Smeaton's experiments on underſhot-wheels, contained in the ſame diſſertation with thoſe we have quoted on over-ſhot-wheels. We have only to obſerve, that to an ordinary reader the experiments will appear too much in favour of underſhot-wheels. His aim is partly to eſtabliſh a theory, which will ſtate the relation between their performance and the velocity of the ſtream, and partly to ſtate the relation between the power expended and the work done. The velocity in his experiments is always conſiderably below that which a body would acquire by falling from the ſurface of the head of water; or it is the velocity acquired by a ſhorter fall. Therefore if we eſtimate the power expended by the quantity of water multiplied by this diminiſhed fall, we ſhall make it too ſmall; and the difference in ſome caſes is very great: yet, even with theſe conceſſions, it appears that the utmoſt performance of an underſhot wheel does not ſurpaſs the raiſing $\frac{1}{3}$d of the expended water to the place from which it came. It is therefore far inferior to an overſhot wheel expending the ſame power; and Mr Belidor has led engineers into very miſtaken maxims of conſtruction, by ſaying that overſhot wheels ſhould be given up, even in the caſe of great falls, and that we ſhould always bring on the water from a ſluice in the very bottom of the dam, and bring it to the wheel with as great velocity as poſſible. Mr Smeaton alſo ſays, that the maximum takes place when the velocity of the wheel is $\frac{2}{5}$ths of that of the ſtream, inſtead of $\frac{2}{6}$ths according to the theory; and this agrees with the experiments of Boſſut. But he meaſured the velocity by means of the quantity of water which run paſt. This muſt give a velocity ſomewhat too ſmall; as will appear by attending to Buat's obſervations on the ſuperficial, the mean, and the bottom velocities.

The reſt of his obſervations, of which we have given an abſtract in Mechanics, Sect. V. are moſt judicious, and well adapted to the inſtruction of practitioners. We have only to add to them the obſervations of Deparceux and Boſſut, who have evinced, by very good experiments, that there is a very ſenſible advantage gained by inclining the floatboards to the radius of the wheel about 20 degrees, ſo that the loweſt floatboard ſhall not be perpendicular, but have its point turned up the ſtream about 20 degrees. This inclination cauſes the water to heap up along the floatboard, and act by its weight. The floats ſhould therefore be made much broader than the vein of water interrupted by them is deep.

Some engineers, obſerving the great ſuperiority of overſhot wheels above underſhot wheels driven by the ſame expence of power, have propoſed to bring the water home to the bottom of the wheel on an even bottom, and to make the floatboard no deeper than the aperture of the ſluice, which would permit the water to run out. The wheel is to be fitted with a cloſe ſole and ſides, exactly fitted to the end of this trough, ſo that if the wheel is at reſt, the water may be dammed up by the ſole and floatboard. It will therefore preſs forward the floatboard with the whole force of the head of water. But this cannot anſwer; for if we ſuppoſe no floatboards, the water will flow out at the bottom, propelled in the manner thoſe perſons ſuppoſe; and it will be ſupplied from behind,

hind, the water coming *ſlowly* from all parts of the trough to the hole below the wheel. But now add the floats, and ſuppoſe the wheel in motion with the velocity that is expected. The other floats muſt drag into motion all the water which lies between them, giving to the greateſt part of it a motion vaſtly greater then it would have taken in conſequence of the preſſure of the water behind it; and the water out of the reach of the floats will remain ſtill, which it would not have done independent of the floatboards above it, becauſe it would have contributed to the expence of the hole. The motion therefore which the wheel will acquire by this conſtruction muſt be ſo different from what is expected, that we can hardly ſay what it will be.

We are therefore perſuaded, that the beſt way of delivering the water on an underſhot-wheel in a cloſe mill-courſe is, to let it ſlide down a very ſmooth channel, without touching the wheel till near the bottom, where the wheel ſhould be exactly fitted to the courſe; or, to make the floats exceedingly broader than the depth of the vein of water which glides down the courſe, and allow it to be partly intercepted by the firſt floats, and heap up along them, acting by its weight, after its impulſe has been expended. If the bottom of the courſe be an arch of a circle deſcribed with a radius much greater than that of the wheel, the water which ſlides down will be thus gradually intercepted by the floats.

Attempts have been made to conſtruct water-wheels which receive the impulſe obliquely, like the ſails of a common wind-mill. This would, in many ſituations, be a very great acquiſition. A very ſlow but deep river could in this manner be made to drive our mills; and although much power is loſt by the obliquity of the impulſe, the remainder may be very great. It is to be regretted, theſe attempts have not been more zealouſly proſecuted; for we have no doubt of their ſucceſs in a very ſerviceable degree. Engineers have been deterred, becauſe when ſuch wheels are plunged in an open ſtream, their lateral motion is too much impeded by the motion of the ſtream. We have ſeen one, however, which was very powerful: It was a long cylindrical frame, having a plate ſtanding out from it about a foot broad, and ſurrounding it with a very oblique ſpiral like a cork-ſcrew. This was plunged about ¼th of its diameter (which was about 12 feet), having its axis in the direction of the ſtream. By the work which it was performing, it ſeemed more powerful than a common wheel which occupied the ſame *breadth* of the river. Its length was not leſs than 20 feet: it might have been twice as much, which would have doubled its power, without occupying more of the water-way. Perhaps ſuch a ſpiral, continued to the very axis, and moving in a hollow canal wholly filled by the ſtream, might be a very advantageous way of employing a deep and ſlow ſtream.

But mills with oblique floats are moſt uſeful for employing ſmall ſtreams, which can be delivered from a ſpout with a great velocity. Mr Boſſut has conſidered theſe with due attention, and aſcertained the beſt modes of conſtruction. There are two which have nearly equal performances: 1. The vanes being placed like thoſe of a wind-mill, round the rim of a horizontal or vertical wheel, and being made much broader than the vein of water which is to ſtrike them, let the ſpout be ſo directed that the vein may ſtrike them perpendicularly. By this meaſure it will be ſpread about on the vane in a thin ſheet, and exert a preſſure nearly equal to twice the weight of a column whoſe baſe is the orifice of the ſpout, and whoſe height is the fall producing the velocity.

Mills of this kind are much in uſe in the ſouth of Europe. The wheel is horizontal, and the vertical axis carries the millſtone; ſo that the mill is of the utmoſt ſimplicity: and this is its chief recommendation; for its power is greatly inferior to that of a wheel conſtructed in the uſual manner.

2. The vanes may be arranged round the rim of the wheel, not like the ſails of a wind-mill, but in planes inclined to the radii, but parallel to the axis, or to the planes paſſing through the axis. They may either ſtand on a ſole, like the oblique floats recommended by De Parceux, as above mentioned; or they may ſtand on the ſide of the rim, not pointing to the axis, but aſide from it.

This diſpoſition will admit the ſpout to be more conveniently diſpoſed either for a horizontal or a vertical wheel.

We ſhall conclude this article by deſcribing a contrivance of Mr Burns, the inventor of the double bucketed wheel, for fixing the arms of a water-wheel. It is well known to mill-wrights that the method of fixing them by making them to paſs through the axle, weakens it exceedingly, and by lodging water in the joint, ſoon cauſes it to rot and fail. They have, therefore, of late years put caſt-iron flanches on the axis, to which each arm is bolted: or the flanches are ſo faſhioned as to form boxes, ſerving as mortiſes to receive the ends of the arms. Theſe anſwer the purpoſe completely, but are very expenſive; and it is found that arms of fir, bolted into branches of iron, are apt to work looſe. Mr Burns has made wooden flanches of a very curious conſtruction, which are equally firm, and coſt much leſs than the iron ones.

This flanch conſiſts of eight pieces, four of which compoſe the ring repreſented in fig. 15. meeting in the joints *a b*, *a b*, *a b*, *a b*, directed to the centre O. The other four are covered by theſe, and their joints are repreſented by the doted lines αβ, αβ, αβ, αβ. Theſe two rings break joint in ſuch a manner that an arm MN is contained between the two neareſt joints *a′ b′* of the one, and α′ β′ of the other. The tenon formed on the end of the arm A, &c. is of a particular ſhape: one ſide, GF, is directed to the centre O; the other ſide, BCDE, has a ſmall ſhoulder BC; then a long ſide CD directed to the centre O; and then a third part DE parallel to GF, or rather diverging a little from it, ſo as to make up at E the thickneſs of the ſhoulder BC; that is, a line from B to E would be parallel to CD. This ſide of the tenon fits exactly to the correſponding ſide of the mortiſe; but the mortiſe is wider on the other ſide, leaving a ſpace GFK *b* a little narrower at FK than at G *b*. Theſe tenons and mortiſes are made extremely true to the ſquare; the pieces are put round the axle, with a few blocks or wedges of ſoft wood put between them and the axle, leaving the ſpace empty oppoſite to the place of each arm, and firmly bolted together by bolts between the arm-mortiſes. The arms are then put in, and each is preſſed home to the ſide CDE, and a wedge HF of hard wood is then put into the empty part of the mortiſe and driven home. When it comes through the flanch and touches the axle, the part which has come through is cut off with a thin chiſel, and the wedge is driven better home. The ſpaces under the ends of the arms are now filled with wedges, which are driven home from oppoſite ſides, till the circle of the arms ſtands quite perpendicular on the axle, and all is faſt. It needs no hoops to keep it together, for the wedging it up round the axle makes the two half rings draw cloſe on the arms, and it cannot ſtart at its own joints till it cruſhes the arms. Hoops, however, can do no harm, when all is once wedged up, but it would be improper to put them on before this be done. For the account of another very curious hydraulic machine, ſee ZURICH.

WORLD, the aſſemblage of parts which compoſe the globe of the earth. See GEOGRAPHY and ASTRONOMY.

WORM, in gunnery, a ſcrew of iron, to be fixed on the end of a rammer, to pull out the wad of a firelock, carabine, or piſtol, being the ſame with the wad-hook, only the

Fig. 1.

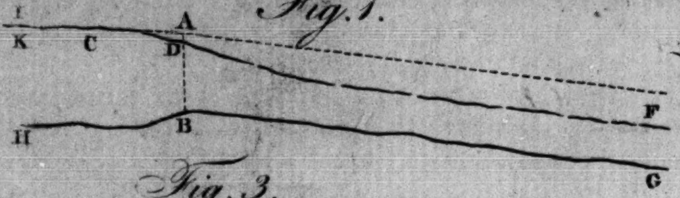


Fig. 2.

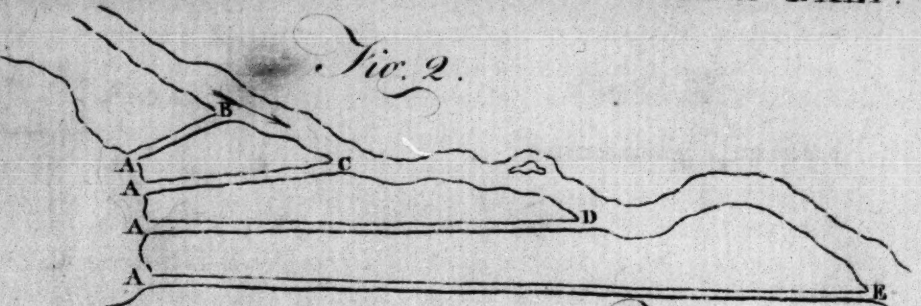
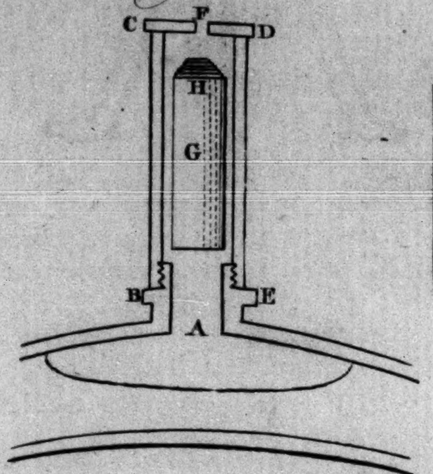


Fig. 3.



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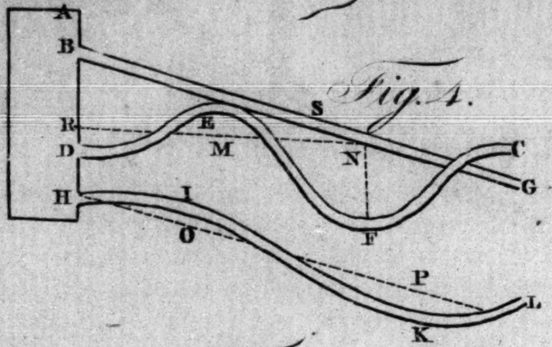
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Fig. 5.

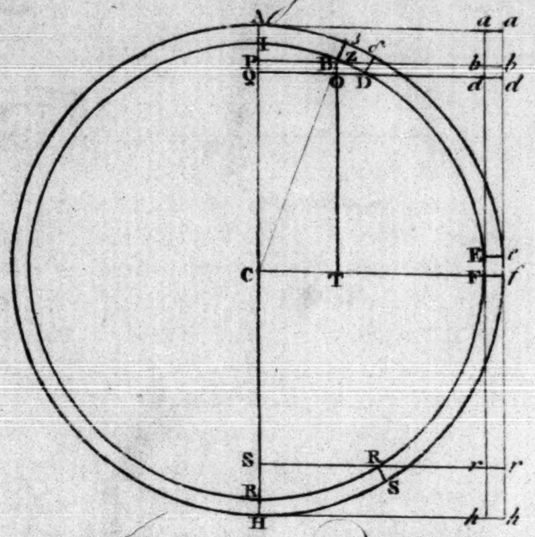
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Fig. 7.

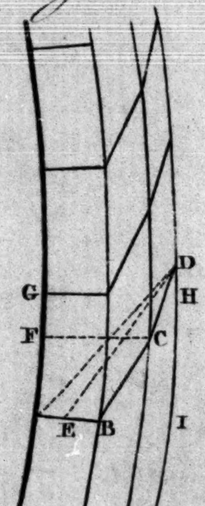

Fig. 6.

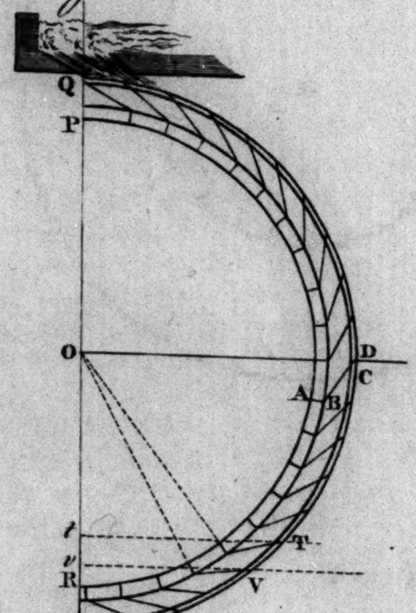
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Fig. 9.

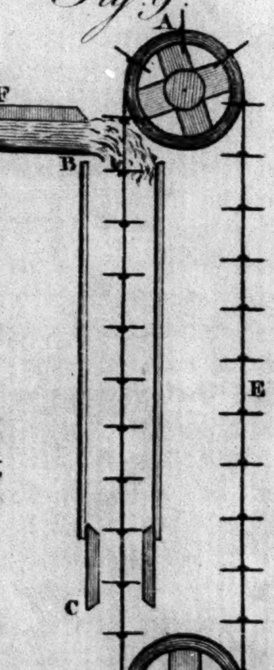

Fig. 10.

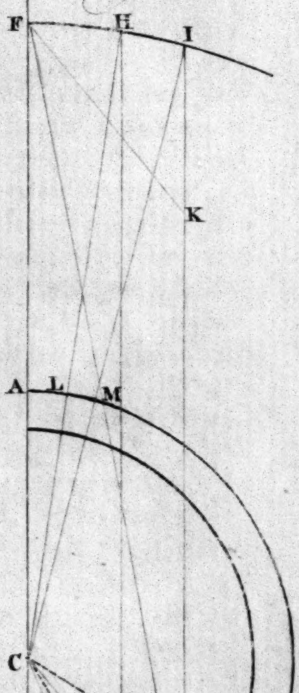
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Fig. 11.

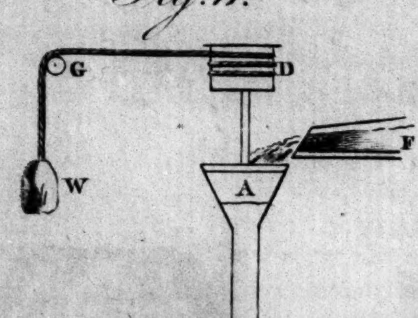

Fig. 8.

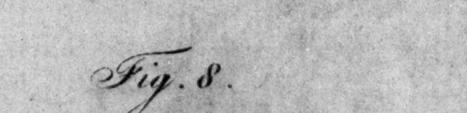
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Fig. 12.

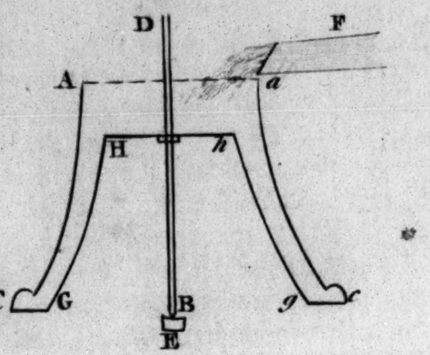
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Fig. 13.

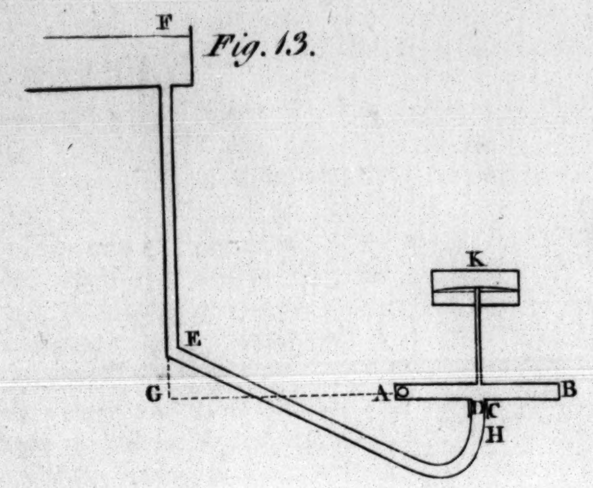

Fig. 14.

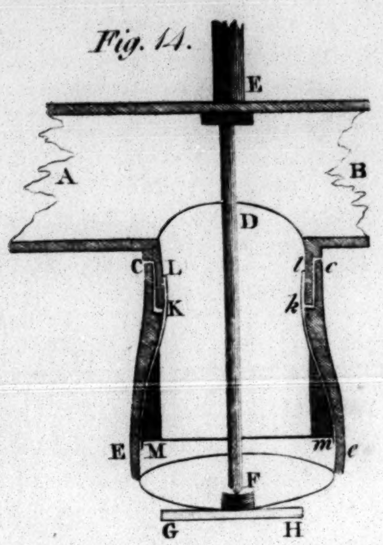
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Fig. 15.

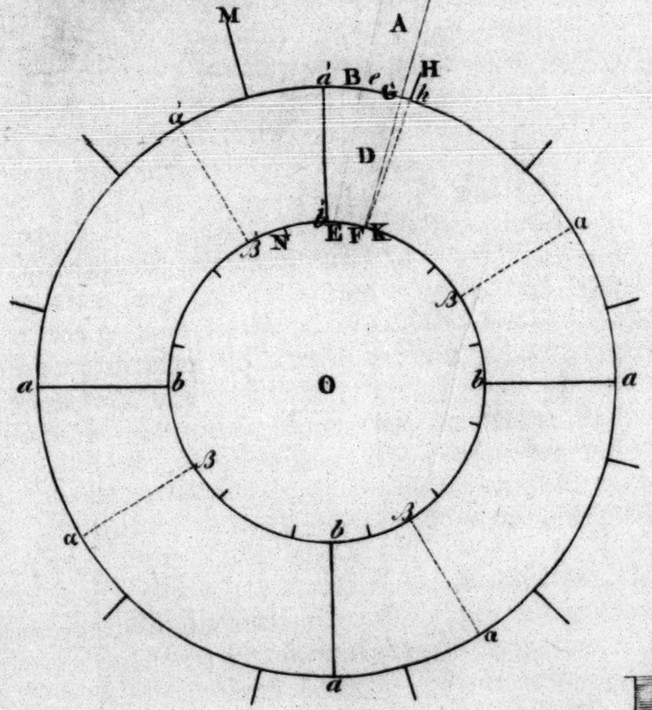
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Fig. 16.

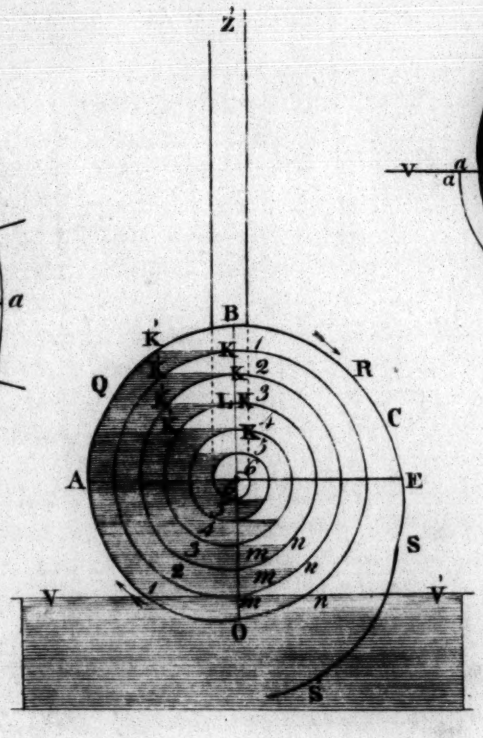
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Fig. 18.

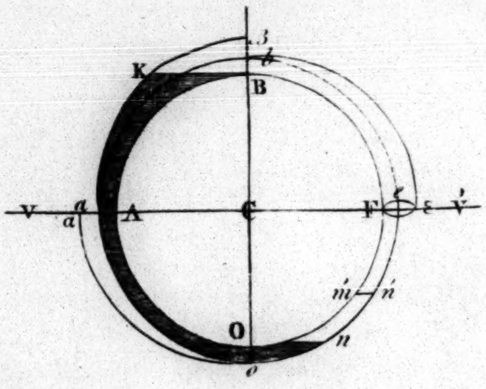
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Fig. 20.

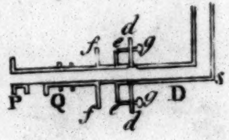
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Fig. 17.

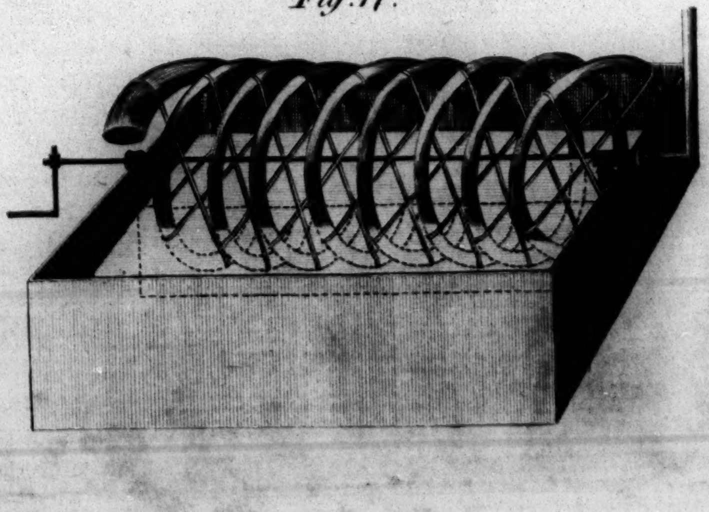
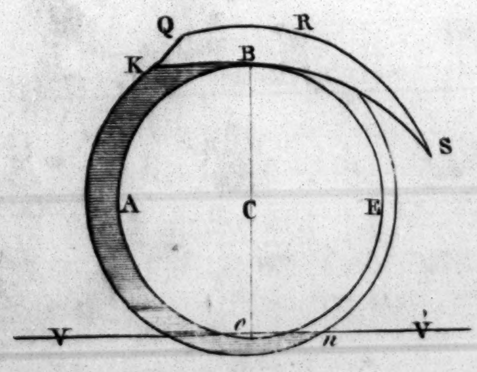


Fig. 19.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one is more proper for ſmall arms, and the other for cannon.

Worm, in chemiſtry, is a long, winding pipe, placed in a tub of water, to cool and condenſe the vapours in the diſtillation of ſpirits.

Blind-Worm, or *Slow-Worm*. See Anguis, n° 2.

Earth-Worm. See Lumbricus.

Glow-Worm. See Lampyris.

Silk-Worm. See Silk, n° 5.

WORMS, Vermes, in natural hiſtory. See Zoology.

Worms, in the human body. See Medicine, n° 407.

Worms, in horſes. See Farriery, ſect. 19.

Worms, in dogs. See Dog, art. 4.

Worms for bait. See Fishing, vol. 7. p. 271.

Worms, an ancient, large, and famous city of Germany, in the palatinate of the Rhine, with a biſhop's ſee, whoſe biſhop is a ſovereign and prince of the empire. It is a free and imperial city, and the inhabitants are Proteſtants. In the war of 1689 it was taken by the French, who almoſt reduced it to aſhes.—The biſhop afterwards built a new palace in it; and it is famous for a diet held here in 1521, at which Luther aſſiſted in perſon. The Proteſtants have lately built a handſome church, where Luther is repreſented as appearing at the diet. It is noted for the excellent wine that grows in the neighbourhood, which they call *our Lady's milk*. In the campaign of 1743, king Geo. II. took up his quarters in this city, and lodged at the biſhop's palace after the battle of Dettingen. It is ſeated on the weſtern bank of the Rhine, 14 miles north-weſt of Heidelburg, 20 ſouth-eaſt of Mentz, and 32 ſouth-weſt of Francfort. E. Long. 8. 29. N. Lat. 49. 32.

WORMING of dogs. All ſpaniels have certain ſtrings under their tongues, by moſt called *a worm*; this muſt be taken out when they are about two months old, with the help of a ſharp knife to ſlit it, and a ſhoemaker's awl to raiſe it up: you muſt be careful to take all out, or elſe your pains are to little purpoſe; for till then he will be hardly ever fat and right, in regard the worm or ſtring will grow foul and troubleſome, and hinder his reſt and eating. This operation is generally recommended as a preventative of madneſs in dogs, or at leaſt as diſabling them, if mad, from biting in that condition.

WORMIUS (Olaus), a learned Daniſh phyſician, born in 1588 at Arhuſen in Jutland. After beginning his ſtudies at home, he ſtudied at ſeveral foreign univerſities, and travelled to various parts of Europe for improvement. He returned to his native country in 1613, and was made profeſſor of the belles lettres in the univerſity of Copenhagen. In 1615, he was tranſlated to the chair of the Greek profeſſor; and in 1624 to the profeſſorſhip of phyſic, which he held to his death. Theſe occupations did not hinder him from practiſing in his profeſſion, and from being the faſhionable phyſician: the king and court of Denmark always employed him; and Chriſtian IV. as a recompenſe for his ſervices, conferred on him a canonry of Lunden. He publiſhed ſome pieces on ſubjects relating to his profeſſion, ſeveral works in defence of Ariſtotle's philoſophy, and ſeveral concerning the antiquities of Denmark and Norway; for which latter he is principally regarded, as they are very learned, and contain many curious particulars. He died in 1654.

WORMWOOD, in botany. See Artemisia.

WORSHIP of God (*cultus Dei*), amounts to the ſame with what we otherwiſe call *religion*. This worſhip conſiſts in paying a due reſpect, veneration, and homage to the Deity, under a certain expectation of reward. And this internal reſpect, &c. is to be ſhown and teſtified by external acts; as prayers, ſacrifices, thankſgivings, &c.

The Quietiſts, and ſome other myſtic divines, ſet aſide not only all uſe of external worſhip, but even the conſideration of rewards and puniſhments. Yet even the heathens had a notion that God did not require us to ſerve him for nought: "Dii quamobrem colendi ſint (ſays Cicero), non intelligo, nullo nec accepto ab illis nec ſperato bono."

The ſchool-divines divide worſhip into divers kinds, *viz. latria*, that rendered to God; and *idololatria*, that rendered to idols or images. To which the Romaniſts add, *dulia*, that rendered to ſaints; and *hyperdulia*, that to the Virgin. Some theological writers have obſerved, that the Greek word, *προσκυνεω, to worſhip*, is not deſcriptive only of the honour which is appropriated to God, but is indifferently uſed to ſignify the honour and reſpect which are paid to ſuperiors of all kinds in heaven or on earth. Accordingly, they have diſtinguiſhed between civil and religious worſhip.

That it is the duty of man to worſhip his Maker, has been ſufficiently proved under other articles (ſee Prayer; and Theology, n° 40—45.). It is not indeed eaſily to be conceived how any one who has tolerably juſt notions of the attributes and providence of God, can poſſibly neglect the duty of *private* worſhip; and though we have admitted in the laſt of the two articles referred to, that *public* worſhip does not ſeem to be enjoined in that ſyſtem which is called the religion of *nature*, yet it is moſt expreſsly commanded by the religion of Christ, and will be regularly performed by every one who reflects on its great utility.

As the illiterate vulgar cannot form to themſelves correct notions of the divine providence and attributes, it is obvious, that without the inſtitution of public worſhip, they would never think of worſhipping God at all, unleſs perhaps occaſionally, when under the preſſure of ſome ſevere calamity; but occaſional worſhip, the offspring of compulſion, could have little of the reſigned ſpirit of true devotion. Ignorant, however, as the loweſt of the vulgar are, and neceſſarily muſt be, it cannot be denied, that in moſt Chriſtian countries, perhaps in all, they are more accurately acquainted with the firſt principles of religion, and the laws of morality, than even the leaders of barbarous nations. This ſuperiority is doubtleſs owing in ſome meaſure to their acceſs to the Sacred Scriptures, but much more, we are perſuaded, to the inſtruction which they receive in the aſſemblies which they frequent for public worſhip. If this be admitted, public worſhip may be eaſily proved to be the duty of every individual of the community: For were thoſe, who may be ſuppoſed to ſtand in no need either of the influence and example of ſociety to kindle their own devotion, or of the preaching of a clergyman to inſtruct them in the doctrines and precepts of the goſpel, to "forſake, on theſe accounts, the aſſembling themſelves together, as the manner of ſome is," religious aſſemblies and public worſhip would very quickly fall into univerſal diſuſe. Man is an animal prone to imitation; and every order in ſociety is ambitious of treading in the footſteps of the order immediately above it. Were the wiſe and the good, therefore, permitted to abſent themſelves from the aſſemblies inſtituted for the public worſhip of the Creator and Redeemer of the world, others would quickly follow their example; impelled to it not only by this univerſal propenſity, but by the additional motive of wiſhing to appear both to the world and to themſelves as wiſe and as good as their privileged neighbours. The conſequence is obvious: one man would ſtay from church with the ſerious intention perhaps of employing the Lord's-day in private devotion and religious ſtudy; another, following his example, would abſent himſelf upon the ſame pretence, but would in reality waſte the day in dozing indolence or in ſecret ſenſuality. For theſe and other reaſons which might be eaſily aſſigned, no ſincere Chriſtian will think himſelf at liberty to diſpute a practice enjoined by the inſpired preachers of his religion, coeval with the inſtitution, and retained by every ſect into which it has ſince been unhappily divided.

As Chriſtian worſhip conſiſts of prayers and praiſes, it has been a matter of ſome debate whether it is moſt properly performed by preconcerted forms or liturgies, or by extemporaneous addreſſes to the Almighty. Both theſe modes have their advantages and diſadvantages; and by the ſacred writers neither of them is preſcribed in oppoſition to the other.

The advantages of a liturgy are, that it prevents abſurd, extravagant, or impious addreſſes to God, which the folly or enthuſiaſm of individuals muſt always be in danger of producing; it gives the congregation an opportunity of *joining* in the prayers which are put up for them, which they cannot poſſibly do in a ſeries of extemporaneous petitions, ſince before they can aſſent to any one of theſe and make it their own, their attention is neceſſarily called away to that which ſucceeds it; and it relieves the clergyman from the labour of compoſition, which ſeems incompatible with that fervour which conſtitutes the ſpirit of devotion.

The diſadvantages of a fixed liturgy, which are the recommendations of extemporary prayer, are principally two. The forms compoſed in one age muſt, by the unavoidable change of language, circumſtances, and opinions, become in ſome degree unfit for another; and the perpetual repetition of the ſame form of words is very apt to produce inattentive laſſitude in the congregation. Would the clergy of the church of England take that liberty which is allowed them in the bidding prayer before ſermon, perhaps the ſervice of that church would unite in itſelf all the advantages both of liturgic and extemporary worſhip. We have only to add on this ſubject, that public prayers, whether precompoſed or not, ought to be compendious; that they ought to expreſs juſt conceptions of the Divine attributes; recite ſuch wants as the congregation are likely to feel and no other; that they ought to contain as few controverted propoſitions as poſſible; and that, if it can be done without offence, the pompous ſtyle of *the ſtate* ſhould be laid aſide in our prayers for the king and all that are in authority; becauſe in every act which carries the mind to God, human greatneſs muſt be annihilated.

WORT, the infuſion of malt, of which beer is made. The uſes of this infuſion in common affairs are well known. By Dr M'Bride it has lately been found to have a ſtrong antiſeptic virtue, and to be uſeful in preventing the ſcurvy and other diſeaſes to which ſailors are liable; which was confirmed by captain Cook in his late voyages. See *Means of Preſerving the Health of* SEAMEN.

WOTTON (Sir Henry), an eminent writer, was the ſon of Thomas Wotton, Eſq; and was born in 1568. He ſtudied for ſome time at New-college, Oxford, whence he removed to Queen's college, where he made a great progreſs in logic and philoſophy; wrote a tragedy for the uſe of that college, called *Tancredo*; and afterwards received the degree of maſter of arts. After this, leaving the univerſity, he travelled into France, Germany, and Italy; and having ſpent about nine years abroad, he returned to England, and became ſecretary to Robert earl of Eſſex, with whom he continued till that earl was apprehended for high-treaſon. He then retired to Florence, where he became known to the grand duke of Tuſcany, who ſent him privately with letters to James VI. king of Scotland, under the name of *Octavio Baldi*, to inform that king of a deſign againſt his life. Some months after he went back to Florence; but king James coming to the poſſeſſion of the crown of England, Mr Wotton returned home, was knighted by his majeſty, and ſent ambaſſador to the republic of Venice; and afterwards was employed in many other embaſſies to that and other courts; but the only reward he obtained for theſe ſervices was his having the provoſtſhip of Eaton conferred upon him about the year 1623, which he kept till his death, which happened in 1639. After his deceaſe ſome of his manuſcripts and printed tracts were publiſhed together in a volume, intitled, *Reliquiæ Wottonianæ*.

WOTTON (Dr William), a very learned divine and writer, was the ſon of Mr Henry Wotton, B. D. rector of Wrentham, in Suffolk, where he was born in 1666. He was educated by his father, a gentleman well ſkilled in the learned languages; under whom he made ſuch amazing proficiency, that at five years of age it is ſaid he could render ſeveral chapters in the goſpels out of Latin and Greek, and many pſalms in Hebrew, into his mother tongue. When he was very young, he remembered the whole of almoſt every diſcourſe he had heard, and often ſurpriſed a preacher by repeating his ſermon to him. He was admitted into Catharine-hall in Cambridge ſome months before he was ten years old; when the progreſs he made in learning in that univerſity engaged Dr Duport, then maſter of Magdalen college, and dean of Peterborough, to write an elegant copy of Latin verſes in his praiſe. In 1679 he took the degree of bachelor of arts when he was but twelve years and five months old; and the winter following he was invited to London by Dr Gilbert Burnet, then preacher at the Rolls, who introduced him to moſt of the learned men in that city, and particularly to Dr William Lloyd, biſhop of St Aſaph; to whom he recommended himſelf by repeating to him one of his ſermons, as Dr Burnet had engaged he ſhould. In 1691 he commenced bachelor of divinity. The ſame year biſhop Lloyd gave him the ſinecure of Llandrillo, in Denbighſhire. He was afterwards made chaplain to the earl of Nottingham, then ſecretary of ſtate, who preſented him to the rectory of Middleton Keynes, in Bucks, and to whom he dedicated his Reflections upon Ancient and Modern Learning. In 1705, biſhop Burnet gave him a prebend in the church of Saliſbury; and in 1707, archbiſhop Teniſon preſented him with the degree of doctor of divinity: but in 1714, the difficulties he laboured under with reſpect to his private fortune, obliged him to retire into South Wales, where he was treated with great kindneſs and humanity by the gentlemen of that country; and wrote there the "Memoirs of the Cathedral Churches of St David's and Landaff," and his "Miſcellaneous Diſcourſes relating to the Traditions and Uſages of the Scribes and Phariſees;" which were afterwards printed. He died in 1726. This great man was remarkable for his humanity and friendlineſs of temper; the narrowneſs of a party ſpirit never broke in upon any of his friendſhips; and his time and abilities were at the ſervice of any perſon who was making advances in real learning. He wrote, beſides the above works, 1. A Hiſtory of Rome. 2. A defence of his Reflections upon Ancient and Modern Learning. 3. A Diſcourſe concerning the Languages of Babel. 4. Advice to a young Student, with a Method of Study for the firſt four Years; and other learned pieces.

WOUNDS. See SURGERY, chap. ii.

WOUNDS, in farriery. See there, § xxvii.

WRASSE, or old wife, in ichthyology. See LABRUS.

WREATH, in heraldry, a roll of fine linen or ſilk (like that of a Turkiſh turban), conſiſting of the colours borne in the eſcutcheon, placed in an atchievement between the

the helmet and the creſt, and immediately ſupporting the creſt.

WRECK, or Shipwreck, the deſtruction of a ſhip by rocks or ſhallows at ſea.

By the ancient common law, where any ſhip was loſt at ſea, and the goods or cargo were thrown upon the land, theſe goods, ſo wrecked, were judged to belong to the king: for it was held, that, by the loſs of the ſhip, all property was gone out of the original owner. But this was undoubtedly adding ſorrow to ſorrow, and was conſonant neither to reaſon nor humanity. Wherefore it was firſt ordained by king Henry I. that if any perſon eſcaped alive out of the ſhip, it ſhould be no wreck; and afterwards king Henry II. by his charter, declared, that if on the coaſts of either England, Poictou, Oleron, or Gaſcony, any ſhip ſhould be diſtreſſed, and either man or beaſt ſhould eſcape or be found therein alive, the goods ſhould remain to the owners, if they claimed them within three months; but otherwiſe ſhould be eſteemed a wreck, and ſhould belong to the king, or other lord of the franchiſe. This was again confirmed with improvements by king Richard I.; who, in the ſecond year of his reign, not only eſtabliſhed theſe conceſſions, by ordaining that the owner, if he was ſhipwrecked and eſcaped, *omnes res ſuas liberas, et quietas haberet*, but alſo, that if he periſhed, his children, or in default of them, his brethren and ſiſters, ſhould retain the property; and in default of brother or ſiſter, then the goods ſhould remain to the king (A). And the law, as laid down by Bracton in the reign of Henry III. ſeems ſtill to have improved in its equity. For then, if not only a dog (for inſtance) eſcaped, by which the owner might be diſcovered, but if any certain mark were ſet on the goods, by which they might be known again, it was held to be no wreck. And this is certainly moſt agreeable to reaſon; the rational claim of the king being only founded upon this, that the true owner cannot be aſcertained. Afterwards, in the firſt ſtatute of Weſtminſter, the time of limitation of claims, given by the charter of Henry II. is extended to a year and a day, according to the uſage of Normandy: and it enacts, that if any man, a dog, or a cat, eſcape alive, the veſſel ſhall not be adjudged a wreck. Theſe animals, as in Bracton, are only put for examples; for it is now held, that not only if any live thing eſcape, but if proof can be made of the property of any of the goods or lading which come to ſhore, they ſhall not be forfeited as wreck. The ſtatute further ordains, that the ſheriff of the county ſhall be bound to keep the goods a year and a day (as in France for one year, agreeable to the maritime laws of Oleron, and in Holland for a year and a half), that if any man can prove a property in them, either in his own right or by right of repreſentation, they ſhall be reſtored to him without delay; but if no ſuch property be proved within that time, they then ſhall be the king's. If the goods are of a periſhable nature, the ſheriff may ſell them, and the money ſhall be liable in their ſtead. This revenue of wrecks is frequently granted out to lords of manors as a royal franchiſe; and if any one be thus intitled to wrecks in his own land, and the king's goods are wrecked thereon, the king may claim them at any time, even after the year and day.

It is to be obſerved, that, in order to conſtitute a legal wreck, the goods muſt come to land. If they continue at ſea, the law diſtinguiſhes them by the barbarous and uncouth appellations of *jetſam*, *flotſam*, and *ligan*. Jetſam is where goods are caſt into the ſea, and there ſink and remain under water: flotſam is where they continue ſwimming on the ſurface of the waves: ligan is where they are ſunk in the ſea, but tied to a cork or buoy, in order to be found again. Theſe are alſo the king's, if no owner appears to claim them; but if any owner appears, he is intitled to recover the poſſeſſion. For even if they be caſt overboard, without any mark or buoy, in order to lighten the ſhip, the owner is not by this act of neceſſity conſtrued to have renounced his property: much leſs can things ligan be ſuppoſed to be abandoned, ſince the owner has done all in his power to aſſert and retain his property. Theſe three are therefore accounted ſo far a diſtinct thing from the former, that by the king's grant to a man of wrecks, things jetſam, flotſam, and ligan, will not paſs.

Wrecks, in their legal acceptation, are at preſent not very frequent: for if any goods come to land, it rarely happens, ſince the improvement of commerce, navigation, and correſpondence, that the owner is not able to aſſert his property within the year and day limited by law. And in order to preſerve this property entire for him, and if poſſible to prevent wrecks at all, our laws have made many very humane regulations; in a ſpirit quite oppoſite to thoſe ſavage laws which formerly prevailed in all the northern regions of Europe, and a few years ago were ſtill ſaid to ſubſiſt on the coaſts of the Baltic Sea, permitting the inhabitants to ſeize on whatever they could get as lawful prize; or, as an author of their own expreſſes it, "*in naufragorum miſeria et calamitate tanquam vultures ad prædam currere.*" For by the ſtatute 27 Edw. III. c. 13. if any ſhip be loſt on the ſhore, and the goods come to land (which cannot, ſays the ſtatute, be called *wreck*), they ſhall be preſently delivered to the merchants, paying only a reaſonable reward to thoſe that ſaved and preſerved them, which is intitled *ſalvage*. Alſo by the common law, if any perſons (others than the ſheriff) take any goods ſo caſt on ſhore, which are not legal wreck, the owners might have a commiſſion to inquire and find them out, and compel them to make reſtitution. And by 12 Ann. ſt. 2. c. 18. confirmed by 4 Geo. I. c. 12. in order to aſſiſt the diſtreſſed, and prevent the ſcandalous illegal practices on ſome of our ſea-coaſts (too ſimilar to thoſe on the Baltic), it is enacted, that all head-officers and others of towns near the ſea, ſhall, upon application made to them, ſummon as many hands as are neceſſary, and ſend them to the relief of any ſhip in diſtreſs, on forfeiture of L. 100; and in caſe of aſſiſtance given, ſalvage ſhall be paid by the owners, to be aſſeſſed by three neighbouring juſtices. All perſons that ſecrete any goods ſhall forfeit their treble value: and if they wilfully do any act whereby the ſhip is loſt or deſtroyed, by making holes in her, ſtealing her pumps, or otherwiſe, they are guilty of felony without benefit of clergy. Laſtly, by the ſtatute 26 Geo. II. c. 19. plundering any veſſel, either in diſtreſs or wrecked, and whether any living creature be on board or not (for whether wreck or otherwiſe, it is clearly not the property of the populace), ſuch plundering or preventing the eſcape of any perſon that endeavours to ſave his life, or wounding him with intent to deſtroy him, or putting out falſe lights in order to bring any veſſel into danger, are all declared to be capital felonies; in like manner as the deſtroying of trees, ſteeples, or

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(A) In like manner Conſtantine the Great, finding that by the imperial law the revenue of wrecks was given to the prince's treaſury or fiſcus, reſtrained it by an edict (Cod. 11. 5. 1.) and ordered them to remain to the owners; adding this humane expoſtulation: "Quod enim jus habet fiſcus in aliena calamitate, ut de re tam luctuoſa compendium ſectetur?"

or other ſtated ſea-marks, is puniſhed by the ſtatute 8 Eliz. c. 13. with a forfeiture of L. 100 or outlawry. Moreover, by the ſtatute of Geo. II. pilfering any goods caſt aſhore is declared to be petty larceny; and many other ſalutary regulations are made, for the more effectually preſerving ſhips of any nation in diſtreſs.

By the civil law, to deſtroy perſons ſhipwrecked, or prevent their ſaving the ſhip, is capital. And to ſteal even a plank from a veſſel in diſtreſs or wrecked, makes the party liable to anſwer for the whole ſhip and cargo. The laws alſo of the Wiſigoths, and the moſt early Neapolitan conſtitutions, puniſhed with the utmoſt ſeverity all thoſe who neglected to aſſiſt any ſhip in diſtreſs, or plundered any goods caſt on ſhore.

WREN, in ornithology. See Motacilla.

Wren (Sir Chriſtopher), a great philoſopher, and one of the moſt learned and moſt eminent architects of his age, was the ſon of Chriſtopher Wren dean of Windſor, and was born in 1632. He ſtudied at Wadham college in Oxford; where he took the degree of maſter of arts in 1653, and was choſen fellow of All Souls college. When very young he diſcovered a ſurpriſing genius for the mathematics; in which ſcience he made great advances before he was ſixteen years old. In 1657, he was made profeſſor of aſtronomy at Greſham college, London; which he reſigned in 1660, on his being choſen to the Savilian profeſſorſhip of aſtronomy in Oxford: he was the next year created doctor of laws, and in 1663 was elected fellow of the Royal Society. He was one of the commiſſioners for the reparation of St Paul's; and in 1665 travelled into France, to examine the moſt beautiful edifices there, when he made many curious obſervations. At his return to England, he drew a noble plan for rebuilding the city of London after the fire, which he preſented to parliament; and upon the deceaſe of Sir John Denham in 1668, was made ſurveyor-general of his majeſty's works; and from that time had the direction of a great number of public edifices, by which he acquired the higheſt reputation. He built the magnificent theatre at Oxford, St Paul's cathedral, the churches of St Stephen Walbrook, and St Mary-le-Bow, the Monument, the modern part of the palace of Hampton Court, Chelſea College, one of the wings of Greenwich Hoſpital, and many other beautiful edifices. He was preſident of the Royal Society, one of the commiſſioners of Chelſea College, and twice member of parliament; firſt for Plymouth in Devonſhire, and then for Melcomb Regis in the ſame county; but in 1718 was removed from his place of ſurveyor-general. He died in 1723, and was interred in the vault under St Paul's.

This great man alſo diſtinguiſhed himſelf by many curious inventions and diſcoveries in natural philoſophy; and, among many others, contrived an inſtrument for meaſuring the quantity of rain that falls on any ſpace of land for a year; he invented many ways of making aſtronomical obſervations more accurate and eaſy; and was the firſt author of the anatomical experiment of injecting liquors into the veins of animals, &c. He tranſlated into Latin Mr Oughtred's *Horologiographica Geometrica;* and wrote a Survey of the cathedral church of Saliſbury, and other pieces. After his death his poſthumous works and draughts were publiſhed by his ſon.

WRESTLING, a kind of combat or engagement between two perſons unarmed, body to body, to prove their ſtrength and dexterity, and try which can throw his opponent to the ground.

Wreſtling is an exerciſe of very great antiquity and fame. It was in uſe in the heroic age; witneſs Hercules, who wreſtled with Antæus.

It continued a long time in the higheſt repute, and had conſiderable rewards and honours aſſigned to it at the Olympic games. It was the cuſtom for the Athletæ to anoint their bodies with oil, to give the leſs hold to their antagoniſts.

Lycurgus ordered the Spartan maids to wreſtle in public quite naked, in order, as it is obſerved, to break them of their too much delicacy and niceneſs, to make them appear more robuſt, and to familiarize the people, &c. to ſuch nudities.

WRIST, in Anatomy. See there, n° 53.

WRIT, in law, ſignifies, in general, the king's precept in writing under ſeal, iſſuing out of ſome court, directed to the ſheriff or other officer, and commanding ſomething to be done in relation to a ſuit or action, or giving commiſſion to have the ſame done. And, according to Fitzherbert, a writ is ſaid to be a formal letter of the king in parchment, ſealed with his ſeal, and directed to ſome judge, officer, or miniſter, &c. at the ſuit of a ſubject, for the cauſe briefly expreſſed, which is to be determined in the proper court according to law.

Writs, in civil actions, are either original or judicial: original, are ſuch as are iſſued out of the court of chancery for the ſummoning of a defendant to appear, and are granted before the ſuit is commenced, in order to begin the ſame; and judicial writs iſſue out of the court where the original is returned, after the ſuit is begun. See Process.

The original writ is the foundation of the ſuit. See Suit.

When a perſon hath received an injury, and thinks it worth his while to demand a ſatisfaction for it, he is to conſider with himſelf, or take advice, what redreſs the law has given for that injury; and thereupon is to make application or ſuit to the crown, the fountain of all juſtice, for that particular ſpecific remedy which he is determined or adviſed to purſue. As for money due on bond, an action of debt; for goods detained without force, an action of *detinue* or *trover;* or, if taken with force, an action of *treſpaſs vi et armis;* or, to try the title of lands, a writ of entry or action of treſpaſs in ejectment: or for any conſequential injury received, a ſpecial action on the caſe. To this end he is to ſue out, or purchaſe by paying the ſtated fees, an *original* or original writ, from the court of chancery, which is the *officina juſtitiæ*, the ſhop or mint of juſtice, wherein all the king's writs are framed. It is a mandatory letter from the king in parchment, ſealed with his great ſeal, and directed to the ſheriff of the county wherein the injury is committed, or ſuppoſed ſo to be, requiring him to command the wrongdoer or party accuſed, either to do juſtice to the complainant, or elſe to appear in court, and anſwer the accuſation againſt him. Whatever the ſheriff does in purſuance of this writ, he muſt return or certify to the court of common-pleas, together with the writ itſelf: which is the foundation of the juriſdiction of that court, being the king's warrant for the judges to proceed to the determination of the cauſe. For it was a maxim introduced by the Normans, that there ſhould be no proceedings in common-pleas before the king's juſtices without his original writ; becauſe they held it unfit that thoſe juſtices, being only the ſubſtitutes of the crown, ſhould take cognizance of any thing but what was thus expreſsly referred to their judgment. However, in ſmall actions, below the value of forty ſhillings, which are brought in the court-baron or county-court, no royal writ is neceſſary; but the foundation of ſuch ſuits continue to be (as in the times of the Saxons), not by original writ, but by plaint; that is, by a private memorial tendered in open court to the judge, wherein the party injured ſets forth his cauſe of action: and the judge is bound of common right to adminiſter juſtice therein, without any ſpecial mandate from the king. Now indeed even the royal writs are held to be demandable of common right, on paying the uſual fees: for

Writ, Writing.

any delay in the granting them, or ſetting an unuſual or exorbitant price upon them, would be a breach of magna charta, c. 29. "nulli vendemus, nulli negabimus, aut differemus juſtitiam vel rectum."

Original writs are either optional or peremptory; or, in the language of our law, they are either a *præcipe*, or a *ſi te fecerit ſecurum*. The *præcipe* is in the alternative, commanding the defendant to do the thing required, or ſhow the reaſon wherefore he hath not done it. The uſe of this writ is where ſomething certain is demanded by the plaintiff, which is in the power of the defendant himſelf to perform; as, to reſtore the poſſeſſion of land, to pay a certain liquidated debt, to perform a ſpecific covenant, to render an account, and the like; in all which caſes the writ is drawn up in the form of a *præcipe* or command, to do thus, or ſhow cauſe to the contrary; giving the defendant his choice to redreſs the injury or ſtand the ſuit. The other ſpecies of original writs is called a *ſi fecerit te ſecurum*, from the words of the writ; which directs the ſheriff to cauſe the defendant to appear in court, without any option given him, provided the plaintiff gives the ſheriff ſecurity effectually to proſecute his claim. This writ is in uſe where nothing is ſpecifically demanded, but only a ſatisfaction in general; to obtain which, and miniſter complete redreſs, the intervention of ſome judicature is neceſſary. Such are writs of treſpaſs, or on the caſe, wherein no debt or other ſpecific thing is ſued for in certain, but only damages to be aſſeſſed by a jury. For this end the defendant is immediately called upon to appear in court, provided the plaintiff gives good ſecurity of proſecuting his claim. Both ſpecies of writs are teſted, or witneſſed, in the king's own name; "witneſs ourſelf at Weſtminſter," or wherever the chancery may be held.

The ſecurity here ſpoken of, to be given by the plaintiff for proſecuting his claim, is common to both writs, though it gives denomination only to the latter. The whole of it is at preſent become a mere matter of form; and John Doe and Richard Roe are always returned as the ſtanding pledges for this purpoſe.—The ancient uſe of them was to anſwer for the plaintiff, who in caſe he brought an action without cauſe, or failed in the proſecution of it when brought, was liable to an amercement from the crown for raiſing a falſe accuſation; and ſo the form of the judgment ſtill is. In like manner, as by the Gothic conſtitutions no perſon was permitted to lay a complaint againſt another, *niſi ſub ſcriptura aut ſpecificatione trium teſtium, quod actionem vellet perſequi*: and, as by the laws of Sancho I. king of Portugal, damages were given againſt a plaintiff who proſecuted a groundleſs action.

The day on which the defendant is ordered to appear in court, and on which the ſheriff is to bring in the writ, and report how far he has obeyed it, is called the *return of the writ*; it being then returned by him to the king's juſtices at Weſtminſter. And it is always made returnable at the diſtance of leaſt 15 days from the date or teſt, that the defendant may have time to come up to Weſtminſter, even from the moſt remote parts of the kingdom; and upon ſome day in one of the four terms, in which the court ſits for the diſpatch of buſineſs.

WRITING, the art or act of ſignifying and conveying our ideas to others, by letters or characters viſible to the eye. See Composition, Grammar, and Language.

The moſt ancient remains of writing, which have been tranſmitted to us, are upon hard ſubſtances, ſuch as ſtones and metals, which were uſed by the ancients for edicts and matters of public notoriety; the decalogue was written on two tables of ſtone; but this practice was not peculiar to the Jews, for it was uſed by moſt of the eaſtern nations, as well as by the Greeks and Romans; and therefore the ridicule which Voltaire attempts to caſt upon that part of the book of Geneſis, where the people are commanded to write the law on ſtones, is abſurd; for what is there ſaid by no means implies, that other materials might not be uſed on common occaſions. The laws penal, civil, and ceremonial, among the Greeks, were engraven on tables of braſs which were called *Cyrbes*.

Writing.

We find that wood was alſo uſed for writing on in different countries. In the Sloanian library (N° 4852.) are ſix ſpecimens of Kufic writing, on boards about two feet in length, and ſix inches in depth. The Chineſe, before the invention of paper, wrote or engraved with an iron tool upon thin boards or on bamboo. Pliny ſays, that table books of wood were in uſe before the time of Homer. Theſe table books were called by the Romans *pugillares*. The wood was cut into thin ſlices, and finely plained and poliſhed. The writing was at firſt upon the bare wood, with an iron inſtrument called a *ſtyle*. In later times theſe tables were uſually waxed over, and written upon with that inſtrument. The matter written upon the tables which were thus waxed over was eaſily effaced, and by ſmoothing the wax new matter might be ſubſtituted in the place of what had been written before. The Greeks and Romans continued the uſe of waxed table-books long after the uſe of papyrus, leaves, and ſkins, became common, becauſe they were ſo convenient for correcting extemporary compoſitions.

Table books of ivory are ſtill uſed for memorandums, but they are commonly written upon with black lead pencils. The practice of writing on table-books covered with wax was not entirely laid aſide till the commencement of the 14th century.

The bark of trees was alſo uſed for writing by the ancients, and is ſo ſtill in ſeveral parts of Aſia. The ſame thing may be ſaid of the leaves of trees. It is needleſs to obſerve the uſe of parchment and vellum, papyrus and paper, for writing; it is too well known. The method of fabricating theſe ſubſtances has been already deſcribed as they occurred in the order of the alphabet.

It is obvious, that when men wrote, or rather engraved, on hard ſubſtances, inſtruments of metal were neceſſary, ſuch as the chiſel and the ſtylus; but the latter was chiefly uſed for writing upon boards, waxed tablets, or on bark.

When the ancients wrote on ſofter materials than wood or metal, other inſtruments were uſed for writing with, of which reeds and canes ſeem to have been the firſt. Reeds and canes are ſtill uſed as inſtruments for writing with by the Tartars, the Indians, the Perſians, the Turks, and the Greeks. Pencils made of hair are uſed by the Chineſe for their writing: they firſt liquify their ink, and dip their pencils into it. Hair-pencils have likewiſe been uſed for writing in Europe. Large capital letters were made with them from the time of the Roman emperors till the 16th century. After the invention of printing they were drawn by the illuminators. Quills of geeſe, ſwans, peacocks, crows, and other birds, have been uſed in theſe weſtern parts for writing with, but how long is not eaſy to aſcertain. St Iſidore of Seville, who lived about the middle of the 7th century, deſcribes a pen made of a quill as uſed in his time.

Method of reſtoring decayed Writings. In the 77th vol. of the Phil. Tranſ. there is a paper on this ſubject by Sir Charles Blagden. One of the beſt methods he found upon experiment to be, covering the letters with phlogiſticated or pruſſicalkali, with the addition of a diluted mineral acid; upon the application of which, the letters changed very ſpeedily to a deep blue colour, of great beauty and intenſity. To prevent the ſpreading of the colour, which, by blotting the parchment, detracts greatly from the legibility, the alkali ſhould be put on firſt, and the diluted acid added upon it.

The method found to anſwer beſt has been, to ſpread the alkali thin with a feather over the traces of the letters, and then to touch it gently, as nearly upon or over the letters as can be done with the diluted acid, by means of a feather or a bit of ſtick cut to a blunt point. Though the alkali ſhould occaſion no ſenſible change of colour, yet the moment the acid comes upon it, every trace of a letter turns at once to a fine blue, which ſoon acquires its full intenſity, and is beyond compariſon ſtronger than the colour of the original trace had been. If, then, the corner of a bit of blotting paper be carefully and dexterouſly applied near the letters, ſo as to imbibe the ſuperfluous liquor, the ſtaining of the parchment may be in a great meaſure avoided; for it is this ſuperfluous liquor which, abſorbing part of the colouring matter from the letters, becomes a dye to whatever it touches. Care muſt be taken not to bring the blotting paper in contact with the letters, becauſe the colouring matter is ſoft whilſt wet, and may eaſily be rubbed off. The acid chiefly employed was the marine; but both the vitriolic and nitrous ſucceed very well. They ſhould be ſo far diluted as not to be in danger of corroding the parchment, after which the degree of ſtrength does not ſeem to be a matter of much nicety.

Method of Copying WRITINGS. The ingenious Mr Watt, about 16 years ago, invented a method of copying writings very ſpeedily, and without the poſſibility of committing miſtakes. A piece of thin unſized paper is to be taken exactly of the ſize of the paper to be copied; it is to be moiſtened with water, or, what is better, with the following liquid: Take of diſtilled vinegar two pounds weight, diſſolve it in one ounce of boracic acid; then take four ounces of oyſter-ſhells calcined to whiteneſs, and carefully freed from their brown cruſt; put them into the vinegar, ſhake the mixture frequently for 24 hours, then let it ſtand until it depoſits its ſediment; filter the clear part through unſized paper into a glaſs veſſel; then add two ounces of the beſt blue Aleppo galls bruiſed, and place the liquor in a warm place, ſhaking it frequently for 24 hours; then filter the liquor again through unſized paper, and add to it after filtration one quart, ale meaſure, of pure water. It muſt then ſtand 24 hours, and be filtered again if it ſhows a diſpoſition to depoſit any ſediment, which it generally does. When the paper has been wet with this liquid, put it between two thick unſized papers to abſorb the ſuperfluous moiſture; then lay it over the writing to be copied, and put a piece of clean writing paper above it. Put the whole on the board of a rolling-preſs, and preſs them thro' the rolls, as is done in printing copperplates, and a copy of the writing ſhall appear on both ſides of the thin moiſtened paper; on one ſide in a reverſed order and direction, but on the other ſide in the natural order and direction of the lines.

WRITTEN MOUNTAINS. See MOUNTAINS.

WRY-NECK, in ornithology. See JYNX.

WURTEMBURG, or WIRTENBURG, a ſovereign duchy of Germany, in Suabia; bounded on the north by Franconia, the archbiſhopric of Mentz, and the palatinate of the Rhine; on the eaſt by the county of Oeting, the marquiſate of Burgau, and the territory of Ulm; on the ſouth by the principality of Hoen Zollern, Furſtenburg, and the marquiſate of Hohenburg; and on the weſt by the palatinate of the Rhine, the marquiſate of Baden, and the Black Foreſt. It is 65 miles in length, and as much in breadth, and the river Neckar runs almoſt through the middle of it from ſouth to north. Though there are many mountains and woods, yet it is one of the moſt populous and fertile countries in Germany, producing plenty of graſs, corn, fruits, and a great deal of wine towards the confines of the palatinate. There are alſo mines, and ſalt ſprings, with plenty of game and fiſh. It contains 645 villages, 88 towns, and 26 cities, of which Stutgard is the capital.

WURTSBURG, a large biſhopric in Germany, comprehending the principal part of Franconia. It is bounded by the county of Henneburg, the duchy of Coburg, the abbey of Fuld, the archbiſhopric of Mentz, the marquiſate of Anſpach, the biſhopric of Bamberg, and the county of Wertheim; being about 65 miles in length, and 50 in breadth, and divided into 50 bailiwicks. The ſoil is very fertile, and produces more corn and wine than the inhabitants conſume. The territories of the biſhop comprehend above 400 towns and villages, of which he is ſovereign, being one of the greateſt eccleſiaſtical princes of the empire.

WURTZBURG, a large and handſome city of Germany, and one of the principal in the circle of Franconia. It is defended with good fortifications, and has a magnificent palace. There is a handſome hoſpital, in which are generally 400 poor men and women. The caſtle is at a ſmall diſtance from the city, and commands it, as it ſtands upon an eminence. It communicates with the city by a ſtone-bridge, on which are 12 ſtatues, repreſenting as many ſaints. The arſenal and the cellars of the biſhop deſerve the attention of the curious. There is alſo an univerſity, founded in 1403. It is ſeated on the river Maine, in E. Long. 10. 2. N. Lat. 49. 40.

WYCHERLEY (William), an eminent Engliſh comic poet, was born about 1640. A little before the reſtoration of King Charles II. he became a gentleman commoner of Queen's college Oxford, where he was reconciled by Dr Barlow to the Proteſtant religion, which he had a little before abandoned in his travels. He afterward entered himſelf in the Middle-temple, but ſoon quitted the ſtudy of the law for purſuits more agreeable to his own genius, as well as to the taſte of the age. Upon writing his firſt play, intitled, Love in a Wood, or St James's Park, which was acted in 1672, he became acquainted with ſeveral of the celebrated wits both of the court and town, and likewiſe with the ducheſs of Cleveland. Some time after appeared his comedies, called The Gentleman Dancing-Maſter, the Plain Dealer, and the Country Wife; all which were acted with applauſe. George duke of Buckingham had a very high eſteem for him, and beſtowed on him ſeveral advantageous poſts. King Charles alſo ſhowed him ſignal marks of favour; and once gave him a proof of his eſteem, which perhaps never any ſovereign prince before had given to a private gentleman. Mr Wycherley being ill of a fever, at his lodgings in Bow-ſtreet, the king did him the honour of a viſit. Finding him extremely weakened, he commanded him to take a journey to the ſouth of France, and aſſured him, at the ſame time, that he would order him 500 l. to defray the charges of the journey. Mr Wycherley accordingly went into France; and having ſpent the winter there, returned to England entirely reſtored to his former vigour. The king, ſhortly after his arrival, told him, that he had a ſon, who he was reſolved ſhould be educated like the ſon of a king, and that he could not chooſe a more proper man for his governor than Mr Wycherley; for which ſervice 1500 l. *per annum* ſhould be ſettled upon him.

Immediately after this offer he went down to Tunbridge, where walking one day upon the Well's-walk with his friend Mr Fairbeard of Gray's-Inn, juſt as he came up to the bookſeller's ſhop, the counteſs of Drogheda, a young widow, rich, noble, and beautiful came there to enquire for the Plain Dealer; "Madam," ſays Mr Fairbeard, "ſince you are for the Plain Dealer, there he is for you;" puſhing Mr Wycherley towards her. "Yes," ſays Mr

Wycherley, " this lady can bear plain dealing; for ſhe appears to be ſo accompliſhed, that what would be a compliment to others, would be plain dealing to her." " No, truly, Sir," ſaid the counteſs, " I am not without my faults, any more than the reſt of my ſex; and yet, notwithſtanding, I love plain-dealing, and am never more fond of it than when it tells me of them." " Then, madam," ſays Mr Fairbeard, " you and the Plain-Dealer ſeem deſigned by Heaven for each other."—In ſhort, Mr Wycherley walked a turn or two with the counteſs, waited upon her home, viſited her daily while ſhe ſtaid at Tunbridge, and married her ſoon after without acquainting the king. By this ſtep, which was looked upon as a contempt of his majeſty's orders, he forfeited the royal favour. The counteſs of Drogheda ſettled her whole fortune upon him; but his title being diſputed after her death, he was ſo reduced by the expences of the law and other incumbrances, as to be unable to ſatisfy the impatience of his creditors, who threw him into priſon; and the bookſeller who printed his Plain-Dealer, by which he got almoſt as much money as the other gained reputation, was ſo ungrateful as to refuſe to lend him 20l. in his extreme neceſſity. In that confinement he languiſhed ſeven years; but at length king James going to ſee the above play, was ſo charmed with it, that he gave immediate orders for the payment of his debts, and even granted him a penſion of 200l. *per annum*. But that prince's bountiful intentions were in a great meaſure defeated merely through Mr Wycherley's modeſty; he being aſhamed to tell the earl of Mulgrave, whom the king had ſent to demand it, a true ſtate of his debts. He laboured under the weight of theſe difficulties till his father died, who left him 600 l. a year. But this eſtate was under uneaſy limitations, he being only a tenant for life, and not being allowed to raiſe any money for the payment of his debts. However, he took a method of doing it which few ſuſpected to be his choice; and this was making a jointure. He had often declared, that he was reſolved to die married, though he could not bear the thoughts of living in that ſtate again: accordingly, juſt at the eve of his death, he married a young gentlewoman with 1500l. fortune, part of which he applied to the uſes he wanted it for. Eleven days after the celebration of theſe nuptials, in December 1715, he died, and was interred in the vault of Covent-garden church.

Beſides his plays above-mentioned, he publiſhed a volume of poems in folio. In 1728 his poſthumous works in proſe and verſe were publiſhed by Mr Theobald.

WYNDHAM (Sir William), deſcended of an ancient family, was born about the year 1687, and ſucceeded young to the title and eſtate of his father. On his return from his travels, he was choſen member for the county of Somerſet; in which ſtation he ſerved in the three laſt parliaments of Queen Anne, and as long as he lived: after the change of the miniſtry in 1710, he was appointed ſecretary at war; and in 1713 was raiſed to be chancellor of the exchequer. Upon the breach between the earl of Oxford and lord Bolingbroke, he adhered to the intereſts of the latter. He was removed from his employment on the acceſſion of George I. and falling under ſuſpicion on the breaking out of the rebellion in 1715, was apprehended. He made his eſcape; a reward was publiſhed for apprehending him; he ſurrendered, was committed to the Tower, but never brought to a trial. After he regained his liberty, he continued in oppoſition to the ſeveral adminiſtrations under which he lived; and died in 1740.

WYKEHAM (William of). See WILLIAM.

WYE, a river of Wales, which riſing on the confines of Cardiganſhire, and running ſouth-eaſt, divides the counties of Radnor and Brecknock: then croſſing Herefordſhire, it runs ſouth and falls into the mouth of the Severn at Chepſtow.

X.

X or x, is the 22d letter of our alphabet, and a double conſonant. It was not uſed by the Hebrews or ancient Greeks; for as it is a compound letter, the ancients, who uſed great ſimplicity in their writings, expreſſed this letter by its component letters *c s*. Neither have the Italians this letter, but expreſs it by *ſſ*. X begins no word in our language but ſuch as are of Greek original; and is in few others but what are of Latin derivation; as *perplex*, *reflexion*, *defluxion*, &c. We often expreſs this ſound by ſingle letters, as *cks*, in *backs*, *necks*; by *ks*, in *books*, *breaks*; by *cc*, in *acceſs*, *accident*; by *ct*, in *action*, *unction*, &c. The Engliſh and French pronounce it like *cs* or *ks*; the Spaniards like *c* before *a*, viz. *Alexandro*, as if it were *Alecandro*. In numerals it expreſſeth 10, whence in old Roman manuſcripts it is uſed for *denarius*; and as ſuch ſeems to be made of two V's placed one over the other. When a daſh is added over it, thus X̄, it ſignifies 10,000.

XANTHIUM, in botany; a genus of plants of the claſs *monœcia*, order *pentandria*, and arranged in the natural claſſification under the 49th order, *compoſitæ*. The male flowers are compoſite, common calyx imbricated; corollulæ monopetalous, tubular, quinquefid. Female: calyx involucrum of two leaves, containing two flowers; corolla 0; drupa, dry, prickly; nucleus bilocular. There are five ſpecies, only one of which is a native of Britain, the *ſtrumarium* or leſs burdock. The ſtem of this plant is a foot and a half high, thick, often ſpotted; leaves heart-ſhaped, lobed, on long footſtalks. Flowers, male and female, many together, in the alæ of the leaves. The leaves are bitter and aſtringent. A decoction of the whole plant affords a ſhowy yellow colour, but it is better if only the flowers are uſed. Horſes and goats eat it; cows, ſheep, and ſwine refuſe it.

XANTHOXYLUM. See ZANTHOXYLUM.

XEBEC, or ZEBEC a ſmall three-maſted veſſel, navigated in the Mediterranean Sea, and on the coaſts of Spain, Portugal, and Barbary. See Plate CCCCLII, fig. 10.

The ſails of the xebec are in general ſimilar to thoſe of the poleacre, but the hull is extremely different from that and almoſt every other veſſel. It is furniſhed with a ſtrong prow: and the extremity of the ſtern, which is nothing more than a ſort of railed platform or gallery, projects farther behind the counter and buttock than that of any European ſhip.

Being generally equipped as a corſair, the xebec is conſtructed with a narrow floor, to be more ſwift in purſuit of the enemy; and of a great breadth, to enable her to carry a great force of ſail for this purpoſe without danger of overturning. As theſe veſſels are uſually very low built, their decks are formed with a great convexity from the middle of their breadth towards the ſides, in order to carry off the water which falls aboard more readily by their ſcuppers. But as this extreme convexity would render it very difficult to walk thereon at ſea, particularly when the veſſel rocks by the agitation of the waves, there is a platform of grating extending along the deck from the ſides of the veſſel towards the middle, whereon the crew may walk dry-footed whilſt the water is conveyed through the grating to the ſcuppers.

The xebecs, which are generally armed as veſſels of war by the Algerines, mount from 16 to 24 cannon, and carry from 300 to 450 men, two-thirds of whom are generally ſoldiers.

By the very complicated and inconvenient method of working theſe veſſels, what one of their captains of Algiers told Mr Falconer will be readily believed, viz. that every xebec requires at leaſt the labour of three ſquare-rigged ſhips, wherein the ſtanding ſails are calculated to anſwer every ſituation of the wind.

XENOCRATES, a celebrated ancient Grecian philoſopher, was born at Chalcedon in the 95th Olympiad. At firſt he attached himſelf to Æſchines, but afterwards became a diſciple of Plato, who took much pains in cultivating his genius, which was naturally heavy. His temper was gloomy, his aſpect ſevere, and his manners little tinctured with urbanity. Theſe material defects his maſter took great pains to correct; frequently adviſing him to ſacrifice to the Graces, and the pupil was patient of inſtruction, and knew how to value the kindneſs of his preceptor. As long as Plato lived, Xenocrates was one of his moſt eſteemed diſciples; after his death he cloſely adhered to his doctrine; and, in the ſecond year of the 110th Olympiad, he took the chair in the academy, as the ſucceſſor of Speuſippus.

Xenocrates was celebrated among the Athenians, not only for his wiſdom, but for his virtues. So eminent was his reputation for integrity, that when he was called upon to give evidence in a judicial tranſaction, in which an oath was uſually required, the judges unanimouſly agreed, that his ſimple aſſeveration ſhould be taken, as a public teſtimony to his merit. Even Philip of Macedon found it impoſſible to corrupt him. So abſtemious was he with reſpect to food, that his proviſion was frequently ſpoiled before it was conſumed. His chaſtity was invincible. Phryne, a celebrated Athenian courtezan, attempted without ſucceſs to ſeduce him. Of his humanity the following pathetic incident is a ſufficient proof: A ſparrow, which was purſued by a hawk, flew in his boſom; he afforded it protection till its enemy was out of ſight, and then let it go, ſaying, that he would never betray a ſuppliant. He was fond of retirement, and was ſeldom ſeen in the city. He was diſcreet in the uſe of his time, and carefully allotted a certain portion of each day to its proper buſineſs. One of theſe he employed in ſilent meditation. He was an admirer of the mathematical ſciences; and was ſo fully convinced of their utility, that when a young man, who was unacquainted with geometry and aſtronomy, deſired admiſſion into the academy, he refuſed his requeſt, ſaying, that he was not yet poſſeſſed of the handles of philoſophy. In fine, Xenocrates was eminent both for the purity of his morals and for his acquaintance with ſcience, and ſupported the credit of the Platonic ſchool, by his lectures, his writings, and his conduct. He lived to the firſt year of the 116th Olympiad, or the 82 of his age, when he loſt his life by accidentally falling, in the dark, into a reſervoir of water.

Enfield's Hiſt of Philoſophy, vol. ii.

XENOPHANES, the founder of the Eleaic ſect of philoſophy among the Greeks, was born at Colophon probably about the 65th Olympiad. From ſome cauſe or other he left his country early, and took refuge in Sicily, where he ſupported himſelf by reciting, in the court of Hiero, elegiac and iambic verſes, which he had written in reprehenſion of the theogonies of Heſiod and Homer. From Sicily he paſſed over into Magna Græcia, where he took up the profeſſion of philoſophy, and became a celebrated preceptor in the Pythagorean ſchool. Indulging, however, a greater freedom of thought than was uſual among the diſciples of Pythagoras, he ventured to introduce new opinions of his own, and in many particulars to oppoſe the doctrines of Epimenides, Thales, and Pythagoras. Xenophanes poſſeſſed the Pythagorean chair of philoſophy about ſeventy years, and lived to the extreme age of an hundred years, that is, according to Euſebius, till the 81ſt Olympiad. The doctrine of Xenophanes concerning nature is ſo imperfectly preſerved, and obſcurely expreſſed, that it is no wonder that it has been differently repreſented by different writers. Perhaps the truth is, that he held the univerſe to be one in nature and ſubſtance, but diſtinguiſhed in his conception between the matter of which all things conſiſt, and that latent divine force which, though not a diſtinct ſubſtance but an attribute, is neceſſarily inherent in the univerſe, and is the cauſe of all its perfection.

XENOPHON, an illuſtrious philoſopher, general, and hiſtorian, was born at Athens in the 3d year of the 82d Olympiad. When he was a youth, Socrates, ſtruck with his external appearance, determined to admit him into the number of his pupils. Meeting him by accident in a narrow paſſage, the philoſopher put his ſtaff acroſs the path, and ſtopping him, aſked, where thoſe things were to be purchaſed which are neceſſary to human life? Xenophon appearing at a loſs for a reply to this unexpected ſalutation, Socrates proceeded to aſk him, where honeſt and good men were to be found? Xenophon ſtill heſitating, Socrates ſaid to him, "Follow me, and learn." From that time Xenophon became a diſciple of Socrates, and made a rapid progreſs in that moral wiſdom for which his maſter was ſo eminent. Xenophon accompanied Socrates in the Peloponneſian war, and fought courageouſly in defence of his country. He afterwards entered into the army of Cyrus as a private volunteer in his expedition againſt his brother. This enterprize proving unfortunate, Xenophon, after the death of Cyrus, adviſed his fellow ſoldiers to attempt a retreat into their own country. They liſtened to his advice; and having had many proofs of his wiſdom as well as courage, they gave him the command of the army, in the room of Proxenus who had fallen in battle. In this command he acquired great glory by the prudence and firmneſs with which he conducted them back, through the midſt of innumerable dangers, into their own country. The particulars of this memorable adventure are related by Xenophon himſelf in his Retreat of the Ten Thouſand. After his return into Greece, he joined Ageſilaus, king of Sparta, and fought with him againſt the Thebans in the celebrated battle of Chæronea. The Athenians, diſpleaſed at this alliance, brought a public accuſation againſt him for his former conduct in engaging in the ſervice of Cyrus, and condemned him to exile. The Spartans, upon this, took Xenophon, as an injured man, under their protection, and provided him a comfortable retreat at Scilluntes in Elea. Here, with his wife and two children, he remained ſeveral years, and paſſed his time in the ſociety of his friends, and in writing theſe hiſtorical works which have rendered his name immortal. A war at length aroſe between the Spartans and Eleans ; and Xenophon was obliged to retire to Lepreus, where his eldeſt ſon had ſettled. He afterwards removed, with his whole family, to Corinth, where, in the firſt year of the hundred and fifth Olympiad, he finiſhed his days.

Xenophon the *Younger*, a Greek writer, ſo called to diſtinguiſh him from the celebrated Xenophon, was born at Epheſus, and lived, according to ſome authors, before Heliodorus, that is, about the beginning of the 4th century. He is only known by his *Epheſiaca*, a Greek romance in five books, which is eſteemed, and contains the amours or adventures of Abracomes and Anthia. This romance was printed at London, in Greek and Latin, in 1724, 4to.

XERXES I. the fifth king of Perſia, memorable for the vaſt army he is ſaid to have carried into the field againſt Leonidas king of Sparta ; conſiſting, according to ſome hiſtorians, of 800,000 men, while others make it amount to 3,000,000, excluſive of attendants. The fleet that attended this prodigious land force is likewiſe made to conſiſt of 2000 ſail ; and all the ſucceſs they met with was the taking and burning the city of Athens ; for the army was ſhamefully repulſed near the ſtraits of Thermopylæ by Leonidas, and the fleet was diſperſed and partly deſtroyed by Themiſtocles at the ſtraits of Salamis, who had only 380 ſail under his command. Xerxes was aſſaſſinated by Artabanes, chief captain of his guards, and his diſtinguiſhed favourite. See SPARTA.

XIMENES (Francis), a juſtly celebrated cardinal, biſhop of Toledo, and prime miniſter of Spain, was born at Torrelaguna, in Old Caſtile, in 1437, and ſtudied at Alcala and Salamanca. He then went to Rome ; and being robbed on the road, brought nothing back but a bull for obtaining the firſt vacant prebend : but the archbiſhop of Toledo refuſed it him, and threw him in priſon. Being at length reſtored to liberty, he obtained a benefice in the dioceſe of Siguenca, where cardinal Gonzales de Mendoza, who was the biſhop, made him his grand vicar. Ximenes ſome time after entered among the Franciſcans of Toledo ; but being there troubled with viſits, he retired to a ſolitude named *Caſtanel*, and applied himſelf to the ſtudy of divinity and the oriental tongues. At his return to Toledo, queen Iſabella of Caſtile choſe him for her confeſſor, and afterwards nominated him archbiſhop of Toledo ; which, next to the papacy, is the richeſt dignity in the church of Rome. "This honour (ſays Dr Robertſon) he declined with a firmneſs which nothing but the authoritative injunction of the pope was able to overcome. Nor did this height of promotion change his manners. Though obliged to diſplay in public that magnificence which became his ſtation, he himſelf retained his monaſtic ſeverity. Under his pontifical robes he conſtantly wore the coarſe frock of St Francis, the rents of which he uſed to patch with his own hands. He at no time uſed linen, but was commonly clad in hair-cloth. He ſlept always in his habit ; moſt frequently on the floor or on boards, and rarely in a bed. He did not taſte any of the delicacies which appeared at his table, but ſatisfied himſelf with that ſimple diet which the rule of his order preſcribed. Notwithſtanding theſe peculiarities, ſo oppoſite to the manners of the world, he poſſeſſed a thorough knowledge of its affairs, and diſcovered talents for buſineſs which rendered the fame of his wiſdom equal to that of his ſanctity." His firſt care was to provide for the neceſſities of the poor ; to viſit the churches and hoſpitals ; to purge his dioceſe of uſurers and places of debauchery ; to degrade corrupt judges, and place in their room perſons whom he knew to be diſtinguiſhed by their probity and diſintereſtedneſs. He erected a famous univerſity at Alcala ; and in 1499 founded the college of St Ildephonſo. Three years after he undertook the Polyglot Bible ; and for that purpoſe ſent for many learned men to come to him at Toledo, purchaſed ſeven copies in Hebrew for 4000 crowns, and gave a great price for Latin and Greek manuſcripts. At this Bible they laboured above 12 years. It contains the Hebrew text of the Bible ; the verſion of the Septuagint, with a literal tranſlation ; that of St Jerom, and the Chaldee paraphraſes of Onkelos ; and Ximenes added to it a dictionary of the Hebrew and Chaldee words contained in the Bible. This work is called *Ximenes's Polyglot*. In 1507 pope Julius II. gave him the cardinal's hat, and king Ferdinand the Catholic entruſted him with the adminiſtration of affairs. Cardinal Ximenes was from this moment the ſoul of every thing that paſſed in Spain. He diſtinguiſhed himſelf at the beginning of his miniſtry by diſcharging the people from the burdenſome tax called *acavale*, which had been continued on account of the war againſt Granada ; and laboured with ſuch zeal and ſucceſs in the converſion of the Mahometans, that he made 3000 converts, among whom was a prince of the blood of the kings of Granada. In 1509 cardinal Ximenes extended the dominions of Ferdinand, by taking the city of Oran in the kingdom of Algiers. He undertook this conqueſt at his own expence, and marched in perſon at the head of the Spaniſh army cloathed in his pontifical ornaments, and accompanied by a great number of eccleſiaſtics and monks. Some time after, foreſeeing an extraordinary ſcarcity, he erected public granaries at Toledo, Alcala, and Torrelaguna, and had them filled with corn at his own expence ; which gained the people's hearts to ſuch a degree, that to preſerve the memory of this noble action they had an eulogium upon it cut on marble, in the hall of the ſenate-houſe at Toledo, and in the market-place. King Ferdinand dying in 1516, left cardinal Ximenes regent of his dominions ; and the archduke Charles, who was afterwards the emperor Charles V. confirmed that nomination. The cardinal immediately made a reform of the officers of the ſupreme council and of the court, and put a ſtop to the oppreſſion of the grandees. He vindicated the rights of the people againſt the nobility ; and as by the feudal conſtitution the military power was lodged in the hands of the nobles, and men of inferior condition were called into the field only as their vaſſals, a king with ſcanty revenues depended on them in all his operations. From this ſtate Ximenes reſolved to deliver the crown ; and iſſued a proclamation, commanding every city in Caſtile to inrol a certain number of its burgeſſes, and teach them military diſcipline ; he himſelf engaging to provide officers to command them at the public expence. This was vigorouſly oppoſed by the nobles ; but by his intrepidity and ſuperior addreſs he carried his point. He then endeavoured to diminiſh the poſſeſſions of the nobility, by reclaiming all the crown-lands, and putting a ſtop to the penſions granted by the late king Ferdinand. This addition made to the revenues enabled him to diſcharge all the debts of Ferdinand, and to eſtabliſh magazines of warlike ſtores. The nobles, alarmed at theſe repeated attacks, uttered loud complaints ; but before they proceeded to extremities, appointed ſome grandees of the firſt rank to examine the powers in conſequence of which he exerciſed acts of ſuch high authority. Ximenes received them with cold civility ; produced the teſtament of Ferdinand, by which he was appointed regent, together with the ratification of that deed by Charles. To both theſe they objected ; and he endeavoured to eſtabliſh their validity. As the converſation grew warm, he led them inſenſibly to a balcony, from which they had a view of a large body of troops under arms, and of a formidable train of artillery.

“Behold (ſays he, pointing to theſe, and raiſing his voice) the powers which I have received from his Catholic majeſty! With theſe I govern Caſtile; and with theſe I will govern it, till the king, your maſter and mine, takes poſſeſſion of his kingdom!” A declaration ſo bold and haughty ſilenced them, and aſtoniſhed their aſſociates. They ſaw that he was prepared for his defence, and laid aſide all thoughts of a general confederacy againſt his adminiſtration. At length, from the repeated intreaties of Ximenes, and the impatient murmurs of the Spaniſh miniſtry, Charles V. embarked, and landed in Spain, accompanied by his favourites. Ximenes was advancing to the coaſt to meet him, but at Bos Equillos was ſeized with a violent diſorder, which his followers conſidered as the effects of poiſon. This accident obliging Ximenes to ſtop, he wrote to the king, and with his uſual boldneſs adviſed him to diſmiſs all the ſtrangers in his train, whoſe number and credit already gave offence to the Spaniards, and earneſtly deſired to have an interview with him, that he might inform him of the ſtate of the nation, and the temper of his ſubjects. To prevent this, not only the Flemings, but the Spaniſh grandees, employed all their addreſs to keep Charles at a diſtance from Aranda, the place to which the cardinal had removed. His advice was now ſlighted and deſpiſed. Ximenes, conſcious of his own integrity and merit, expected a more grateful return from a prince to whom he delivered a kingdom more flouriſhing than it had been in any former age, and a more extenſive authority than the moſt illuſtrious of his anceſtors had ever poſſeſſed; and lamented the fate of his country, about to be ruined by the rapaciouſneſs and inſolence of foreign favourites. While his mind was agitated by theſe paſſions, he received a letter from the king; in which, after a few cold and formal expreſſions of regard, he was allowed to retire to his dioceſe; and he expired a few hours after reading it in 1517, in the 81ſt year of his age.

This famous cardinal ought not to be confounded with *Roderick* XIMENES, archbiſhop of Toledo, in the 13th century, who wrote a Hiſtory of Spain in nine books; nor with ſeveral other Spaniſh writers of the name of *Ximenes*.

XIPHIAS, in zoology, the SWORD-FISH; a genus of fiſhes belonging to the order of *apodes*. The upper jaw terminates in a long ſword-ſhaped roſtrum, from which it is called the *ſword-fiſh*: there are no teeth in the mouth; the gill-membrane has eight rays; and the body is ſomewhat cylindrical. There is but one ſpecies, *viz.* the *gladius*, found in the European ocean. This fiſh ſometimes frequents our coaſts, but is much more common in the Mediterranean Sea, eſpecially in the part that ſeparates Italy from Sicily, which has been long celebrated for it: the promontory Pelorus, now Capo di Faro, was a place noted for the reſort of the xiphias, and poſſibly the ſtation of the ſpeculatores, or the perſons who watched and gave notice of the approach of the fiſh.

The ancient method of taking them is particularly deſcribed by Strabo, and agrees exactly with that practiſed by the moderns. A man aſcends one of the cliffs that overhangs the ſea: as ſoon as he ſpies the fiſh, he gives notice, either by his voice or by ſigns, of the courſe it takes. Another, that is ſtationed in a boat, climbs up the maſt, and on ſeeing the ſword-fiſh, directs the rowers towards it. As ſoon as he thinks they are got within reach, he deſcends, and taking a ſpear in his hand, ſtrikes it into the fiſh; which, after wearying itſelf with its agitation, is ſeized and drawn into the boat. It is much eſteemed by the Sicilians, who buy it up eagerly, and at its firſt coming into ſeaſon give about ſixpence Engliſh *per* pound. The ſeaſon laſts from May till Auguſt. The ancients uſed to cut this fiſh into pieces and ſalt it; whence it was called *Tomus Thurianus*, from Thurii, a town in the bay of Tarentum, where it was taken and cured.

The ſword-fiſh is ſaid to be very voracious, and that it is a great enemy to the tunny, who (according to Belon) are as much terrified at it as ſheep are at the ſight of a wolf. It is a great enemy to the whales, and frequently deſtroys them. See BALÆNA.

XYLO-ALOES, or ALOE WOOD, in the materia medica, is the product of a tree growing in China and ſome of the Indian iſlands. See EXCÆCARIA.

This drug is diſtinguiſhed into three ſorts: the calambac or tambac, the common lignum aloes, and calambour.

The calamback, or fineſt aloes-wood, called by authors *lignum aloes præſtantiſſimum*, and by the Chineſe *ſukhiang*, is the moſt reſinous of all the woods we are acquainted with: it is of a light ſpongy texture, very porous, and its pores ſo filled up with a ſoft and fragrant reſin, that the whole may be preſſed and dented by the fingers like wax, or moulded about by chewing in the mouth, in the manner of maſtich. This kind, laid on the fire, melts in great parts like reſin, and burns away in a few moments with a bright flame and perfumed ſmell. Its ſcent, while in the maſs, is very fragrant and agreeable; and its taſte acrid and bitteriſh, but very aromatic and agreeable. It is ſo variable in its colour, that ſome have divided it into three kinds; the one variegated with black and purple; the ſecond, with the ſame black, but with yellowiſh inſtead of purple; and the third, yellow alone like the yolk of an egg; this laſt is the leaſt ſcented of the three. The variation, however, is owing to the trunk of the tree being itſelf of three different colours; and the heart of it is the valuable ſort firſt deſcribed. The two following are ſuppoſed to be the other parts of the trunk; though this ſeems doubtful, eſpecially in regard to the laſt ſort, from the circumſtances mentioned of its being found in large logs entire, and ſometimes only the *heart*, which, as above noticed, conſtitutes the calambac.

The lignum aloes vulgare is the ſecond in value. This is of a more denſe and compact texture, and conſequently leſs reſinous than the other; there is ſome of it, however, that is ſpongy, and has the holes filled up with the right reſinous matter; and all of it, when good, has veins of the ſame reſin in it. We meet with it in ſmall fragments, which have been cut and ſplit from larger: theſe are of a tolerably denſe texture in the more ſolid pieces, and of a duſky brown colour, variegated with reſinous black veins. It is in this ſtate very heavy, and leſs fragrant than in thoſe pieces which ſhow a multitude of little holes, filled up with the ſame blackiſh matter that forms the veins in others. The woody part of theſe laſt pieces is ſomewhat darker than the other, and is not unfrequently purpliſh, or even blackiſh. The ſmell of the common aloe-wood is very agreeable, but not ſo ſtrongly perfumed as the former. Its taſte is ſomewhat bitter and acrid, but very aromatic.

The calambour, called alſo *agallochum ſylveſtre*, and *lignum aloes mexicanum*, is light and friable, of a duſky and often mottled colour, between a duſky green black and a deep brown. Its ſmell is fragrant and agreeable, but much leſs ſweet than that of either of the others; and its taſte bitteriſh, but not ſo much acrid or aromatic as either of the two former. This is ſaid to be met with very frequently, and in large logs: and theſe ſometimes entire, ſometimes only the heart of the tree. This is the aloe-wood uſed by the cabinet-makers and inlayers.

This drug is eſteemed a cordial taken inwardly; and is ſometimes given in diſorders of the ſtomach and bowels, and to deſtroy the worms. A very fragrant oil may be procured from it by diſtillation; which is recommended in paralytic caſes from five to fifteen drops. It is at preſent, however, Xynoecia, Xyſtarcha.

however, but little uſed ; and would ſcarce be met with anywhere in the ſhops, but that it is an ingredient in ſome of the old compoſitions.

XYNOECIA, in Grecian antiquity, an anniverſary feaſt obſerved by the Athenians in honour of Minerva, upon the ſixteenth of Hecatombæon, to commemorate their leaving, by the perſuaſion of Theſus, their country-ſeats, in which they lay diſperſed here and there in Attica, and uniting together in one body.

XYSTARCHA, in antiquity, the maſter or director of the xyſtus. In the Greek gymnaſium, the xyſtarcha was the ſecond officer, and the gymnaſiarcha the firſt ; the former was his lieutenant, and preſided over the two xyſti, and all the exerciſes of the athletæ therein.

Xyſtus.

XYSTUS, among the Greeks, was a long portico, open or covered at the top, where the athletæ practiſed wreſtling and running : the gladiators, who practiſed therein, were called *xyſtici*. Among the Romans, the xyſtus was only an alley, or double row of trees, meeting like an arbour, and forming a ſhade to walk under.

Y.

Y ‖ Yard.

Y, or y, the 23d letter of our alphabet : its ſound is formed by expreſſing the breath with a ſudden expanſion of the lips from that configuration by which we expreſs the vowel *u*. It is one of the ambigenial letters, being a conſonant in the beginning of words, and placed before all vowels, as in *yard*, *yield*, *young*, &c. but before no conſonant. At the end of words it is a vowel, and is ſubſtituted for the ſound of *i*, as in *try*, *deſcry*, &c. In the middle of words it is not uſed ſo frequently as *i* is, unleſs in words derived from the Greek, as in *chyle*, *empyreal*, &c. though it is admitted into the middle of ſome pure Engliſh words, as in *dying*, *flying*, &c. The Romans had no capital of this letter, but uſed the ſmall one in the middle and laſt ſyllables of words, as in *coryambus*, *onyx*, *martyr*. Y is alſo a numeral, ſignifying 150, or according to Baronius 159 ; and with a daſh a-top, as Ȳ, it ſignified 150,000.

YACHT, or YATCH, a veſſel of ſtate, uſually employed to convey princes, ambaſſadors, or other great perſonages, from one kingdom to another.

As the principal deſign of a yacht is to accommodate the paſſengers, it is uſually fitted with a variety of convenient apartments, with ſuitable furniture, according to the quality or number of the perſons contained therein.

The royal yachts are commonly rigged as ketches, except the principal one reſerved for the ſovereign, which is equipped with three maſts like a ſhip. They are in general elegantly furniſhed, and richly ornamented with ſculpture ; and always commanded by captains in his majeſty's navy.

Beſides theſe, there are many other yachts of a ſmaller kind, employed by the commiſſioners of the exciſe, navy and cuſtoms ; or uſed as pleaſure-boats by private gentlemen.

YAMS. See DISCOREA.

YAMBOO. See EUGENIA.

YARD *of a* SHIP, a long piece of timber ſuſpended upon the maſts of a ſhip, to extend the ſails to the wind. See MAST and SAIL.

All yards are either ſquare or lateen ; the former of which are ſuſpended acroſs the maſts at right angles, and the latter obliquely. See Plate CCCCXLIV, fig. 1.

The ſquare yards are nearly of a cylindrical ſurface. They taper from the middle, which is called the *ſlings*, towards the extremities, which are termed the *yard arms* ; and the diſtance between the ſlings and the yard-arms on each ſide is by the artificers divided into quarters, which are diſtinguiſhed into the firſt, ſecond, third quarters, and yard-arms. The middle quarters are formed into eight ſquares, and each of the end parts is figured like the fruſtum of a cone. All the yards of a ſhip are ſquare except that of the mizen.

Yard.

The proportions for the length of yards, according to the different claſſes of ſhips in the Britiſh navy, are as follows :

			Guns.
1000 : gun-deck : :	560 :	main-yard fig. 1. Pl. CCCLXIV.—Note, the figure repreſents the yard and ſails of a ſhip of 74 guns.	100
	559 :		90 80
	570 :		70
	576 :		60
	575 :		50
	561 :		44
1000 : main-yard : :	880 :	fore-yard.	100 90 80
	874 :		all the reſt.

To apply this rule to practice, ſuppoſe the gun-deck 144 feet. The proportion for this length is as 1000 is to 575, ſo is 144 to 83 ; which will be the length of the main-yard in feet, and ſo of all the reſt.

			Guns.
1000 main-yard : :	820 :	mizen-yard	100 90 80 60 44
	847 :		70
	840 :		24
1000 : main-yard : :	726 :	main topſail-yard	24
	720 :		all the reſt.
1000 : fore-yard : :	719 :	fore topſail-yard	70
	726 :		24
	715 :		all the reſt.
1000 : main topſail-yard : :		main top gall. yard	all the rates.
1000 fore topſail-yard : :	696 :	fore top-gallant-yard.	70
	690 :		all the reſt.
1000 : fore topſail yard : :	768 :	mizen topſail-yard	70
	750 :		all the reſt.

Croſs-jack and ſprit-ſail yard equal to the fore topſail-yard.

Sprit-topſail-yard equal to the fore top-gallant-yard.

The diameters of yards are in the following proportions to their length.

The main and fore yards five-ſevenths of an inch to one yard. The topſail, croſs-jack, and ſprit-ſail yards, nine-fourteenths of an inch to one yard. The top-gallant, mizen top-ſail, and ſprit-ſail topſail yards, eight-thirteenths of an inch to one yard.

The mizen-yard five-ninths of an inch to one yard.

All ſtudding-ſail booms and yards half an inch to one yard in length.

The lifts of the main-yard are exhibited in the above figure by *gg* ; the horſes and their ſtirrups by *h*, *i* ; the reef-tackles and their pendents by *k*, *l* ; and the braces and brace pendents by *m*, *n*.

The lateen-yards evidently derive their names from ha-

Yard ‖ Yawning.

ving been peculiar to the ancient Romans. They are uſually compoſed of ſeveral pieces faſtened together by wooldings, which alſo ſerve as ſteps whereby the ſailors climb to the peek or upper extremity, in order to furl or caſt looſe the ſail.

The mizen-yard of a ſhip, and the main-yard of a bilander, are hung obliquely on the maſt, almoſt in the ſame manner as the lateen-yard of a xebec, ſettee, or polacre.

YARD, a meaſure of length uſed in Britain and Spain, conſiſting of three feet, chiefly to meaſure cloth, ſtuffs, &c.

YARD-Arm is that half of the yard that is on either ſide of the maſt, when it lies athwart the ſhip.

YARDS alſo denote places belonging to the navy, where the ſhips of war, &c. are laid up in harbour.—There are belonging to his majeſty's navy ſix great yards, *viz.* Chatham, Deptford, Woolwich, Portſmouth, Sheerneſs, and Plymouth; theſe yards are fitted with ſeveral docks, wharfs, lanches, and graving places, for the building, repairing, and cleaning of his majeſty's ſhips; and therein are lodged great quantities of timber, maſts, planks, anchors, and other materials: there are alſo convenient ſtore-houſes in each yard, in which are laid up vaſt quantities of cables, rigging, ſails, blocks, and all other ſorts of ſtores needful for the royal navy.

YARE, among ſailors, implies ready or quick: as, be yare at the helm; that is, be quick, ready, and expeditious at the helm. It is ſometimes alſo uſed for bright by ſeamen: as, to keep his arms yare; that is, to keep them clean and bright.

YARE, a river of Norfolk, which runs from weſt to eaſt through that county, paſſing by Norwich, and falling into the German ſea at Yarmouth.

YARMOUTH, a ſea-port town of Norfolk, with a market on Wedneſdays and Saturdays, and a fair on Friday and Saturday in Eaſter-week for petty chapmen. It is ſeated on the river Yare, where it falls into the ſea; and is a place of great ſtrength, both by art and nature, being almoſt ſurrounded with water; and there is a draw-bridge over the river. It is eſteemed the key of this coaſt, and is a clean handſome place, whoſe houſes are well built, it being a conſiderable town for trade. It has one large church, and a neat chapel, and the ſteeple of St Nicholas's is ſo high that it ſerves for a ſea-mark. It is governed by a mayor. The harbour is a very fine one, though it is very dangerous for ſtrangers in windy weather; and it has for its ſecurity a pretty ſtrong fort. It is 27 miles eaſt of Norwich, and 112 north-eaſt of London. E. Long. 1. 55. N. Lat. 52. 45.

YARMOUTH, a town of the Iſle of Wight, in Hampſhire, with a market on Fridays, and one fair on July 25th for toys. It is ſeated on the weſtern part of the iſland, on the ſea-ſhore, and is encompaſſed with water; for, not many years ago a channel was cut through the peninſula, over which there is a draw-bridge, and it is defended by a ſtrong caſtle on the quay. It is a handſome place, whoſe houſes are chiefly built with ſtone, and covered with ſlate; and it ſends two members to parliament. The market is now diſuſed. W. Long. 1. 28. N. Lat. 50. 40.

YARN, wool or flax ſpun into thread, of which they weave cloth. See CLOTH.

YARROW, in botany. See ACHILLÆA:

YAWNING, an involuntary opening of the mouth, generally produced by wearineſs or an inclination to ſleep. Yawning, according to Boerhaave, is performed by expanding at one and the ſame time all the muſcles capable of ſpontaneous motion; by greatly extending the lungs; by drawing in gradually and ſlowly a large quantity of air; and gradually and ſlowly breathing it out, after it has been retained for ſome time and rarefied; and then reſtoring the muſcles to their natural ſtate. Hence the effect of yawning is to move, accelerate, and equally diſtribute all the humours through all the veſſels of the body, and conſequently to qualify the muſcles and organs of ſenſation for their various functions.

Sanctorius obſerves, that a great deal is inſenſibly diſcharged, when nature endeavours to get rid of the retained perſpirable matter, by yawning and ſtretching of the limbs. To theſe a perſon is moſt inclined juſt after ſleep, becauſe a greater quantity going off by the pores of the ſkin than at other times, whenſoever a perſon wakes, the increaſing contraction that then happens cloſes a great deal of the perſpirable matter in the cutaneous paſſages, which will continually give ſuch irritations as excite yawning and ſtretching; and ſuch motions, by ſhaking the membranes of the whole body, and ſhifting the contacts of their fibres, and the incloſed matter, by degrees throw it off. Hence we ſee the reaſon why healthful ſtrong people are moſt inclined to ſuch motions, becauſe they perſpire moſt in time of ſleep, and therefore have more of the perſpirable matter to lodge in the pores, and greater irritations thereunto. The advantages of ſome little exerciſe juſt after waking in a morning are conſiderable, as it throws off all the perſpirable matter that is ready for its exit out of the body. When yawning is troubleſome, Hippocrates ſays that long deep reſpiration or drawing in the air at long intervals cures it.

Year.

YEAR, in aſtronomy and chronology. See ASTRONOMY, nº 347. p. 520. and KALENDAR.

The ancient Roman year was the lunar year, which, as firſt ſettled by Romulus, conſiſted only of ten months; *viz.* 1. March, containing 31 days. 2. April, 30. 3. May, 31. 4. June, 30. 5. Quintilis, 31. 6. Sextilis, 30. 7. September, 30. 8. October, 31. 9. November, 30. 10. December, 30.—in all 304 days; which came ſhort of the true lunar year by 50 days, and of the ſolar, by 61 days. Numa Pompilius corrected this irregular conſtitution of the year, and compoſed two new months, January and February, of the days that were uſed to be added to the former year.

The ancient Egyptian year, called alſo the *year of Nabonaſſar*, on account of the epocha of Nabonaſſar, is the ſolar year of 365 days, divided into 12 months, of 30 days each, beſides five intercalary days added at the end. The names, &c. of the months are as follows: 1. Thoth. 2. Paophi. 3. Athyr. 4. Chojac. 5. Tybi. 6. Mecheir. 7. Phamenoth. 8. Pharmuthi. 9. Pachon. 10. Pauni. 11. Epiphi. 12. Meſori; beſide the ἡμεραι επαγομεναι.

The ancient Greek year was lunar; conſiſting of 12 months, which at firſt had 30 days apiece, then alternately 30 and 29 days, computed from the firſt appearance of the new moon; with the addition of an emboliſmic month of 30 days every 3d, 5th, 8th, 11th, 14th, 16th, and 19th year of a cycle of 19 years; in order to keep the new and full moons to the ſame terms or ſeaſons of the year. Their year commenced with that new moon, the full moon of which comes next after the ſummer ſolſtice. The order, &c. of their months was thus: 1. 'Εκατομϐαιων, containing 29 days. 2. Μηταγειτνιων' 30. 3. Βοηδρομιων, 29. 4. Μαιμακτηριων, 30. 5. Πυανεψιων, 29. 6. Ποσειδεων, 30. 7. Γαμηλιων, 29. 8. Ανθεϛηριων, 30. 9. Ελαφηϐολιων, 30. 10. Μενυχιων, 30. 11. Θαργηλιων, 29. 12. Σκιροφοριων, 30.

The ancient Jewiſh year is a lunar year, conſiſting commonly of 11 months, which alternately contain 30 and 29 days. It was made to agree with the ſolar year, either by the adding of 11, and ſometimes 12 days, at the end of the year, or by an emboliſmic month. The names and quantities

ties of the months ſtand thus: 1. Niſan, or Abib, 30 days. 2. Jiar, or Zius, 29. 3. Siban, or Siwan, 30. 4. Thammuz, or Tammuz, 29. 5. Ab, 30. 6. Elul, 29. 7. Tiſri, or Ethanim, 30. 8. Marcheſvam, or Bul, 29. 9. Ciſleu, 30. 10. Tebeth, 29. 11. Sabat, or Schebeth, 30. 12. Adar, in the emboliſmic year, 30. Adar, in the common year, was but 29. Note, in the defective year, Ciſleu was only 29 days; and in the redundant year, Marcheſvam was 30.

The Perſian year is a ſolar year of about 365 days; conſiſting of 12 months of 30 days each, with 5 intercalary days added at the end.

The Arabic, Mahometan, and Turkiſh years, called alſo the *year of the Hegira*, is a lunar year, equal to 354 days 8 hours and 48 minutes, and conſiſts of 12 months, which contain alternately 30 and 29 days.

The Hindoo year differs from all theſe, and is indeed different in different provinces of India. The beſt account that we have of it is by Mr Cavendiſh, in the Phil. Tranſ. of the Royal Society of London for the year 1792. "Before I ſpeak of the civil year of the Hindoos (ſays this eminent philoſopher), it will be proper to ſay a few words of the aſtronomical year, by which it is regulated.

" The aſtronomical year begins at the inſtant when the ſun comes to the firſt point of the Hindoo zodiac. In the year 1792, it began on April 9th, at 22h. 14′ after midnight of their firſt meridian, which is about 41′ of time weſt of Calcutta; but, according to Mr Gentil's account of the Indian aſtronomy, it began 3 h. 24′ earlier. As this year, however, is longer than ours, its commencement falls continually later, in reſpect of the Julian year, by 50′ 26″ in four years. This year is divided into 12 months, each of which correſponds to the time of the ſun's ſtay in ſome ſign; ſo that they are of different lengths, and ſeldom begin at the beginning of a day.

" The civil day in all parts of India begins at ſunriſe, and is divided into 60 parts called *dandas*, which are again divided into 60 palas. In thoſe parts of India in which the Benares almanac, or as it is there called *patras*, is uſed, the civil year is luniſolar, conſiſting of 12 lunar months, with an intercalary month inſerted between them occaſionally. It begins at the day after the new moon next before the beginning of the ſolar year. The lunar month is divided into 30 parts called *teethees;* theſe are not ſtrictly of the ſame length, but are equal to the time in which the moon's true motion from the ſun is 12°. From the new moon till the moon arrives at 12° diſtance from the ſun is called the firſt *teethee*; from thence till it comes to 24°, is called the ſecond *teethee;* and ſo on till the full moon, after which the teethees return in the ſame order as before.

" The civil day is conſtantly called by the number of that teethee which expires during the courſe of the day; and as the teethee is ſometimes longer than one day, a day ſometimes occurs in which no teethee ends. When this is the caſe, the day is called by the ſame number as the following day; ſo that two ſucceſſive days go by the ſame name. It oftener happens, however, that two teethees end on the ſame day; in which caſe the number of the firſt of them gives name to the day, and there is no day called by the number of the laſt, ſo that a gap is made in the order of the days. In the latter part of the month the days are counted from the full moon, in the ſame manner as in the former part they are counted from the new moon; only the laſt day, or that on which the new moon happens, is called the *30th*, inſtead of the *15th*. It appears, therefore, that each half of the month conſtantly begins on the day after that on which the new or full moon falls; only ſometimes the half month begins with the ſecond day, the firſt being wanting.

" This manner of counting the days is ſufficiently intricate; but that of counting the months is ſtill more ſo.

" The civil year, as was before ſaid, begins at the day after the new moon; and, moreover, in the years which have an intercalary month, this month begins at the day after the new moon; but notwithſtanding this, the ordinary civil month begins at the day after the full moon. To make their method more intelligible, we will call the time from new moon to new moon the natural month. The civil month Viſakha, the firſt in the Hindoo kalender, which extends from the 9th of our April to the 10th of May, begins at the day after that full moon which is neareſt to the inſtant at which the ſun enters Meſha, the firſt in order of the Indian ſigns, whether before or after; however, it is not always accurately the neareſt.

" A conſequence of this way of counting the months is, that the firſt half of Chitra, the laſt month in the Indian kalender, extending from March the 10th to April the 9th, falls in one year, and the latter half in the following year; and whenever the ſun enters no ſign during a natural month, this month is intercalary. The number of days in the month varies from 29 to 32. Indeed the Hindoo months, both ſolar and lunar, conſiſt neither of a determinate number of days, nor are regulated by any cycle, but depend ſolely on the motions of the ſun and moon; ſo that a Hindoo has no way of knowing what day of the month it is but by conſulting his almanac; and what is more, the month ought ſometimes to begin on different days, in different places, on account of the difference in latitude and longitude, not to mention the difference which may ariſe from errors in computation. This mode of computing time muſt be attended with many inconveniences; but in the tranſactions of civil life the Hindoos do not much regard it. A diſagreement, however, in the computation of the teethee, which ſometimes alſo happens, occaſions no ſmall perplexity; becauſe by the teethees or lunar days are regulated moſt of their religious feſtivals. Every Brahmin in charge of a temple, or whoſe duty is to announce the times for the obſervance of religious ceremonies, is therefore furniſhed with one of their almanacs; and if he be an aſtronomer, he makes ſuch corrections in it as the difference of latitude and longitude render neceſſary."

New Year's Gift. See Gift.

YEAST, or Yest, a head or ſcum riſing upon beer or ale while working or fermenting in the vat. See Brewing.

It is uſed for a leaven or ferment in the baking of bread, as ſerving to ſwell or puff it up very conſiderably in a little time, and to make it much lighter, ſofter, and more delicate. See Baking, Barm, and Bread.

Mr Henry has publiſhed a method of preparing *artificial yeaſt*, by which good bread may be made without the aſſiſtance of any other ferment. The method is this: Boil flour and water together to the conſiſtence of treacle, and when the mixture is cold ſaturate it with fixed air. Pour the mixture thus ſaturated into one or more large bottles or narrow-mouthed jars; cover it over looſely with paper, and upon that lay a ſlate or board with a weight to keep it ſteady. Place the veſſel in a ſituation where the thermometer will ſtand from 70° to 80°, and ſtir up the mixture two or three times in 24 hours. In about two days ſuch a degree of fermentation will have taken place, as to give the mixture the appearance of yeaſt. With the yeaſt in this ſtate, and before it has acquired a thoroughly vinous ſmell, mix the quantity of flour intended for bread, in the proportion of ſix pounds of flour to a quart of the yeaſt, and a ſufficient portion of warm water. Knead them well together in a proper veſſel, and covering it with a cloth, let the dough ſtand for 12 hours, or till it appears to be ſufficiently fermented in the fore-mentioned degree of warmth. It is then to be formed into loaves and baked. Mr Henry adds, that perhaps the yeaſt would be more perfect, if a decoction of malt were uſed inſtead of ſimple water.

It has lately been diſcovered, that a decoction of malt alone, without any addition, will produce a yeaſt proper enough for the purpoſe of brewing. This diſcovery was made by Joſeph Senyor, ſervant of the reverend Mr Maſon of Aſton near Rotheram; and he received for it a reward of L. 20 from the Society for promoting Arts, Manufactures, and Commerce. The proceſs is as follows: Procure three earthen or wooden veſſels of different ſizes and apertures, one capable of holding two quarts, the other three or four, and the third five or ſix: boil a quarter of a peck of malt for about eight or ten minutes in three pints of water; and when a quart is poured off from the grains, let it ſtand in the firſt or ſmaller veſſel in a cool place till not quite cold, but retaining that degree of heat which the brewers uſually find to be proper when they begin to work their liquor. Then remove the veſſel into ſome warm ſituation near a fire, where the thermometer ſtands between 70 and 80 degrees Fahrenheit, and there let it remain till the fermentation begins, which will be plainly perceived within 30 hours: add then two quarts more of a like decoction of malt, when cool, as the firſt was; and mix the whole in the ſecond or larger veſſel, and ſtir it well in, which muſt be repeated in the uſual way, as it riſes in a common vat; then add a ſtill greater quantity of the ſame decoction, to be worked in the largeſt veſſel, which will produce yeaſt enough for a brewing of 40 gallons.

Common ale yeaſt may be kept freſh and fit for uſe ſeveral months by the following method: Put a quantity of it into a cloſe canvas bag, and gently ſqueeze out the moiſture in a ſcrew-preſs till the remaining matter be as firm and ſtiff as clay. In this ſtate it may be cloſe packed up in a tight caſk for ſecuring it from the air; and will keep freſh, ſound, and fit for uſe, for a long time. This is a ſecret that might be of great uſe to the brewers and diſtillers, who, though they employ very large quantities of yeaſt, ſeem to know no method of preſerving it, or raiſing nurſeries of it; for want of which they ſuſtain a very conſiderable loſs; whereas the brewers in Flanders make a very great advantage of ſupplying the malt-diſtillers of Holland with yeaſt, which is rendered laſting and fit for carriage by this eaſy expedient.

YELL, one of the iſlands of Shetland, lying north-eaſt from the main land, and divided from it by an arm of the ſea, called *Yell-Sound*. By ſome it is thought to have been the *Thule* of the ancients. In the old deſcriptions it is ſaid to be 20 miles long and 8 broad. It is very mountainous and full of moſs; but there are pretty conſiderable paſtures in which they feed a great many ſheep; and it alſo affords plenty of peat. It has eight large harbours, which would not be thought deſpicable in other countries. Anciently it ſeems to have been pretty populous, ſince there are in it three churches, twenty chapels, and many brughs or Pictiſh forts.

YELLOW, one of the original colours of light.

Yellow-Colour for Houſe-painting. See Chemistry, n° 699.

Naples Yellow, a beautiful colour much uſed by painters, formerly thought to be prepared from arſenic, but now diſcovered to have lead for its baſis.

Yellow-Hammer, in ornithology. See Fringilla.

Yellow-Fever. See Medicine, n° 168.

YEMEN, a province of Arabia, ſtretching along the Red Sea and Indian Ocean, and forming a part of the country once known by the name of Arabia Felix.

YEOMAN, the firſt or higheſt degree among the plebeians of England, next in order to the gentry.

The yeomen are properly freeholders, who having land of their own, live on good huſbandry.

Yeomen is alſo a title of office in the king's houſehold, of a middle place or rank between an uſher and a groom.

Yeomen of the Guard were anciently 250 men of the beſt rank under gentry, and of larger ſtature than ordinary, each being required to be ſix feet high. At preſent there are but 100 yeomen in conſtant duty, and 70 more not in duty; and as any of the 100 dies, his place is ſupplied out of the 70. They go dreſſed after the manner of King Hen. VIII.'s time. They formerly had diet as well as wages when in waiting; but this was taken off in the reign of Queen Anne.

YEST, or Yeast. See Yeast.

YEW, in botany. See Taxus.

YNCA, an appellation anciently given to the kings of Peru, and the princes of their blood; the word literally ſignifying, lord, king, emperor, and royal blood.

YOAK, or Yoke, in agriculture, a frame of wood fitted over the necks of oxen, whereby they are coupled together, and harneſſed to the plough.

Yoak of Land, in our ancient cuſtoms, was the ſpace which a yoke of oxen, that is, two oxen, may plow in one day.

YOLK, the yellow part in the middle of an egg (ſee Egg). It contains a lymphatic ſubſtance mixed with a certain quantity of mild oil, which, on account of this mixture, is ſoluble in water. When expoſed to heat, it aſſumes a conſiſtence not ſo hard as the white of the egg; and when bruiſed gives out the oil which it contains. This oil has been uſed externally as a liniment.

YONNE, a river in France, which riſing in Burgundy, and running north through Nivernois and Champaign, falls into the Seyne at Monterau ſur Yonne.

YORK, in Latin *Eboracum*, the capital of Yorkſhire in England. This city is ſo ancient that the origin of it is uncertain. In the time of the Romans a legion was ſtationed here, it being then the capital of the Brigantes; and here died the emperor Severus, and Flavius Valerius Conſtantius Chlorus, father of Conſtantine the Great. There was then alſo a temple of Bellona here, and no leſs than three military ways went from hence. In the time of the Saxons it was erected into an archbiſhopric by Pope Honorius, to which are now ſubject the biſhoprics of Cheſter, Durham, Carliſle, and the Iſle of Man; though anciently 12 biſhoprics in England, and all Scotland, were. A horn is ſtill kept in the minſter, by which Ulphius, one of the Saxon princes, beſtowed all his lands and revenues upon the church.

This city ſuffered very much during the ravages of the Danes; but, after the conqueſt, it began to flouriſh again. The cathedral, which coſt a long time and a great deal of money in building, is a moſt ſtately Gothic pile. Its chapter-houſe is particularly admired for its painted glaſs, its fine marble ſtalls, its pillars of alabaſter, and curious contrivance. In it is the following line in gold letters:

Ut Roſa, flos florum, ſic eſt Domus iſta Domorum.

The choir is remarkable for its fine carvings, particularly the ſtatues of all the Engliſh monarchs; and the windows are exquiſitely painted with the hiſtory of the Bible. The lanthorn ſteeple is 70 feet ſquare, and 188 high, and the windows are 45. At the ſouth end is a circular light, called the *marigold window* from the colour of its glaſs; and at the north end is a very large one, whoſe painting repreſents embroidery.

This city is generally reckoned the ſecond city in England; but though it ſtands upon more ground, it is inferior in trade, wealth, and number of people, to Briſtol. The inhabitants are reckoned at 12,784. It is ſituate in a fine plain, in the middle of the ſhire, on both ſides the Ouſe, walled and divided into four wards, containing 28 pariſhes. It enjoys large privileges and immunities, conferred upon it by a ſucceſſion of kings from Henry II. and its chief magiſtrate has the title of *lord mayor*, which is an honour peculiar to it and London. Richard II. made it a county of itſelf. The conſervancy of moſt of the rivers of the county, within certain limits, belongs to the lord mayor and aldermen. The middle arch of the bridge here over the Ouſe is thought to equal the Rialto at Venice in architecture, height, and breadth, the diameter being 81 feet, and the height 51. Though this city is 60 miles diſtant from the ſea, yet ſhips of 70 tons burden come up the river to it. The town-houſe or Guild-hall ſtands upon the bridge, and is ſuperior in all reſpects to that of London. In the Popiſh times there were nine abbeys here, and a vaſt number of churches; but of the latter there are only 17 now. The ſteeple of that of Allhallows is reckoned the fineſt in England. The archbiſhop has a fine palace; and the aſſembly-room, deſigned by the earl of Burlington, is very noble. Here are plays, aſſemblies, concerts, and the like entertainments, at ſome houſe or other, almoſt every night in the week. In the old caſtle, built originally by William the Conqueror, and repaired in 1701, the aſſizes are kept. It ſerves alſo for the county-goal, which is the neateſt and pleaſanteſt in England, with an area larger than that of the King's-bench, and it has a handſome chapel in it, with a good allowance for a preacher. This city has long given the title of *duke* to ſome branch of the royal family.

The plenty and cheapneſs of proviſions induces many perſons of ſmall fortune, or that would live frugally, to take up their abode here; and the venerable remains of Roman antiquities, and thoſe of a later date, as abbeys, churches, and caſtles, procure this city a viſit from every curious traveller. Many Roman altars, urns, coins, inſcriptions, &c. have been found; and Saxon coins are ſtill extant that have been ſtruck here. The members for this city have precedence of all others, except thoſe of London, in the houſe of commons. An infirmary, after the manner of thoſe of Bath, Briſtol, &c. hath been erected in it; and a cotton manufacture eſtabliſhed and brought to great perfection. Beſides four weekly markets, it has a great many fairs; one, in particular, every other Thurſday for cattle and ſheep. W. Long. 1. 1. N. Lat. 53. 59.

YORKSHIRE, the largeſt county of England, bounded on the ſouth by Derbyſhire, Nottinghamſhire, and Lincolnſhire; on the north by Durham and Weſtmoreland; on the eaſt by the German Ocean; and on the weſt by Lancaſhire and a part of Cheſhire.—It is upwards of 80 miles in length from eaſt to weſt, nearly as much in breadth, and about 360 in circumference, containing, in the whole, 26 hundreds or wapentakes, 49 market-towns, 563 pariſhes, 242 vicarages, with many chapels of eaſe, and 2330 villages. Its area is computed by ſome at 4684 ſquare miles, by others at 3,770,000 acres, and its inhabitants at upwards of 530,000. It is divided into three parts or ridings, viz. the Weſt, Eaſt, and North; ſo denominated from their ſituation, in reſpect of the city of York. Each of theſe is as large, if not larger than any ordinary county. There are other diviſions, as Richmondſhire, Allertonſhire, Howdenſhire, Hallanſhire, Craven, Cleveland, Marſhland, Holderneſs, &c.

As the ſoil and face of the country vary greatly, ſo does the air. In the hilly parts the air is good, but the ſoil very indifferent; of the lower ſome are marſhy, others drier, and the ſoil of both rich; but the air of the former is more foggy and unhealthy than that of the latter. The manufactures of this country are cutlery and hard-wares; particularly knives, bits, and ſpurs; but the principal are ſtockings and woollen cloth, with which it ſupplies in a great meaſure Germany and the North. As to the produce, it abounds in corn, cattle, horſes, lead, and iron, coal, wood, lime, liquorice, alum, jet, &c. It lies wholly in the northern circuit, and much the greater part of it in the dioceſe of York; that only which is called *Richmondſhire* belonging to the dioceſe of Cheſter. The members it ſends to parliament are 30; of which two are for the ſhire and 28 for the towns.

New-York, one of the United States of America, is bounded towards the ſouth-eaſt by the Atlantic Ocean; eaſt by Connecticut, Maſſachuſets, and Vermont; north by the 45th degree of latitude, which divides it from Canada; northweſtwardly by the river Iroquois or St Lawrence, and the lakes Ontario and Erie; ſouthweſt and ſouth by Pennſylvania and New Jerſey. The whole ſtate contains about 44,000 ſquare miles, equal to 28,160,000 acres.

The ſettlements already made in this ſtate are chiefly upon two narrow oblongs, extending from the city of New York eaſt and north. The one eaſt is Long Iſland, which is 140 miles long, and narrow, and ſurrounded by the ſea. The one extending north is about 40 miles in breadth, and biſected by Hudſon's river. And ſuch is the interſection of the whole ſtate by the branches of the Hudſon, the Delaware, the Suſquehannah, and other large rivers, that there are few places throughout its whole extent which are more than 15 or 20 miles from ſome navigable ſtream. There are few fiſh in the rivers, but in the brooks are plenty of trout; and on the lakes yellow perch, ſun-fiſh, ſalmon-trout, catfiſh, and a variety of others.

The State, to ſpeak generally, abounds with lakes, ſome of ſalt and others of freſh water. It is interſected by ridges of mountains running in a north-eaſt and ſouth-weſt direction. Beyond the Allegany mountains, however, the country is a dead level, of a fine rich ſoil, covered, in its natural ſtate, with maple, beach, birch, cherry, black-walnut, locuſt, hickory, and ſome mulberry trees. On the banks of lake Erie are a few cheſnut and oak ridges. Hemlock ſwamps are interſperſed thinly through the country. All the creeks that empty into lake Erie have falls, which afford many excellent mill ſeats. Eaſt of the Allegany mountains, the country is broken into hills with rich intervening valleys. The hills are clothed thick with timber, and when cleared afford fine paſture; the valleys, when cultivated, produce wheat, hemp, flax, peaſe, graſs, oats, Indian corn. Of the commodities produced from culture, wheat is the ſtaple; of which immenſe quantities are raiſed and exported. Indian corn and peaſe are likewiſe raiſed for exportation; and rye, oats, barley, &c. for home conſumption. In ſome parts of the State excellent dairies are kept, which furniſh for the market butter and cheeſe.

The ſituation of New York, with reſpect to foreign markets, has decidedly the preference to any other of the United States. It has at all ſeaſons of the year a ſhort and eaſy acceſs to the ocean. Its exports to the Weſt Indies are, biſcuit, peaſe, Indian corn, apples, onions, boards, ſtaves, horſes, ſheep, butter, cheeſe, pickled oyſters, beef, and pork. But wheat is the ſtaple commodity of the State, of which no leſs than 677,700 buſhels were exported in the year 1775, beſides 2555 tons of bread and 2828 tons of flour. Inſpectors of flour are appointed to prevent impoſitions, and to ſee that none is exported but that which is deemed by them merchantable. Beſides the above-mentioned articles, are exported flax-ſeed, cotton, wool, ſarſaparilla, coffee, indigo, rice, pig-iron, bar-iron, pot-aſh, pearl-aſh, furs, deer-ſkins, logwood, fuſtick, mahogany, bees-wax, oil, Madeira wine, rum, tar, pitch, turpentine, whale-fins, fiſh, ſugars, molaſſes, ſalt, tobacco, lard, &c. but moſt of theſe articles are imported for re-exportation. In the year 1774, there were employed, in the trade of this State, 1075 veſſels, whoſe tonnage amounted to 40,812.

Since the revolution the literature of the State has engaged the attention of the legiſlature. In one of their earlieſt ſeſſions an act paſſed, conſtituting 21 gentlemen (of whom the governor and lieutenant-governor for the time being are members *ex officiis)* a body corporate and politic, by the name and ſtyle of "The regents of the univerſity of the State of New-York." They are intruſted with the care of literature in general in the State, and have power to grant charters of incorporation for erecting colleges and academies throughout the ſtate—are to viſit theſe inſtitutions as often as they ſhall think proper, and report their ſtate to the legiſlature once a year. All degrees above that of maſter of arts are to be conferred by the regents. A univerſal toleration is granted in religion.

The ſupreme legiſlative powers of the State are veſted in two branches, a ſenate and aſſembly. The members of the ſenate are elected by the freeholders of the State, who poſſeſs freehold eſtates to the value of L. 100 clear of debts. For the purpoſe of electing ſenators, the State is divided into four great diſtricts, each of which chooſes a certain number.

The aſſembly of the State is compoſed of repreſentatives from the ſeveral counties, choſen annually in May. Every male inhabitant of full age, who has reſided in the State ſix months preceding the day of election, and poſſeſſing a freehold to the value of L. 20, in the county where he is to give his vote; or has rented a tenement therein of the yearly value of forty ſhillings, and has been rated and actually paid taxes—is intitled to vote for repreſentatives in aſſembly. The number of repreſentatives is limited to 300.

The ſupreme executive power of the State is veſted in a governor choſen once in three years by the freemen of the State. The lieutenant governor is, by his office, preſident of the ſenate; and, upon an equal diviſion of voices, has a caſting vote; but has no voice on other occaſions. The governor has not a ſeat in the legiſlature; but as a member of the council of reviſion and council of appointment, he has a vaſt influence in the State. The council of reviſion is compoſed of the chancellor, the judges of the ſupreme court, or any of them, and the governor. In the year 1790 the number of inhabitants in this State was 340,120, of whom 21,324 were negroes.

New-York, a city of North America, capital of the State of the ſame name. It is ſituated at the ſouth-weſt point of an iſland, at the confluence of Hudſon and Eaſt rivers, and is about four miles in circumference. The ſituation is both healthy and pleaſant. Surrounded on all ſides by water, it is refreſhed by cool breezes in ſummer, and the air in winter is more temperate than in other places under the ſame parallel. York Iſland is 15 miles in length, and hardly one in breadth. It is joined to the main by a bridge called King's Bridge. The channels between Long and Staten Iſlands, and between Long and York Iſlands, are ſo narrow as to occaſion an unuſual rapidity of the tides, which is increaſed by the confluence of the waters of Hudſon and Eaſt rivers. This rapidity, in general, prevents the obſtruction of the channel by ice. There is no baſon or bay for the reception of ſhips, but the road where they lie in Eaſt river is defended from the violence of the ſea by the iſlands which interlock with each other; ſo that, except that of Rhode Iſland, the harbour of New-York, which admits ſhips of any burden, is the beſt of the United States. The number of inhabitants in 1790 was 33,131. New-York is 97 miles north-eaſt of Philadelphia. W. Long. 74. 5. N. Lat. 40. 43.

YOUNG (Dr Edward), was the ſon of a clergyman of the ſame name, and was born about the year 1679. When ſufficiently qualified, he was matriculated into All-Souls college, Oxford; and deſigning to follow the civil law, he took a degree in that profeſſion. In this ſituation he wrote his poems called *The Laſt Day*, publiſhed in 1704; which coming from a layman gave univerſal ſatisfaction: this was ſoon after followed by another, intitled *The Force of Religion*, or *Vanquiſhed Love*. Theſe productions gained him a reſpectable acquaintance; he was intimate with Addiſon, and thus became one of the writers of the Spectator: but the turn of his mind leading him to the church, he took orders, was made one of the king's chaplains, and obtained the living of Welwyn in Hartfordſhire, worth about L. 500 *per annum*, but he never roſe to higher preferment. For ſome years before the death of the late prince of Wales, Dr Young attended his court pretty conſtantly; but upon his deceaſe all his hopes of church preferment vaniſhed; however, upon the death of Dr Hales, he was taken into the ſervice of the princeſs-dowager of Wales, and ſucceeded him as her privy chaplain. When pretty far advanced in life, he married the lady Elizabeth Lee, daughter of the late earl of Litchfield. This lady was a widow, and had an amiable ſon and daughter, who both died young. What he felt for their loſs, as well as for that of his wife, is finely expreſſed in his Night Thoughts, in which the young lady is characteriſed under the name of Narciſſa; her brother by that of Philander; and his wife, though nameleſs, is frequently mentioned; and he thus, in an apoſtrophe to death, deplores the loſs of all the three.

> Inſatiate archer, could not once ſuffice!
> Thy ſhaft flew thrice, and thrice my peace was ſlain,
> And thrice ere thrice yon moon renew'd her horn.

He wrote three tragedies, *The Revenge*, *Buſiris*, and *The Brothers*. His ſatires, called *Love of Fame the univerſal Paſſion*, are by many eſteemed his principal performance; though Swift ſaid the poet ſhould have been either more angry or more merry: they have been characteriſed as a ſtring of epigrams written on one ſubject, that tire the reader before he gets through them. His *Complaint*, or *Night Thoughts*, exhibit him as a moral and melancholy poet, and are eſteemed his maſterpiece. They form a ſpecies of poetry peculiarly his own, and in which he has been unrivalled by all thoſe who attempted to write in this manner. They were written under the recent preſſure of his ſorrow for the loſs of his wife, daughter, and ſon-in-law; they are addreſſed to Lorenzo, a man of pleaſure and the world, and who, as it is inſinuated by ſome, is his own ſon, but then labouring under his father's diſpleaſure. As a proſe-writer, he arraigned the prevailing manners of his time, in a work called *The Centaur not Fabulous*; and when he was above 80 years of age, publiſhed *Conjectures on Original Compoſition*. He publiſhed ſome other pieces; and the whole of his works are collected in 4 and 5 vols 12mo. Dr Young's turn of mind was naturally ſolemn; and he uſually, when at home in the country, ſpent many hours of the day walking in his own church-yard among the tombs. His converſation, his writings, had all a reference to the life after this; and this turn of diſpoſition mixed itſelf even with his improvements in gardening. He had, for inſtance, an alcove with a bench, ſo painted near his houſe, that at a diſtance it looked as a real one which the ſpectator was then approaching. Upon coming up near it, however, the deception was perceived, and this motto appeared, *Inviſibilia non decipiunt*, "The things unſeen do not deceive us." Yet, notwithſtanding this gloomineſs of temper, he was fond of innocent ſports and amuſement; he inſtituted an aſſembly and a bowling-green in the pariſh of which he was rector, and often promoted the gaiety of the company in perſon. His wit was generally poignant, and ever levelled at thoſe who teſtified any contempt for decency and religion. His epigram, ſpoken extempore upon Voltaire, is well known; who happening in his company to ridicule Milton, and the allegorical perſonages of Death and Sin, Young thus addreſſed him:

> Thou art ſo witty, profligate, and thin,
> You ſeem a Milton with his Death and Sin.

One Sunday preaching in office at St James's, he found, that though he ſtrove to make his audience attentive he could not prevail. Upon which his pity for their folly got the better of all decorums, and he ſat back in the pulpit and burſt into a flood of tears. Towards the latter part of his life he knew his own infirmities, and ſuffered himſelf to be in pupilage to his houſe-keeper; for he conſidered that, at a certain time of life, the ſecond childhood of age demanded its wonted protection. His ſon, whoſe boyiſh follies were long obnoxious to paternal ſeverity, was at laſt forgiven in his will; and our poet died regretted by all, having performed all that man could do to fill his poſt with dignity. His death happened in 1765.

YOUTH, that ſtate of man in which he approaches towards his greateſt perfection of body.

YPRES, a handſome, large, and populous town of the Auſtrian Netherlands, with a biſhop's ſee. It has a conſiderable manufactory in cloth and ſerges, and every year in Lent there is a conſiderable fair. It is one of the barrier towns, but was beſieged and taken by the French in 1744. It is ſeated on a fertile plain on the river Ypre, in E. Long. 2. 48. N. Lat. 50. 51.

YUCCA, ADAM'S NEEDLE, in botany; a genus of plants of the claſs *hexandria* and order *monogynia*. The corolla is campanulate and patent, there is no ſtyle, the capſule is trilocular. There are four ſpecies, none of which are natives of Britain. All of them are exceedingly curious in their growth, and are therefore much cultivated in gardens. The Indians make a kind of bread from the roots of this plant.

YULE, YOOL, or *Iul*. See IUL.

YUNX, in zoology, a genus of birds of the order *picæ*. The bill is ſhort, roundiſh, and pointed; the noſtrils concave and naked; the tongue very long and cylindrical; there are two fore and two hind claws. There is only one ſpecies, the *torquilla*, wry-neck, which is a native of Europe, Aſia, and Africa, and is often ſeen in Britain. It is aſh-coloured above, with light black and brown ſtrokes. Beneath light brown, with black ſpots. Tail aſh-colour, with four black bars. Weight 1¼ oz. Irides hazel. Length 7 inches. Migrates.

Z.

Z, or z, the 24th and laſt letter, and the 19th conſonant of our alphabet; the ſound of which is formed by a motion of the tongue from the palate downwards and upwards to it again, with a ſhutting and opening of the teeth at the ſame time. This letter has been reputed a double conſonant, having the ſound *ds*; but ſome think with very little reaſon: and, as if we thought otherwiſe, we often double it, as in *puzzle*, *muzzle*, &c. Among the ancients, Z was a numeral letter, ſignifying 2000; and with a daſh added a-top, Z̄ ſignified 2000 times 2000, or 4,000,000.

In abbreviation this letter formerly ſtood as a mark for ſeveral ſorts of weights; ſometimes it ſignified an ounce and a half; and very frequently it ſtood for half an ounce; ſometimes for the eighth part of an ounce, or a dram Troy weight: and it has in earlier times been uſed to expreſs the third part of an ounce or eight ſcruples. ZZ were uſed by ſome of the ancient phyſicians to expreſs myrrh, and at preſent they are often uſed to ſignify zinziber or ginger.

ZAARA, ZAPARA, SAHARA, or *the Deſert*, a vaſt country of Africa, bounded on the north by Barbary, on the eaſt by Fezzan and Caſhna, on the ſouth by Tombuctoo, and on the weſt by the Atlantic Ocean. Zaara contains a variety of wandering nations, all proceeding from Arabs, Moors, and fugitive Portugueſe, who took refuge there when the family of the Sheriſs made themſelves maſters of the three kingdoms of Barbary. All theſe people bear indiſcriminately the names of *Nars*, *Moors*, or *Arabs*. They are ſubdivided into various nations, of which the moſt conſiderable are the Mongearts, Traſars, and Bracnars. The Mongearts lead a wandering life, and live chiefly on the milk of their flocks, with a little barley-meal, and ſome dates. The poorer ſort go naked, except the females, who commonly wrap a clout about their middle, and wear a kind of bonnet on their head; but the wealthier ſort have a kind of looſe gown, made of blue callicoe, with large ſleeves, that is brought them from Negro-land. When they move from one place to another for freſh paſture, water, or prey, moſt of them ride on camels, which have generally a ſort of ſaddle between the bunch and the neck, with a ſtring or ſtrap run through their noſtrils, which ſerves for a bridle; and inſtead of ſpurs they uſe a ſharp bodkin. Their tents or huts are covered with a coarſe ſtuff, made of camel's hair, and a kind of wool or moſs that grows on the palm trees. Theſe Arabs live here under the government of their ſheiks or cheyks; as in Arabia, Egypt, and other places. The other two tribes are rather more civiliſed. They are all Mahometans.

ZABULON (anc. geog.), one of the twelve tribes; bounded on the north by the tribes of Aſher and Naphthali; on the eaſt by the ſea of Galilee; on the ſouth by the tribe of Iſſachar or the brook Ciſon, which ran between both; on the weſt by the Mediterranean; ſo that it touched two ſeas, or was bimarous.

ZABULON (anc. geog.), a very ſtrong town in the tribe of that name, on the Mediterranean, ſirnamed *of men*, near Ptolemais: its vicinity to which makes it probable that it was alſo Chabulon, unleſs either name is a faulty reading in Joſephus; diſtant about 60 ſtadia from Ptolemais.

ZACYNTHUS (anc. geog.), an iſland to the ſouth of Cephalonia 60 ſtadia, but nearer to Peloponneſus, in the Ionian Sea, formerly ſubject to Ulyſſes, in compaſs above 160 ſtadia, woody and fruitful, with a conſiderable cognominal town and port. The iſland lies over againſt Elis, having a colony of Achæans from Peloponneſus, over againſt the Corinthian Gulf. Both iſland and town are now called *Zante*.

ZAFFRE, is the oxyd of cobalt, employed for painting pottery ware and porcelain of a blue colour. The method of preparing it is as follows: The cobalt taken out of the mine is broken with hammers into pieces about the ſize of an hen's egg; and the ſtony involucrum, with ſuch other heterogeneous matters as are diſtinguiſhable by the eye, are ſeparated as much as poſſible. The choſen mineral is then pounded in ſtamping mills, and ſifted through braſs wire ſieves. The lighter parts are waſhed off by water, and it is afterwards put into a large flat-bottomed arched furnace, reſembling a baking oven, where the flame of the wood reverberates upon the ore; which is occaſionally ſtirred and turned with long handled iron hooks or rakes; and the proceſs is continued till it ceaſes to emit any fumes. The oven or furnace is terminated by a long horizontal gallery, which ſerves for a chimney; in which the arſenic, naturally mixed with the ore, ſublimes. If the ore contains a little biſmuth, as this ſemimetal is very fuſible, it is collected at the bottom of the furnace The cobalt remains in the ſtate of a dark grey oxyd, and is called *zaffre*. One hundred pounds of the cobalt ore loſe 20 and even 30 *per cent*. during this operation, which is continued 4 or even 9 hours, according to the quality of the ore. The roaſted ore being taken out from the furnace, ſuch parts as are concreted into lumps are pounded and ſifted afreſh. Zaffre, in commerce, is never pure, being mixed with two or rather three parts of powdered flints. A proper quantity of the beſt ſort of theſe, after being ignited in a furnace, are thrown into water to render them friable, and more eaſily reduced to powder; which, being ſifted, is mixed with the zaffre, according to the before mentioned doſe; and the mixture is put into caſks, after being moiſtened with water. This oxyd, fuſed with three parts of ſand and one of pot-aſh, forms a blue glaſs; which, when pounded, ſifted, and afterwards ground in mills, included in large caſks, forms *ſmalt*.

Magellan's Cronſtedt's Mineralogy.

The blue of zaffre is the moſt ſolid and fixed of all the colours that can be employed in vitrification. It ſuffers no change from the moſt violent fire. It is ſucceſsfully employed to give ſhades of blue to enamels, and to the cryſtal-glaſſes made in imitation of ſome opaque and tranſparent precious ſtones, as the lapis lazuli, the turquois, the ſapphire, and others of this kind.

ZALEUCUS, a famous legiſlator of the Locrians, and the diſciple of Pythagoras, flouriſhed 500 years B. C. He made a law, by which he puniſhed adulterers with the loſs of both their eyes; and his ſon offending, was not abſolved from this puniſhment: yet, to ſhow the father as well as the juſt lawgiver, he put out his own right, and his ſon's left eye. This example of juſtice and ſeverity made ſo ſtrong an impreſſion on the minds of his ſubjects, that no inſtance was found of the commiſſion of that vice during the reign of that legiſlator. It is added, that Zaleucus forbad any wine being given to the ſick on pain of death, unleſs it was preſcribed by the phyſicians; and that he was ſo jealous of his laws, that he ordered, that whoever was deſirous of changing them, ſhould be obliged, when he made the propoſal, to have a cord about his neck, in order that he might be immediately ſtrangled, if thoſe alterations were eſteemed no better than the laws already eſtabliſhed. Diodorus Siculus attributes the ſame thing to Charondas legiſlator of the Sybarites.

ZAMA (anc. geog.), a town of Chamane, a diſtrict of Cappadocia, of unknown ſituation.—Another Zama, of Meſopotamia, on the Saocoras, to the ſouth of Niſibis.—A third, of Numidia, diſtant five days journey to the weſt of Carthage; it was the other royal reſidence of the Kings of Numidia, hence called *Zama Regia*. It ſtood in a plain; was ſtronger by art than nature; richly ſupplied with every neceſſary; and abounding in men, and every weapon both of defence and annoyance.

The laſt of theſe is remarkable for the deciſive battle fought between the two greateſt commanders in the world, Hannibal the Carthaginian and Scipio Africanus. Of this engagement, the moſt important perhaps that ever was fought, Mr Hooke gives us the following account.

"Scipio drew up his army after the Roman manner, except that he placed the cohorts of the Principes directly behind thoſe of the Haſtati, ſo as to leave ſufficient ſpace for the enemy's elephants to paſs through from front to rear. C. Lælius was poſted on the left wing with the Italian horſe, and Maſiniſſa with his Numidians on the right. The intervals of the firſt line Scipio filled up with his Velites, or light armed-troops, ordering them, upon a ſignal given, to begin the battle; and in caſe they were repulſed, or broke by the elephants, to run back through the lanes before mentioned, and continue on their flight till they were got behind the Triarii. Thoſe that were wounded, or in danger of being overtaken, were to turn off to the right and left through the ſpaces between the lines, and that way eſcape to the rear.

"The army thus drawn up, Scipio went from rank to rank, urging his ſoldiers to conſider the conſequences of a defeat and the rewards of victory: on the one hand, certain death or ſlavery (for they had no town in Africa ſtrong enough to protect them); on the other, not only a laſting ſuperiority over Carthage, but the empire of the reſt of the world.

"Hannibal ranged all his elephants, to the number of above 80, in one front. Behind theſe he placed his mercenaries, conſiſting of 12,000 men, Ligurians, Gauls, Baleares, and Mauritanians.

"The new levies of Carthaginians and other Africans, together with 4000 Macedonians, under a general named *Sopater*, compoſed the ſecond line. And in the rear of all, at the diſtance of about a furlong, he poſted his Italian troops, in whom he chiefly confided. The Carthaginian horſe formed his right wing, the Numidians his left.

"He ordered their ſeveral leaders to exhort their troops not to be diſcouraged by their own weakneſs, but to place the hope of victory in him and his Italian army; and particularly directed the captains of the Carthaginians to repreſent to them what would be the fate of their wives and children if the event of this battle ſhould not prove ſucceſsful. The general himſelf, walking through the ranks of his Italian troops, called upon them to be mindful of the 17 campaigns in which they had been fellow-ſoldiers with him; and of that conſtant ſeries of victories by which they had extinguiſhed in the Romans all hope of ever being conquerors. He urged them to remember, above all, the battles of Trebia, Thraſymenus, and Cannæ; with any of which the approaching battle was in no wiſe to be compared, either with reſpect to the bravery or the number of the enemy. 'The Romans were yet unfoiled, and in the height of their ſtrength, when you firſt met them in the field; nevertheleſs you vanquiſhed them. The ſoldiers now before us are either the children of the vanquiſhed, or the remains of thoſe whom you have often put to flight in Italy. Maintain therefore your general's glory and your own, and eſtabliſh to yourſelves the name of invincible, by which you are become famous throughout the world.'

"When the Numidians of the two armies had ſkirmiſhed a while, Hannibal ordered the managers of the elephants to drive them upon the enemy. Some of the beaſts, frightened at the noiſe of the trumpets and other inſtruments of war which ſounded on all ſides, immediately ran back among the Numidians of the Carthaginian left wing, and put them into confuſion; which Maſiniſſa taking advantage of, entirely routed them. Great deſtruction was made of the Velites by the reſt of the elephants, till theſe alſo being terrified, ſome of them ran through the void ſpaces of the Roman army which Scipio had left for that purpoſe; others falling in among the cavalry of the enemy's right wing, gave Lælius the ſame opportunity againſt the Carthaginian horſe as had been given to Maſiniſſa againſt the Numidian, and of which the Roman did not fail to make the ſame uſe. After this the infantry of the foremoſt lines joined battle. Hannibal's mercenaries had the advantage in the beginning of the conflict; but the Roman Haſtati, followed and encouraged by the principes, who exhorted them to fight manfully, and ſhowed themſelves ready to aſſiſt them, bravely ſuſtained the attack, and at length gained ground upon the enemy. The mercenaries not being ſeaſonably ſupported by their ſecond line, and therefore thinking themſelves betrayed, they in their retreat fell furiouſly upon the Africans; ſo that theſe, the Haſtati coming up, were obliged to fight for ſome time both againſt their own mercenaries and the enemy. When the two Carthaginian lines had ceaſed their mutual rage, they joined their ſtrength; and though now but a mere throng of men, broke the Haſtati: but then the Principes advancing to the aſſiſtance of the latter, reſtored the battle; and moſt of the Africans and mercenaries were here cut off. Hannibal did not advance to their relief, the Roman Triarii not having yet engaged, and the Principes being ſtill in good order; and leſt the routed Africans and mercenaries ſhould break the ranks of his Italian ſoldiers, he commanded theſe to preſent their ſpears at thoſe who fled to them for protection, which obliged the runaways to move off to the right and left.

"The ground over which the Romans muſt march before they could attack Hannibal being ſtrewed with heaps of dead bodies and weapons, and being ſlippery with blood, Scipio feared that the order of his battalions would be broke, ſhould he paſs it haſtily. To avoid this miſchief, he commanded the Haſtati to give over the purſuit, and halt where they were, oppoſite to the enemy's centre: after which, having ſent all his wounded to the rear, he advanced leiſurely with the Principes and Triarii, and placed them on the wings of the Haſtati. Then followed a ſharp engagement, in which victory was long and eagerly diſputed. It would ſeem that the Romans, though ſuperior in number, were once upon the point of loſing the day; for Polybius tells us, that Maſiniſſa and Lælius came very ſeaſonably, and as if ſent from heaven, to their aſſiſtance. Theſe generals being returned from the purſuit of the cavalry, fell ſuddenly upon the rear of Hannibal's men, moſt of whom were cut off in their ranks; and of thoſe that fled, very few eſcaped the horſe, the country all around being a plain.

"There died of the Carthaginians in the fight above 20,000, and almoſt the like number were taken priſoners. The loſs on the ſide of the Romans amounted to about 2000 men. Hannibal eſcaped with a few horſe to Adrumetum, having performed every thing in the engagement which could be expected from a great general. His army (ſays Polybius) could not have been more ſkilfully drawn up. For as the order of the Roman battalions makes it extremely difficult to break them, the Carthaginian wiſely placed his elephants in the front, that they might put the enemy in confuſion before the armies ſhould engage. In his firſt line he placed the mercenaries; men bold and active, but not well diſciplined, that by their impetuoſity he might give a check to the ardour of the Romans. The Africans and Carthaginians, whoſe courage he doubted, he poſted in the middle between the mercenaries and his Italian ſoldiers, that they might be forced to fight, or at leaſt that the Romans, by ſlaughtering them, might fatigue themſelves and blunt their weapons. Laſt of all, he drew up the troops he had diſciplined himſelf, and in whom he chiefly confided, at a good diſtance from the ſecond line, that they might not be broken by the route of the Africans and mercenaries, and kept them in reſerve for a vigorous attack upon a tired and weakened enemy."

ZANGUEBAR, a country in Africa, lying on the eaſtern coaſt, between three degrees of north latitude, and 18 ſouth. It includes ſeveral petty kingdoms, in which the Portugueſe have various ſettlements. The inhabitants, except thoſe converted by the Portugueſe, are all Mahometans or idolaters; and the latter much the more numerous. The names of the principal territories are *Mombaza*, *Lamon*, *Melinda*, *Quiola*, and *Moſambique*. The Portugueſe have built ſeveral forts in Mombaza and Moſambique, and have ſettled ſeveral colonies there. They trade with the negroes for ſlaves, ivory, gold, oſtrich-feathers, wax, and drugs. The productions are much the ſame as in other parts of Africa between the tropics.

ZANONIA, in botany; the name of a genus of plants of the order *diœcia*, claſs *pentandria*. The characters are theſe: it produces ſeparate male and female flowers; in the male flower the cup is a perianthium, compoſed of three leaves of an oval figure, expanding every way, and ſhorter than the flower; the flower is monopetalous, but divided into five ſegments, and has an open mouth; the ſegments are jagged, and are equal in ſize, and bend backwards; the ſtamina are five filaments of the length of the cup, ſtanding open at their ends, and terminated by ſimple apices; the female flowers grow on ſeparate plants, and have the cup and flower the ſame as in the male, only that the cup ſtands upon the germen of the piſtil; this germen is oblong, and from it are propagated three reflex conic ſtyles; the ſtigmata are bifid and curled; the fruit is a long and very large berry, truncated at the end, and very ſmall at the baſe; it contains three cells, and has a curled ſuture near the apex; the ſeeds are two; they are of an oblong figure, and flat. There is one ſpecies, the *indica*.

ZANTE, an iſland of the Mediterranean, near the coaſt of the Morea, 19 miles ſouth-eaſt of the iſland of Cephalonia, belonging to the Venetians. It is about 24 miles in length and 12 in breadth, and very pleaſant and fertile; but its principal riches conſiſt in currants, with which it greatly abounds. They are cultivated in a very large plain, under the ſhelter of mountains on the ſhore of this iſland; for which reaſon the ſun has greater power to bring them to perfect maturity. The town called *Zante* may contain near 20,000 inhabitants; the whole iſland contains about 40,000. The houſes are low, on account of the frequent earthquakes, for ſcarce a year paſſes without one; however, they do no great damage. The natives ſpeak both Greek and Italian. There are very few Roman Catholics among them; but they have a biſhop as well as the Greeks. This place has no fortifications, but there is a fortreſs upon an eminence planted with cannon. In one part of this iſland is a place which ſhakes when trod upon like a quagmire; and a ſpring which throws out a great deal of bitumen, eſpecially at the time of an earthquake. It ſerves inſtead of pitch to pay the bottoms of the ſhips, and about 100 barrels in a year are uſed for this purpoſe. There are about 50 villages in the iſland; but no other large town beſide Zante. It is ſeated on the eaſtern ſide of the iſland, and has a good harbour. The Engliſh and Dutch have each a factory and conſul here. E. Long. 21. 3. N. Lat. 37. 53.

ZANTHOXYLUM, the TOOTHACH-TREE, in botany; a genus of plants of the claſs of *diœcia*, and order of *pentandria;* and in the natural ſyſtem arranged under the 46th order, *Hederaceæ*. The calyx is quinquepartite, there is no corolla; the female flower has five piſtils and as many monoſpermous capſules. There are two ſpecies, the clava *herculis*, and the *trifoliatum;* neither of which are natives of Britain.

ZAPATA, a kind of feaſt or ceremony held in Italy, in the courts of certain princes, on St Nicholas's day; wherein people hide preſents in the ſhoes or ſlippers of thoſe they would do honour to, in ſuch a manner as may ſurpriſe them on the morrow when they come to dreſs; being done in imitation of the practice of St Nicholas, who uſed in the night-time to throw purſes of money in at the windows to marry poor maids withal.

ZEA, INDIAN CORN, in botany; a genus of plants of the claſs *monœcia*, order *triandria*. The male-flowers are placed on diſtinct ſpikes; the calyx is a biflorous, beardleſs glume; the corolla a beardleſs glume; the female calyx is a bivalve glume, as is the corolla. There is one filiform, pendulous ſtyle; the ſeeds are ſolitary and buried in an oblong receptacle. There is only one ſpecies, the *Mays*, maize. The Indians in New England, and many other parts of America, had no other vegetable but maize or Indian corn for making their bread. They call it *weachin;* and in the United States of America there is much of the bread of the country made of this grain, not of the European corn. In Italy and Germany alſo there is a ſpecies of maize which is the food of the poor inhabitants.

The ear of the maize yields a much greater quantity of grain than any of our corn ears. There are commonly about eight rows of grain in the ear, often more, if the ground be good. Each of theſe rows contains at leaſt 30, grains, and each of theſe gives much more flour than a grain of any of our corn. The grains are uſually either white or yellowiſh; but ſometimes they are red, bluiſh, greeniſh, or olive-coloured, and ſometimes ſtriped and variegatied. This ſort of grain, though ſo eſſentially neceſſary to the natives of the place, is yet liable to many accidents. It does not ripen till the end of September; ſo that the rains often fall heavy upon it while on the ſtalk, and the birds in general peck it when it is ſoft and unripe. Nature has, to defend it from theſe accidents, covered it with a thick huſk, which keeps off ſlight rains very well; but the birds, if not frighted away, often eat through it, and devour great quantity of the grain.

There are three or four varieties of maize in different parts of America. That of Virginia is very tall and robuſt, growing to ſeven or eight feet high; that of New England is ſhorter and lower. And the Indians farther up in the country have a yet ſmaller kind in common uſe. The ſtalk of the maize is joined like the ſugar-cane; it is very ſoft and juicy, and the juice is ſo ſweet and ſaccharine, that a ſyrup, as ſweet as that of ſugar, has been often made of it; and things ſweetened with it have been found not diſtinguiſhable from thoſe done with ſugar. It has not been tried yet whether it will cryſtallize into ſugar; but in all probability it will.

The Americans plant this corn any time from the beginning of March to the beginning of June; but the beſt ſeaſon is the middle of April. The ſavage Indians, who knew nothing of our account of months, uſed to guide themſelves in the ſeed-time of this uſeful plant by the budding of ſome particular trees of that country, and by the coming up of a ſort of fiſh into their rivers which they call the *alooſe*. Theſe things were both ſo regular, that they were in no danger of miſtaking the time.

The manner of planting maize is in rows, at equal diſtances, every way about five or ſix feet. They open the earth with a hoe, taking away the ſurface to three or four inches deep, and of the breadth of the hoe; they then throw in a little of the finer earth, ſo as to leave the hole four inches deep or thereabouts, and in each of theſe holes they place four or five grains at a little diſtance from one another. If two or three of theſe grow up, it is very well; ſome of them are uſually deſtroyed either by the birds or other animals.

When the young plants appear, they hoe up the weeds from time to time; and when the ſtalk gathers ſome ſtrength, they raiſe the earth a little about it, and continue this at every hoeing till it begins to put forth the ears; then they enlarge the hill of earth, round the root, to the ſize of a hop-hill, and after this they leave it till the time of harveſt, without any farther care. When they gather the ears, they either immediately ſtrip off the corn, or elſe hang up the ears, tied in traces at diſtances from one another; for if they are laid near together, they will heat and rot or elſe ſprout and grow; but kept cool and ſeparate, they will remain good all the winter. The beſt method is to threſh out the corn as ſoon as the harveſt is over, to dry it well on mats in the ſun, and then lay it up in holes of the ground, well lined with mats, graſs, or the like, and afterwards covered at top with more earth. The moſt careful among the Indians uſe this method, and this ſort of ſubterranean granary always proves good.

The uſes of this plant among the Indians are very many. The great article is the making their bread of it; but beſides this, the ſtalks, when cut up before they are too much dried, are an excellent winter food for cattle; but they uſually leave them on the ground for the cattle to feed on. The huſks about the ear are uſually ſeparated from the reſt, and make a particular ſort of fodder, not inferior to our hay. The Indian women have a way of ſlitting them into narrow parts, and they then weave them artificially into baſkets and many other toys. The original way of eating the grain among the Indians was this: they boiled it whole in water till it ſwelled and became tender, and then they fed on it either alone or eat it with their fiſh and veniſon inſtead of bread. After this, they found the way of boiling it into a ſort of pudding, after bruiſing it in a mortar; but the way of reducing it to flour is the beſt of all. They do this by parching it carefully in the fire, without burning, and then beating it in mortars and ſifting it. This flour they lay up in bags as their conſtant proviſion, and take it out with them when they go to war, eating it either dry or with water. The Engliſh have contrived, by mixing it into a ſtiff paſte, either by itſelf or with rye or wheat-meal, fermenting it with leaven or yeaſt, and baking it in a hot oven, to make good bread of it. They have likewiſe found out a method of making good beer, either of the bread or by malting the grain.

ZEAL, paſſionate ardour for any perſon or cauſe. It is moſt frequently uſed to denote a ſtrong and warm attachment

ment to the diſtinguiſhing doctrines or worſhip of ſome particular ſect of Chriſtians. Thus we ſay, a zealous *Calviniſt*, *Arminian*, or *Papiſt*; though we may likewiſe with the greateſt propriety ſay of an upright and benevolent man, that he is zealous of *good works*.

ZEALAND, the chief of the Daniſh iſlands, is ſituated at the entrance of the Baltic Sea, bounded by the Schaggerrac Sea on the north; by the Sound, which ſeparates it from Schonen, on the eaſt; by the Baltic Sea on the ſouth; and by the ſtrait called the *Great Belt*, which ſeparates it from the iſland of Funen, on the weſt; being of a round figure, near 200 miles in circumference: the chief town is Copenhagen.

ZEALAND, is alſo a province of the United Netherlands, conſiſting of eight iſlands, which lie in the mouth of the river Scheld, bounded by the province of Holland, from which they are ſeparated by a narrow channel on the north; by Brabant on the eaſt; by Flanders, from which they are ſeparated by one of the branches of the Scheld, on the ſouth; and by the German Ocean on the weſt.

New Zealand, a country of Aſia, in the South Pacific Ocean, firſt diſcovered by Taſman, the Dutch navigator, in the year 1642, who gave it the name of *Staten Land*, though it has been generally diſtinguiſhed in our maps and charts by the name of *New Zealand*, and was ſuppoſed to be part of a ſouthern continent: but it is now known, from the late diſcoveries of Captain Cook who ſailed round it, to conſiſt of two large iſlands, divided from each other by a ſtrait four or five leagues broad. They are ſituated between the latitudes of 34 and 48 degrees ſouth, and between the longitudes of 166 and 180 degrees eaſt from Greenwich. One of theſe iſlands is for the moſt part mountainous, rather barren, and but thinly inhabited; but the other is much more fertile, and of a better appearance. In the opinion of Sir Joſeph Banks and Dr Solander, every kind of European fruits, grain, and plants, would flouriſh here in the utmoſt luxuriance. From the vegetables found here, it is ſuppoſed that the winters are milder than thoſe in England, and the ſummers not hotter, though more equally warm; ſo that it is imagined, that if this country were ſettled by people from Europe, they would, with moderate induſtry, be ſoon ſupplied, not only with the neceſſaries, but the luxuries of life, in great abundance. Here are foreſts of vaſt extent, filled with very large timber trees; and near 400 plants were found here that had not been deſcribed by the naturaliſts. The inhabitants of New Zealand are ſtout and robuſt, and equal in ſtature to the largeſt Europeans. Their colour in general is brown, but in few deeper than that of the Spaniard who has been expoſed to the ſun, and in many not ſo deep; and both ſexes have good features. Their dreſs is very uncouth, and they mark their bodies in a manner ſimilar to the inhabitants of Otaheite, and which is called *tattowing*. Their principal weapons are lances, darts, and a kind of battle-axes; and they have generally ſhown themſelves very hoſtile to the Europeans who have viſited them.

ZEALOTS, an ancient ſect of the Jews, ſo called from their pretended zeal for God's law and the honour of religion.

ZEBRA, in zoology. See EQUUS.

ZEBU, in zoology; a name given by M. de Buffon to the bos indicus of Linnæus. See BOS, vi.

ZECHARIAH, a canonical book of the Old Teſtament. See SCRIPTURE, nº 80.

ZECHIN, or ZECCHINO. See SEQUIN.

ZEDOARY, in the materia medica. See KÆMPFERIA.

ZELL, a city of Germany in the circle of Lower Saxony, capital of the duchies of Zell and Lunenburg, ſituated at the confluence of the rivers Aller and Fuhſe, 30 miles north of Hanover, and 40 ſouth of Lunenburg. E. Long. 10. 12. N. Lat. 52. 49.

ZEMBLA NOVA, a very large iſland, lying in the Northern Ocean, to the north of Ruſſia, from which it is ſeparated by the ſtrait of Waigate. It has no inhabitants except wild beaſts, particularly white foxes and bears. In 1595 a Dutch veſſel was caſt away on the coaſt, and the ſhip's company were obliged to winter here; but they did not ſee the ſun from the fourth of November to the beginning of February, and had great difficulty to keep themſelves from being frozen to death.

ZEMINDAR. See HINDOSTAN, Vol. VIII. page 585.

ZEND, or ZENDAVESTA, a book aſcribed to Zoroaſter, and containing his pretended revelations; which the ancient Magicians and modern Perſees, called alſo *Gaurs*, obſerve and reverence in the ſame manner as the Chriſtians do the Bible, and the Mahometans the Koran, making it the ſole rule both of their faith and manners. The word, it is ſaid, originally ſignifies any inſtrument for kindling fire, and is applied to this book to denote its aptitude for kindling the flame of religion in the hearts of thoſe who read it.

The Zend contains a reformed ſyſtem of Magianiſm; teaching that there is a Supreme Being, eternal, ſelf-exiſtent, and independent, who created both light and darkneſs, out of which he made all other things; that theſe are in a ſtate of conflict, which will continue till the end of the world; that then there ſhall be a general reſurrection and judgment; and that juſt retribution ſhall be rendered unto men according to their works; that the angel of darkneſs with his followers ſhall be conſigned to a place of everlaſting darkneſs and puniſhment, and the angel of light with his diſciples introduced into a ſtate of everlaſting light and happineſs; after which light and darkneſs ſhall no more interfere with each other. The Zend alſo enjoins the conſtant maintenance of ſacred fires and fire-temples for religious worſhip; the diſtinction of clean and unclean beaſts; the payment of tithes to prieſts, which are to be of one family or tribe; a multitude of waſhings and purifications, reſembling thoſe of the Jewiſh law; and a variety of rules and exhortations for the exerciſe of benevolence and charity.

In this book there are many paſſages evidently taken out of the Scriptures of the Old Teſtament, particularly out of the Pſalms of David: The author repreſents Adam and Eve as the firſt parents of all mankind, gives in ſubſtance the ſame account of the creation and deluge with Moſes, differing indeed with regard to the former, by converting the ſix days of the Moſaic account into ſix times, comprehending in the whole 365 days; and ſpeaks alſo of Abraham, Joſeph, Moſes, and Solomon. Moreover, Dr Baumgarten aſſerts, that this work contains doctrines, opinions, and facts, actually borrowed from the Jews, Chriſtians, and Mahometans; whence, and from other circumſtances, he concludes that both the hiſtory and writings of this prophet were probably invented in the later ages, when the fire-worſhippers under the Mahometan government thought fit to vindicate their religion from the ſuſpicion of idolatry.

At whatever period the Zend may have been written, we are aſſured by Dr Hyde that it is in the pure old Perſian language, and in the character called *Peplavi*. Some parts of it contain the original text, and others Zoroaſter's ſecond thoughts ſubjoined, for explaining more fully his doctrine. Theſe were occaſioned by the oppoſition of adverſaries, and unforeſeen circumſtances which occurred during the fabrication of the impoſture. About 300 years ago, when the old Perſian language had become antiquated and little underſtood, one of the deſtoura or high-prieſts among the Perſees compoſed the *Sadda*, which is a compendium in the vulgar or modern Perſic tongue, of thoſe parts of the Zend that relate to religion, or a kind of code of canons and precepts, drawn from the theological writings of Zoroaſter, ſerving as an authoritative rule of ſaith and practice for his followers. This Sadda is written in a low kind of Perſic verſe, and, as Dr Hyde informs us, it is *bonorum & malorum farrago*, having many good and pious things, and others very ſuperſtitious and trifling. See PERSEES and ZOROASTER.

ZENITH, in aſtronomy, the vertical point, or a point in the heavens directly over our heads.

ZENO ELEATES, an eminent Grecian philoſopher, was born at Elea about 504 years before Chriſt. He was a zealous friend of civil liberty, and is celebrated for his courageous and ſucceſsful oppoſition to tyrants; but the inconſiſtency of the ſtories related by different writers concerning him in a great meaſure deſtroys their credit. He choſe to reſide in his ſmall native city of Elea rather than at Athens, becauſe it afforded freer ſcope to his independent and generous ſpirit, which could not eaſily ſubmit to the reſtraints of authority. It is related, that he vindicated the warmth with which he reſented reproach, by ſaying, "If I were indifferent to cenſure, I ſhould alſo be indifferent to praiſe." The invention of the dialectic art has been improperly aſcribed to Zeno; but there can be no doubt that this philoſopher, and other metaphyſical diſputants in the Eleatic ſect, employed much ingenuity and ſubtlety in exhibiting examples of moſt of the logical arts, which were afterwards reduced to rule by Ariſtotle and others.

Enfield's History of Philoſophy.

According to Ariſtotle, he taught, that nothing can be produced either from that which is ſimilar or diſſimilar; that there is only one being, God; who is eternal, homogeneous, and ſpherical, neither finite nor infinite, neither quieſcent nor moveable; that there are many worlds; that there is in nature no vacuum; that all bodies are compoſed of four elements, heat and moiſture, cold and dryneſs; and that the body of man is from the earth, and his ſoul an equal mixture of theſe four elements. He argued with great ſubtlety againſt the poſſibility of motion. If Seneca's account of this philoſopher deſerves credit, he reached the higheſt point of ſcepticiſm, and denied the real exiſtence of external objects. The truth is, that after all that has been advanced by different writers, it is impoſſible to determine whether Zeno underſtood the term *One*, metaphyſically, logically, or phyſically; or whether he admitted or denied a nature properly divine.

Zeno, the founder of the ſect of the Stoics, was born about 300 years before Chriſt, at Citium in the iſland of Cyprus. This place having been originally peopled by a colony of Phœnicians, Zeno is ſometimes called a Phœnician. His father was by profeſſion a merchant, but diſcovering in the youth a ſtrong propenſity towards learning, he early devoted him to philoſophy. In his mercantile capacity he had frequent occaſion to viſit Athens, where he purchaſed for his ſon ſeveral of the writings of the moſt eminent Socratic philoſophers. Theſe he read with great avidity; and when he was about 30 years of age, he determined to take a voyage to a city which was ſo celebrated both as a mart of trade and of ſcience. If it be true, as ſome writers relate, that he brought with him a valuable cargo of Phœnician purple, which was loſt by ſhipwreck upon the coaſt of Piræus, this circumſtance will account for the facility with which he at firſt attached himſelf to a ſect whoſe leading principle was the contempt of riches. Upon his firſt arrival in Athens, going accidentally into the ſhop of a bookſeller, he took up a volume of the commentaries of Xenophon; and after reading a few paſſages, was ſo much delighted with the work, and formed ſo high an idea of the author, that he aſked the bookſeller where he might meet with ſuch men. Crates the Cynic philoſopher happening at that inſtant to be paſſing by, the bookſeller pointed to him, and ſaid, "Follow that man." Zeno attended upon the inſtructions of Crates, and was ſo well pleaſed with his doctrine that he became one of his diſciples. But though he admired the general principles of the Cynic ſchool, he could not eaſily reconcile himſelf to their peculiar manners. Beſides, his inquiſitive turn of mind would not allow him to adopt that indifference to every ſcientific enquiry which was one of the characteriſtic diſtinctions of the ſect. He therefore attended upon other maſters, who profeſſed to inſtruct their diſciples in the nature and cauſes of things. When Crates, diſpleaſed at his following other philoſophers, attempted to drag him by force out of the ſchool of Stilpo, Zeno ſaid to him, "You may ſeize my body, but Stilpo has laid hold of my mind." After continuing to attend upon the lectures of Stilpo ſeveral years, he paſſed over to other ſchools, particularly to thoſe of Xenocrates and Diodorus Cronus. By the latter he was inſtructed in dialectics. He was ſo much delighted with this branch of ſtudy, that he preſented to his maſter a large pecuniary gratuity, in return for his free communication of ſome of his ingenious ſubtleties. At laſt, after attending almoſt every other maſter, he offered himſelf as a diſciple of Polemo. This philoſopher appears to have been aware, that Zeno's intention in thus removing from one ſchool to another, was to collect materials from various quarters for a new ſyſtem of his own; for, when he came into Polemo's ſchool, he ſaid to him, "I am no ſtranger, Zeno, to your Phœnician arts; I perceive that your deſign is to creep ſlyly into my garden, and ſteal away my fruit." Polemo was not miſtaken in his opinion. Having made himſelf maſter of the tenets of others, Zeno determined to become the founder of a new ſect. The place which he made choice of for his ſchool was a public portico, adorned with the pictures of Polygnotus, and other eminent painters. It was the moſt famous portico in Athens, and called, by way of eminence, Στοα, "the Porch." It was from this circumſtance that the followers of Zeno were called *Stoics*.

In his perſon Zeno was tall and ſlender; his aſpect was ſevere, and his brow contracted. His conſtitution was feeble, but he preſerved his health by great abſtemiouſneſs. The ſupplies of his table conſiſted of figs, bread, and honey; notwithſtanding which, he was frequently honoured with the company of great men. In public company, to avoid every appearance of an aſſuming temper, he commonly took the loweſt place. Indeed ſo great was his modeſty, that he ſeldom choſe to mingle with a crowd, or wiſhed for the company of more than two or three friends at once. He paid more attention to neatneſs and decorum in external appearance than the Cynic philoſophers. In his dreſs indeed he was plain, and in all his expences frugal; but this is not to be imputed to avarice, but a contempt of external magnificence. He ſhowed as much reſpect to the poor as to the rich; and converſed freely with perſons of the meaneſt occupations. He had only one ſervant, or, according to Seneca, none.

Zeno lived to the extreme age of 98; and at laſt, in conſequence of an accident, voluntarily put an end to his life. As he was walking out of his ſchool he fell down, and in the fall broke one of his fingers; upon which he was ſo affected with the conſciouſneſs of infirmity, that, ſtriking the earth, he ſaid, "Why am I thus importuned? I obey thy ſummons;" and immediately went home and ſtrangled himſelf.

ſelf. He died in the firſt year of the 129th Olympiad. The Athenians, at the requeſt of Antigonus, erected a monument to his memory in the Ceramicum.

We ought not to confound the two Zenos already mentioned with

Zeno, a celebrated Epicurean philoſopher, born at Sidon, who had Cicero and Pomponius Atticus for his diſciples, and who wrote a book againſt the mathematics, which, as well as that of Poſſidonius's refutation of it, is loſt; nor with ſeveral other *Zenos* mentioned in hiſtory.

ZENOBIA, queen of Palmyra. See **Palmyra**.

ZEOLITE. See **Clay**, Vol. V. page 49. and **Mineralogy**, Vol. XII. page 88.

ZEPHANIAH, a canonical book of the Old Teſtament. See **Scripture**, n° 79.

ZEPHYR, the *Weſt-Wind*, or that which blows from the cardinal point of the horizon oppoſite to the eaſt.

ZEPHYRUS, one of the Pagan deities, was repreſented as the ſon of Aurora, and the lover of the nymph Chloris, according to the Greeks, or of Flora according to the Romans; and as preſiding over the growth of fruits and flowers. He is deſcribed as giving a refreſhing coolneſs to the air by his ſoft and agreeable breath, and as moderating the heat of ſummer by fanning the air with his ſilken wings. He is depictured under the form of a youth, with a very tender air, with wings reſembling thoſe of the butterfly, and with his head crowned with a variety of flowers. As the poets of Greece and Rome lived in a warm climate, they are laviſh in their praiſe of this beneficent deity, and under his name deſcribe the pleaſure and advantage they received from the weſtern breezes.

ZERDA. See **Canis**, Sp. xiv.

ZERTA, the **Zerte**, a fiſh caught in the rivers of Italy and ſome other places, of the figure of the chub, and called by authors *capito anodromus*, and the *blike*. It ſeldom grows to more than two pounds weight, and at times lives in rivers, at times in the ſea; and is eſteemed a very well taſted fiſh, eſpecially a little before the ſeaſon of its ſpawning. The zerte is that ſpecies of cyprinus deſcribed by Geſner, and others under the name of *capito anodromus*.

ZEST, the woody thick ſkin quartering the kernel of a walnut; preſcribed by ſome phyſicians, when dried and taken with white-wine, as a remedy againſt the gravel.

Zeſt is alſo uſed for a chip of orange or lemon peel; ſuch as is uſually ſqueezed into ale, wine, &c. to give it a flavour; or the fine oil which ſpurts out of that peel on ſqueezing it.

ZEUGMA, a figure in grammar, whereby an adjective or verb which agrees with a nearer word, is alſo, by way of ſupplement, referred to another more remote.

ZEUS, in ichthyology, a genus of fiſhes of the order of *thoracici*. The head is compreſſed, and declines, the upper lip being vaulted over by a tranſverſe membrane; the tongue is ſubulated; there are ſeven rays in the gill membrane; and the body is compreſſed.—The ſpecies are eight; of which the moſt remarkable is the *faber* or *doree*. It is of a hideous form, its body is oval, and greatly compreſſed on the ſides; the head large; the ſnout vaſtly projecting; the mouth very wide; the teeth very ſmall; the eyes great, the irides yellow; the lateral line oddly diſtorted; ſinking at each end, and riſing near the back in the middle; beneath it on each ſide is a round black ſpot. The tail is round at the end, and conſiſts of 15 yellow rays. The colour of the ſides is olive, varied with light blue and white, and while living is very reſplendent, and as if gilt; for which reaſon it is called the *doree*. The largeſt fiſh we have heard of weighed 12 pounds.

Superſtition hath made the doree rival to the haddock, for the honour of having been the fiſh out of whoſe mouth St Peter took the tribute-money, leaving on its ſides thoſe inconteſtible proofs of the identity of the fiſh, the marks of his finger and thumb. It is rather difficult at this time to determine on which part to decide the diſpute; for the doree likewiſe aſſerts an origin of its ſpots of a ſimilar nature, but of a later date than the former. St Chriſtopher, in wading through an arm of the ſea, having caught a fiſh of this kind *en paſſant*, as an eternal memorial of the fact, left the impreſſions on its ſides to be tranſmitted to all poſterity. In our own country it was very long before this fiſh attracted our notice, at leaſt as an edible one. We are indebted to the late Mr Quin for adding a moſt delicious fiſh to our table, who, overcoming all the vulgar prejudices on account of its deformity, has effectually eſtabliſhed its reputation. This fiſh was ſuppoſed to be found only in the ſouthern ſeas of this kingdom, but it has been diſcovered likewiſe on the coaſt of Angleſey. Thoſe of the greateſt ſize are taken in the Bay of Biſcay, off the French coaſts; they are alſo very common in the Mediterranean: Ovid muſt therefore have ſtyled it *rarus faber*, on account of its excellency, not its ſcarcity.

ZEUXIS, a celebrated painter of antiquity, flouriſhed about 400 years before Chriſt. He was born at Heraclea; but as there have been many cities of that name, it cannot be certainly determined which of them had the honour of his birth. Some learned men, however, conjecture, that it was the Heraclea near Crotona in Italy. He carried painting to a much higher degree of perfection than Apollodorus had left it; diſcovered the art of properly diſpoſing of lights and ſhades, and particularly excelled in colouring. He amaſſed immenſe riches; and then reſolved to ſell no more of his pictures, but gave them away; ſaying very frankly, "That he could not ſet a price on them equal to their value." Before this time he made people pay for ſeeing them; and nobody was admitted to ſee his Helena without ready money, which occaſioned the wags calling his picture *Helen the Courtezan*. It is not known whether this Helen of Zeuxis was the ſame with that which was at Rome in Pliny's time, or that which he painted for the inhabitants of Crotona to be hung up in the temple of Juno: this laſt he painted from five beautiful girls of that city, copying from each her greateſt excellencies. Pliny obſerves, that this admirable painter, diſputing for the prize of painting with Parrhaſius, painted ſome grapes ſo naturally, that the birds flew down to peck them. Parrhaſius, on the other hand, painted a curtain ſo very artfully, that Zeuxis miſtaking it for a real one that hid his rival's work, ordered the curtain to be drawn aſide, to ſhow what Parrhaſius had done; but having found his miſtake, he ingenuouſly confeſſed himſelf vanquiſhed, ſince he had only impoſed upon birds, while Parrhaſius had deceived even a maſter of the art. Another time he painted a boy loaded with grapes; when the birds alſo flew to this picture, at which he was vexed; and confeſſed, that this work was not ſufficiently finiſhed, ſince had he painted the boy as perfectly as the grapes, the birds would have been afraid of him. Archelaus, king of Macedon, made uſe of Zeuxis's pencil for the embelliſhment of his palace. One of this painter's fineſt pieces was a Hercules ſtrangling ſome ſerpents in his cradle, in the preſence of his affrighted mother: but he himſelf chiefly eſteemed his Athleta, or Champion, under which he placed a Greek verſe that afterwards became very famous, and in which he ſays, "That it was eaſier to criticiſe than to imitate the picture." He made a preſent of his Alcmena to the Agrigentines. Zeuxis did not value himſelf on ſpeedily finiſhing his pictures; but knowing that Agatharchus gloried in his being able to paint with eaſe and in a little time, he ſaid, "That for his part he, on the contrary, gloried in his ſlowneſs; and if he was long in painting, it was becauſe he painted for eternity. Verrius Flaccus ſays, that Zeuxis having painted an old woman, he laughed ſo very heartily at the ſight of this picture, that he died: but as no other of the ancients have mentioned this particular, there is the greateſt reaſon to believe it fabulous. Carlo Dati has compoſed in Italian the Life of Zeuxis, with thoſe of Parrhaſius, Apelles, and Protogenes. This work was printed at Florence in 1667.

ZICLAG, or Ziklag (anc. geog.), a town of the tribe of Simeon, on the borders of the Philiſtines (Joſhua xv. and xix.), but in the hands of the Philiſtines till David's time. (1 Sam. xxvii, and xxx.)

ZIMB, in natural hiſtory. See Ethiopia, n° 11.

ZIMENT-water, Copper-water, in natural hiſtory, the name by which ſome have called water found in places where there are copper-mines, and lightly impregnated with particles of that metal.

The moſt famous ſpring of this kind is about a mile diſtant from Newſol in Hungary, in the great copper-mine called by the Germans *herrn-grundt*. The water in this mine is found at different depths, and is received into baſons, for the purpoſe of ſeparating the copper from it: in ſome of theſe it is much more ſated with this metal than in others, and will make the ſuppoſed change of iron into that metal much ſooner. The moſt common pieces of iron uſed in the experiments are horſe-ſhoes, nails, and the like; and they are found very little altered in ſhape, after the operation, except that their ſurfaces are more raiſed. The water appears greeniſh in the baſon, where it ſtands; but if a glaſs of it be taken up, it looks clear as cryſtal: it has no ſmell, but a ſtrong vitriolic aſtringent taſte, inſomuch that the lips and tongue are bliſtered and ſcorched upon taſting it.

ZIN (anc. geog.), a wilderneſs encompaſſing Idumea, at leaſt on the ſouth and weſt, as far as Paleſtine or Canaan; but according to Wells, on the eaſt of Edom, to the north of Ezion-gaber.

ZINC, a ſemimetal. For a deſcription of the ores of this metal, the method of extracting it from theſe ores, and for its properties, ſee Calamine; Chemistry-*Index*; Mineralogy, Vol. XII. page 128; Metallurgy, Part II. ſect. xii.

Zinc, beſides its medical qualities (for which ſee Pharmacy-*Index*), is of great uſe in the arts: united with copper in different proportions, it forms braſs and pinchbeck; and united with tin, it forms a kind of pewter.

Braſs is formed by mixing two parts of copper with one of zinc; pinchbeck by mixing three or four parts of copper to one of zinc: when the metals are mixed in equal quantities they form a very exact imitation of gold. Its inflammable property renders zinc a uſeful ingredient in fire-works.

It has been propoſed to ſubſtitute this ſemimetal inſtead of tin in the lining of copper veſſels; the latter being thought inſufficient to prevent the dangerous effects of the copper. Mr Malouin, who has made many experiments on the lining of veſſels in this manner, aſſerts that it ſpreads more evenly on the copper than tin itſelf; that it is much harder and leſs fuſible, and conſequently more durable than tin. Mr Macquer owns theſe advantages; but thinks it dangerous to be uſed in culinary veſſels, as it is ſoluble in vegetable acids, and the combination of it with the vitriolic acid is known to be a ſtrong emetic. Gaubius alſo mentions a celebrated remedy for convulſive diſorders, named *luna fixuta ludemaunic* which Macquer affirms to be ſtrongly emetic in very ſmall doſes. "But, may it not be preſumed (ſays Foucroy), that properties which are applicable only to the vitriol and flower zinc, cannot be applied to the ſemimetal itſelf, nor even, without farther experiments, to the ſalts formed by its combination with the vegetable acids." Mr de la Plandic, doctor in medicine of the faculty of Paris, has changed this preſumption into certainty by experiments made with great care on himſelf. He took the ſalts of zinc, formed by its combination with vegetable acids, in a much ſtronger doſe than the aliments prepared in copper covered with zinc can poſſibly contain them, and found no dangerous effects to follow. However, ſince objects which relate to the health and lives of mankind cannot be treated with too much circumſpection, it appears to be prudent, and even neceſſary, not to decide on the ſubject till after a great number of experiments, and that the action of zinc combined with the vegetable acids uſed in cookery have been fully aſcertained. The flowers of zinc have been uſed as an antiſpaſmodic, and are an article of our preſent materia medica; but it does not clearly appear what ſucceſs may be expected from them.

ZINNIA, in botany; a genus of plants of the claſs *Syngeneſia*, order *polygamia ſuperflua*; and in the natural ſyſtem arranged under the 49th order, *Compoſita*. The receptacle is paleaceous, the pappus conſiſts of two erect awns, the calyx is ovato-cylindrical and imbricated; the rays conſiſt of five perſiſting entire florets. There are two ſpecies, the *pauciflora* and *multiflora*, neither of which is a native of Britain.

ZINZENDORFF (Nicholas Lewis), count, was the noted founder of the German religious ſect called *Moravians*, or *Herrnhuters*, or, as they pretend, the reſtorer of that ſociety. From his own narrative it appears, that when he came of age in 1721, his thoughts were wholly bent on gathering together a little ſociety of believers, among whom he might live, and who ſhould entirely employ themſelves in exerciſes of devotion under him. He accordingly purchaſed an eſtate at Bertholſdorff in Upper Luſatia, where being joined by ſome followers, he gave the curacy of the village to a man of his own complexion; and Bertholſdorff ſoon became talked of for a new mode of piety. One Chriſtian David, a carpenter, brought a few proſelytes from Moravia: they began a new town about half a league from the village, where count Zinzendorff fixed his reſidence among them, and where great numbers of Moravians flocked and eſtabliſhed themſelves under his protection: ſo that in 1732 their number amounted to 600. An adjacent hill, called the *Huthberg*, gave occaſion to theſe coloniſts to call their new ſettlement *Huth des Herrn*, and afterward *Herrnhuth*; which may be interpreted "The guard or protection of the Lord:" and from this the whole ſect have taken their name. The count ſpared neither pains nor art to propagate his opinions; he went himſelf all over Europe, and at leaſt twice to America; and ſent his miſſionaries throughout the world. Count Zinzendorff died in 1760. Thoſe who wiſh to know more of the Moravian tenets may conſult Rimius's account of them, tranſlated in 1753. See United Brethren.

ZINZIBER, or Zingiber, in botany. See Amomum and Ginger.

ZION, or Sion (anc. geog.), a very famous mountain, ſtanding on the north ſide of the city of Jeruſalem, (Pſal. xlvii. 2.); containing the upper city, built by King David: and where ſtood the royal palace, (Joſephus). A part of Zion, ſituated at its extremity, was called *Millo*, of, or in the city of David (2 Chron. xxxii. 5.) Modern travellers, who have been upon the ſpot, ſay, that Zion is the whole of the mountain, on which Jeruſalem ſtands at this day, though not to the extent in which it anciently ſtood on the ſame mountain, as appears Pſal. ix. 12. 15. lxv. 1. lxxxvii. 2. 3. Iſ. lxii. 1. It is ſwelled into ſeveral eminences or tops; as Moriah, Acra, Bezetha, and Zion a particular eminence of mount and Zion Proper, &c. encompaſſed on three ſides, eaſt, weſt, and ſouth, with one continued very deep and ſteep valley; by means of which it was impregnable on theſe three ſides, and always attacked and taken, according to Joſephus, by the enemy on the north ſide, where mount Zion becomes level, and the vales of Gihon and Jehoſophat gradually loſe themſelves. This deep and ſteep valley inconteſtibly conſtitutes the compaſs of the old Jeruſalem on thoſe three ſides, as plainly appears to any perſon who has been upon the ſpot. On that particular top of the mount called *Zion* ſtood the fortreſs of the Jebuſites; which being afterwards taken by David, came to be called the *City of David*, where he had his royal reſidence and kept his court. That part of the valley which lay to the eaſt was called *Jehoſophat's*, having mount Olivet lying beyond it; that to the ſouth, *Gebinnon*; and that to the weſt, *Gihon*, from cognominal mountains lying beyond them. At the weſt end of Gihon, without the city, ſtood Golgotha or Calvary. The pretended Golgotha, ſhown at this day within the walls, is the ſpurious brat of intereſted and fraudulent monks, (Korte). There is another *Zion*, the ſame with HERMON.

ZION, or *Sion College*. See LONDON, n° 76.

ZIPH, or SIPH (anc. geog.), the name of a wilderneſs or deſert in the tribe of Judah, where David was a fugitive; lying to the ſouth-eaſt of Hebron; ſo called from Ziph or Siph, a twofold town in this tribe; the one more to the ſouth towards Idumea, on the confines of Eleutheropolis, (Jerome); the other eight miles to the eaſt of Hebron, towards the Dead Sea, inclining ſouthwards, becauſe near mount Carmel. Here was a mountain, mentioned 1 Sam. xxiii. 14. in which David abode, ſaid by Jerome to be rugged, diſmal, and always overcaſt. *Ziphim, Ziphæi*, or *Ziphenſes*, the inhabitants of Ziph, ver. 19.

ZIRCHNITZER-SEE, otherwiſe called the *Lake of Czirknitz*, in Carniola, is about one German or four Engliſh miles in length, and half as much in breadth, contains three beautiful iſlands, and is encompaſſed at ſome diſtance with mountains and foreſts. But what is moſt remarkable is, that it diſappears generally once a-year, about St John's or St James's day, running off through holes or pits in the bottom; ſometimes it will diſappear twice or thrice a-year, and ſometimes even in winter if the weather be dry. On the other hand, it has been known to continue two or three years without running off. Of the holes or pits, there are five much larger than the reſt, each of which ſucceſſively, when the water runs off, ſtands empty five days; ſo that the whole lake becomes dry in 25. As ſoon as the beginning of the ebb is obſerved, the fiſhing in the pits begins, which belongs to five ſeigniories. The fiſh, which are carp, tench, pike, eels, and two other ſorts called *ſchleien* and *ruten*, are caught by laying nets over the holes. Mr Keyſler tells us, that upon the ringing of a bell at Zirknitz, when the waters begin to fall, the peaſants, both men and women, run to the pools quite naked, notwithſtanding both the clergy and magiſtrates have uſed their utmoſt endeavours to ſuppreſs ſo indecent a cuſtom. When the water runs off early in the year, in about three weeks after it is gone there is good graſs on the bottom, which is mowed down, and the bottom afterwards ploughed and ſowed with millet. If the water runs not off early, nothing can be ſown; and if it returns ſoon, the ſeed is loſt. With reſpect to its return, the water at firſt burſts out of ſome pits on the ſouth ſide with great violence, a little rain always falling at the ſame time; but afterwards (when the rain falls heavier, and it thunders at the ſame time ſo loud as to ſhake the earth) it breaks out through all the apertures with great force, inſomuch that the lake is filled in 18 or 24 hours, at which time it is in a manner covered with wild fowl; ſuch as geeſe, ducks, &c. After the millet-harveſt, all manner of game is hunted, caught, or killed in it. On the ſouth ſide are two caverns, out of which, when it thunders, water iſſues with aſtoniſhing violence; and if it happens in harveſt, a great many naked, black, and blind, but fat ducklings, are brought up with the water, which in 14 days receive their ſight, and are covered with feathers.

ZISCA (John), a famous general of the forces of the Huſſites, in the 15th century, was a gentleman educated at the court of Bohemia, in the reign of Wenceſlaus. He entered very young into the army, and after diſtinguiſhing himſelf on ſeveral occaſions, loſt an eye in a battle, whence he was called *Ziſca* or *One-eyed*. At length the Reformation, begun by John Huſs, ſpreading through almoſt all Bohemia, Ziſca placed himſelf at the head of the Huſſites, and had ſoon under his command a body of 40,000 men. With this army he gained ſeveral victories over thoſe of the Romiſh religion, who carried on a kind of cruſade againſt them, and built a town in an advantageous ſituation, to which he gave the name of *Tabor*; whence the Huſſites were afterwards called *Taborites*. Ziſca loſt his other eye by an arrow at the ſiege of the city of Rubi; but this did not prevent his continuing the war, his fighting battles, and gaining ſeveral great victories, among which was that of Auſig on the Elbe, in which 9000 of the enemy were left dead on the field. The emperor Sigiſmund, alarmed at his progreſs, cauſed very advantageous propoſals to be offered to him; which he readily accepted, and ſet out to meet Sigiſmund, but died on the road. He ordered that his body ſhould be left a prey to the birds and wild beaſts; and that a drum ſhould be made of his ſkin, being perſuaded that the enemy would fly as ſoon as they heard the ſound. It is added, that the Huſſites executed his will; and that the news of this order made ſuch an impreſſion on the diſturbed imaginations of the German Papiſts, that in many battles they actually fled at the beat of the drum with the utmoſt precipitation, leaving their baggage and artillery behind them.

ZIZANIA, in botany; a genus of plants of the claſs *monœcia*, order *hexandria*; and in the natural ſyſtem arranged under the 4th order, *Gramina*. There is no male calyx; the corolla is a bivalved, beardleſs glume, intermixed with the female flowers; there is no female calyx, the corolla is an univalved, cucullated, and ariſtated glume; the ſtyle is bipartite, and there is one ſeed covered with the plaited corolla. There are three ſpecies; the aquatica, the paluſtris, and terreſtris, none of which are natives of Britain.

ZODIAC, in aſtronomy, a broad circle, whoſe middle is the ecliptic, and its extremes two circles parallel thereto, at ſuch a diſtance from it as to bound or comprehend the excurſions of the ſun and planets, (ſee ASTRONOMY). It is a curious enough fact, that the ſolar diviſion of the Indian zodiac is the ſame in ſubſtance with that of the Greeks, and yet that it has not been borrowed either from the Greeks or the Arabians. The identity, or at leaſt ſtriking ſimilarity, of the diviſion, is univerſally known; and M. Montucla has endeavoured to prove, that the Bramins received it from the Arabs. His opinion, we believe, has been very generally admitted; but in the ſecond volume of the Aſiatic Reſearches, the accompliſhed preſident Sir William Jones has proved unanſwerably, that neither of thoſe nations borrowed that diviſion from the other; that it has been known among the Hindoos from time immemorial; and that it was probably invented by the firſt progenitors of that race, whom he conſiders as the moſt ancient of mankind, before their diſperſion. The queſtion is not of importance ſufficiently general, ſtraitened as we are by the limits preſcribed us, for our entering into the diſpute; but we think it our duty to mention it, that our aſtronomical readers, if they think it worth their while, may have recourſe to the original writers for further information.

ZOEGEA, in botany; a genus of plants of the claſs *ſyngeneſia*, and order *polygamia fruſtranea*. The receptacle is briſtly; the pappus ſetaceous; the corollulæ of the radius ligulated; the calyx imbricated. There are two ſpecies, the capenſis and the leptaurea, neither of which are natives of Britain.

ZONE, in geography and aſtronomy, a diviſion of the terraqueous globe with reſpect to the different degrees of heat found in the different parts thereof. The zones are denominated torrid, frigid, and temperate. The torrid zone is a band, ſurrounding the terraqueous globe, and terminated by the two tropics. Its breadth is 46°. 58′. The equator, running through the middle of it, divides it into two equal parts, each containing 23°. 29′. The ancients imagined the torrid zone uninhabitable. The temperate zones are contained between the tropics and the polar circles. The breadth of each is 43. 2. The frigid zones are ſegments of the ſurface of the earth, terminated, one by the antarctic, and the other by the arctic circle. The breadth of each is 46. 58.

ZOOLOGY.

IS that part of Natural Hiſtory which relates to *Animals*.

In order to abridge the ſtudy of zoology, many methods of reducing animals to claſſes, genera, and ſpecies, have been invented: But as that of Linnæus is undoubtedly the beſt, the moſt extenſive, and the moſt generally adopted, we ſhall give a brief account of it.

Linnæus divides the whole animal kingdom into ſix claſſes. The characters of theſe ſix claſſes are taken from the internal ſtructure of animals, in the following manner:

Class I. MAMMALIA, includes all animals that ſuckle their young. The characters of this claſs are theſe:—The *heart* has two ventricles and two auricles; the *blood* is red and warm; and the animals belonging to it are *viviparous*.

Class II. AVES, or Birds. The characters are the ſame with thoſe of Claſs I. excepting that the animals belonging to it are *oviparous*. See Bird, and Ornithology.

Class III. AMPHIBIA, or Amphibious Animals. The *heart* has but *one ventricle* and one *auricle;* the *blood* is red and cold; and the animals belonging to this claſs have the command of their *lungs*, ſo that the intervals between *inſpiration* and *expiration* are in ſome meaſure *voluntary*. See Amphibious.

Class IV. PISCES, or Fiſhes. The *heart* has the ſame ſtructure, and the *blood* the ſame qualities, with thoſe of the *Amphibia;* but the animals belonging to this claſs are eaſily diſtinguiſhed from the Amphibia, by having no ſuch voluntary command of their *lungs*, and by having external *branchiæ* or *gills*. See Fiſh, and Ichthyology.

Class V. INSECTA, or Inſects. The *heart* has *one ventricle*, but no *auricle;* the *blood* is cold and white; and the animals are furniſhed with *antennæ* or *feelers*. See Inſect.

Class VI. VERMES, or Worms. The characters are the ſame with thoſe of Claſs V. only the animals have no antennæ, and are furniſhed with *tentacula*.

The *Firſt Claſs*, MAMMALIA, is ſubdivided into ſeven Orders; the characters of which are taken from the number, ſtructure, and ſituation of the Teeth.

Order I. The Primates have four inciſores, or *fore-teeth*, in each jaw, and one *dog-tooth*. N. B. By *one* dog-tooth, Linnæus means one on each ſide of the fore teeth in both jaws.—This order includes four genera, *viz.* Homo, Simia, Lemur, Veſpertilio.

Order II. The Bruta have no *fore-teeth* in either jaw. This order includes ſeven genera, *viz.* Rhinoceros, Elephas, Trichechus, Bradypus, Myrmecophaga, Manis, Daſypus.

Order III. The Feræ have, for the moſt part, ſix *conical fore-teeth* in each jaw. This order includes 10 genera, *viz.* Phoca, Canis, Felis, Viverra, Muſtela, Urſus, Didelphis, Talpa, Sorex, Erinaceus.

Order IV. The Glires have two fore-teeth in each jaw, and no *dog-teeth*.—This order includes 10 genera, *viz.* Hyſtrix, Lepus, Caſtor, Mus, Sciurus, Myoxus, Cavia, Arotomys, Dypus, Hyrox.

Order V. The Pecora, have no *fore-teeth* in the upper jaw, but 6 or 8 in the under-jaw.—This order includes 8 genera, *viz.* Camelus, Moſchus, Giraffa, Cervus, Antilope, Capra, Ovis, Bos.

Order VI. The Belluæ, have *obtuſe-fore-teeth* in each jaw.—This order includes 4 genera, *viz.* Equus, Hippopotamus, Sus, Tapir.

Order VII. The Cete, or *whale kind*, have no uniform character in their teeth, being very different in the different genera; but are ſufficiently diſtinguiſhed from the other orders of Mammalia, by living in the ocean, having pectoral fins, and a fiſtula or ſpiraculum upon the head.—This order includes 4 genera, *viz.* Monodon, Balæna, Phyſeter, Delphinus. See Cetaceous.

The *generic* characters of the Mammalia are, like thoſe of the orders, almoſt entirely taken from the Teeth, excepting the Veſpertilio, which, beſides the character of the order derived from the teeth, has this farther mark, that there is a membrane attached to the feet and ſides, by means of which the creature is enabled to fly:—the Hyſtrix whoſe body is covered with ſharp ſpines:—and the whole order of Pecora, whoſe genera, beſides the characters taken from the teeth, are diſtinguiſhed into thoſe which have *horns*, thoſe which have *no horns*, and by peculiarities in the horns themſelves.

The *ſpecific* characters are very various, being taken from any part of the body which poſſeſſes a peculiar uniform mark of diſtinction. As examples of theſe characters are to be found under the proper name of each genus, it is unneceſſary to ſay any thing further concerning them in this place.

The *Second Claſs*, AVES, is ſubdivided into ſix Orders; the characters of which are taken chiefly from the ſtructure of the bill.

Order I. The Accipitres, have a hooked bill, the ſuperior mandible, near the baſe, being extended on each ſide beyond the inferior; and in ſome it is armed with *teeth*.—This order includes four ſpecies, *viz*. Vultur, Falco, Strix, Lanius.

Order II. The Picæ, have a convex, compreſſed bill, reſembling a knife.—This order contains 23 genera, *viz*. Trochilus, Certhia, Upupa, Glaucopis, Buphaga, Sitta, Oriolus, Coracias, Gracula, Corvus, Paradiſea, Ramphaſtos, Trogon, Pſittacus, Crotophaga, Picus, Yunx, Cuculus, Bucco, Boceros, Alcedo, Merops, Todus.

Order III. The Anseres, have a ſmooth bill, broadeſt at the point, covered with a ſmooth ſkin, and furniſhed with teeth: The *tongue* is fleſhy; and the toes are palmated or webbed.—This order includes 13 genera, *viz*. Anas, Mergus, Phaeton, Plotus, Rhyncops, Diomedea, Aptenodyta, Alca, Procellaria, Pelecanus, Larus, Sterna, Colymbus.

Order IV. The Grallæ, have a ſomewhat cylindrical bill: The tail is ſhort, and the thighs are naked. This order contains 20 genera, *viz*. Phœnicopterus, Platalea, Palamedea, Mycteria, Tantalus, Ardea, Corrira, Recurviroſtra, Scolopax, Tringa, Fulica, Parra, Rallus, Vaginalis, Pſophia, Cancroma, Scopus, Glareola, Hæmatopus, Charadrius.

Order V. The Gallinæ, have a convex bill; the ſuperior mandible is vaulted over the inferior: The *noſtrils* are half covered with a convex cartilaginous membrane; and the *feet* are divided, but connected, at the inmoſt joint.—This order contains 10 genera, *viz*. Otis, Struthio, Didus, Pavo, Meleagris, Penelope, Crax, Phaſianus, Numida, Tetrao.

Order VI. The Passeres, have a conical ſharp-pointed bill; and the *noſtrils* are oval, wide, and naked.—This order contains 17 genera, *viz*. Loxia, Colius, Fringilla, Phytotoma, Emberiza, Caprimulgus, Hirundo, Pipra, Turdus, Ampelis, Tanagra, Mucicapa, Parus, Motacilla, Alauda, Sturnus, Columba.

The *generic* characters of this claſs are taken from peculiarities in the *bill*, the *noſtrils*, the *tongue*, the *feet*, the *feathers*, the *face*, the *figure* of the *body*, &c.

The characters which ſerve to diſtinguiſh the *ſpecies* are very various: For example, the *colour* of the particular *feathers* or parts of *feathers*; *creſts* of feathers on the head, diſpoſed in different manners; the colour of the *cere* or *wax*; the colour of the *feet*; the ſhape and length of the *tail*; the number, ſituation, &c. of the *toes*; the colour and figure of the *bill*, &c.

The *Third Claſs*, AMPHIBIA, is divided into two Orders.

Order I. The Reptiles, have four *feet*, and breathe by the *mouth*.—This order contains four genera, *viz*. Teſtudo, Draco, Lacerta, Rana.

Order II. The Serpentes, have no *legs*, and breathe by the *mouth*.—This order contains ſix genera, *viz*. Crotalus, Boa, Coluber, Anguis, Amphiſbæna, Cœcilia.

The *generic* characters of this claſs are taken from the general figure of the *body*; from their having *tails* or *no tails*; being covered with a *ſhell*; having *teeth* or *no teeth*, in the *mouth*; being furniſhed with *lungs*; having *covered* or *naked* bodies; from the number, ſituation, and figure of the *ſcuta* and *ſcales*; from the number and ſituation of the *ſpiracula*: from the ſituation of the *mouth*, &c.

The *ſpecific* characters are ſo very various, that it would be ſuperfluous to enumerate them.

The *Fourth Claſs*, PISCES, is ſubdivided into ſix Orders, the characters of which are taken from the ſituation of the *belly fins*.

Order I. The Apodes, have no *belly-fins*.—This order contains eight genera, *viz*. Muræna, Gymnotus, Trichiurus, Anarchichas, Ammodytes, Ophidium, Stromateus, Xiphias, Sternoptyx, Leptocephalus.

Order II. The Jugulares, have the *belly-fins* placed before the *pectoral fins*.—This order includes five genera, *viz*. Callionymus, Uranoſcopus, Trachinus, Gadus, Blennius, Kurtus.

Order III. The Thoracici, have the *belly-fins* placed *under* the *pectoral fins*.—This order comprehends 19 genera, *viz*. Cepola, Echeneis, Coryphæna, Gobius, Cottus, Scorphæna, Zeus, Pleuronectes, Chætodon, Sparus, Scarus, Labrus, Sciæna, Perca, Gaſteroſteus, Scomber, Centrogaſter, Mullus, Trigla.

Order IV. The Abdominales, have the *belly-fins* placed *behind* the *pectoral fins*.—This order contains 16 genera, *viz*. Cobitis, Amia, Silurus, Teuthis, Loricaria, Salmo, Fiſtularia, Eſox, Elops, Argentina, Atherina, Mugil, Exocætus, Polynemus, Clupea, Cyprinus.

Order V. The Branchiostegi, have the *gills* deſtitute of bony rays.—This order contains 10 genera, *viz*. Mormyrus, Oſtracion, Tetrodon, Diodon, Syngnathus, Pegaſus, Centricus, Baliſtes, Cyclopterus, Lophius.

Order VI. The Chondropterygii, have cartilaginous *gills*—This order contains five genera, *viz*. Acipenſer, Chimæra, Squalus, Raia, Petromyzon.

The *generic* characters of this claſs are taken from peculiarities in the *head*, the *mouth*, the *teeth*, the *noſtrils*, the *rays* in the *membrane* of the *gills*, the *eyes*, the general *figure* of the *body*, the figure of the *tail*, the ſituation of the *ſpiracula*, &c.

The *ſpecific* characters are taken from peculiarities in all the parts above enumerated, and many others.

See further the articles Fish and Ichthyology.

The *Fifth Claſs*, INSECTA, is ſubdivided into ſeven Orders, the characters of which are taken from the wings. See the article Insect.

Order I. The Coleoptera, have *four wings*, the two ſuperior ones being cruſtaceous, and furniſhed with a *ſtraight ſuture*.—This order comprehends 47 genera, *viz*. Scarabæus, Lucanus, Dermeſtes, Melyris, Byrrhus, Silpha, Tritoma, Hydrophilus, Hiſter, Pauſus, Boſtrichus, Anthrenus, Nitidula, Coccinella, Curculio, Brentus, Attelabus, Erodius, Staphylinus, Scaurus, Zygia, Meloe, Tenebrio, Caſſida, Opatrum, Mordella, Chryſomela, Horia, Apalus, Manticora, Pimelia, Gyrinus, Cucujus, Cryptocephalus, Bruchus, Ptinus, Hiſpa, Bupreſtis, Necydalis, Lampyris, Cantharis, Notoxus, Elater, Calopus, Alurnus, Carabus, Lytta, Serropalpus, Cerambyx, Leptura, Rhinomacer, Zonitis, Cicindela, Dyticus, Forficula.

Order II. The Hemiptera, have *four wings*, the two ſuperior ones being *ſemicruſtaceous*, and *incumbent*, *i. e.* the *interior edges* lie above one another.—This order includes 14 genera, *viz*. Blatta, Pneumora, Mantis, Gryllus, Fulgora, Cicada, Notonecta, Nepa, Cimex, Macrocephalus, Aphis, Chermes, Coccus, Thrips.

ORDER III. The LEPIDOPTERA, have *four wings*, all of them imbricated with *ſcales*.—This order contains three genera, *viz*. Papilio, Sphinx, Phalæna.

ORDER IV. The NEUROPTERA, have *four wings*, interwoven with veins, like a peice of *network*, and no *ſting* in the *anus*.—This order includes ſeven genera, *viz*. Libella, Ephemera, Hemerobius, Myrmelion, Phryganea, Panorpa, Rophidia.

ORDER V. The HYMENOPTERA, have the ſame characters with the former, only the *anus* is armed with a *ſting*. But this mark is peculiar to the *females* and *neuters*; for the males have no *ſting*.—This order comprehends 15 genera, *viz*. Cynips, Tentredo, Sirex, Ichneumon, Sphex, Scolia, Thynnus, Leucoſpis, Tiphia, Chalcis, Chryſis, Veſpa, Apis, Formica, Mutilla.

ORDER VI. The DIPTERA, have *two wings*, and two *clavated halteres* or *balances* behind each wing.—This order contains 12 genera, *viz*. Diopſis, Tipula, Muſca, Tabanus, Empis, Conops, Oeſtrus, Aſilus, Stomoxys, Culex, Bombylius, Hippoboſca.

ORDER VII. The APTERA, have *no wings*.—This order contains 15 ſpecies, *viz*. Lepiſma, Podura, Termes, Pediculus, Pulex, Acarus, Hydrachna, Aranea, Phalangium, Scorpio, Cancer, Monoculus, Oniſcus, Scolopendra, Julus. See farther the articles ENTOMOLOGY and INSECT.

The *Sixth Claſs*, VERMES, is divided into five ORDERS.

ORDER I. The INTESTINA, are the moſt *ſimple animals*, being perfectly *naked*, and without *limbs* of any kind.—This order contains 21 genera, *viz*. Aſcaris, Trichocephalus, Uncinaria, Tilaria, Scolex, Ligula, Linguatula, Strongylus, Echinorhynchus, Hæruca, Cucullanus, Caryophyllæus, Faſciola, Tænia, Furia, Myxine, Gordius, Hirudo, Lumbricus, Sipunculus, Planaria.

ORDER II. The MOLLUSCA, are likewiſe *ſimple naked animals*, without any *ſhell*; but they are *brachiated*, or furniſhed with a kind of *limbs*.—This order comprehends 31 genera, *viz*. Actiania, Clava, Mammaria, Pedicellaria, Aſcidia, Salpa, Dagyſa, Pterotrachea, Limax, Aplyſia, Doris, Tethis, Holothuria, Terebella, Triton, Sepia, Clio, Lobaria, Lernæa, Scyllæa, Glaucus, Aphrodita, Amphitrite, Spio, Nereis, Nais, Phyſſophora, Meduſa, Lucernaria, Aſterias, Echinus.

ORDER III. The TESTACEA, have the ſame characters with thoſe of Order II. but are covered with a *ſhell*.—This order includes 36 genera, *viz*. Chiton, Lepas, Pholas, Mya, Solen, Tellina, Cardium, Mactra, Donax, Venus, Spondylus, Chama, Arca, Oſtrea, Anomia, Mytilus, Pinna, Argonauta, Nautilus, Conus, Cypræa, Bulla, Voluta, Buccinum, Strombus, Murex, Trochus, Turbo, Helix, Nerita, Haliotis, Patella, Dentalium, Serpula, Teredo, Sabella.

ORDER IV. The ZOOPHYTA, are *compound animals*, furniſhed with a kind of *flowers*, and having a vegetating *root* and *ſtem*.—This order contains 15 genera, *viz*, Tubipora, Madrepora, Millepora, Cellepora, Iſis, Antipathes, Gorgonia, Alcyonium, Spongia, Fluſtra, Tubularia, Corralina, Sertularia, Pennatula, Hydra. See *ANIMAL Flower*.

ORDER V. The INFUSORIA, conſiſts of very ſmall *ſimple animals*.—This order contains 15 genera, *viz*. Brachionus, Vorticella, Trichoda, Cercaria, Leucopera, Gonium, Colpoda, Paramecium, Cyclidium, Burſaria, Vibrio, Enchelis, Bacillaria, Volvox, Monas.

For more particular information concerning the ſeveral branches and ſubjects of zoology, the reader may conſult the various articles above referred to, and he will find moſt of the genera deſcribed in their order in the alphabet.

ZOOPHYTE, in natural hiſtory, the 4th order of the claſs of *Vermes*. See ZOOLOGY.

ZOOTOMY, the art of diſſecting animals or living creatures, being the ſame with anatomy. See ANATOMY, and COMPARATIVE *Anatomy*.

ZORILLE, in zoology, a ſpecies of weaſel, having the back and ſides marked with ſhort ſtripes of black and white, the laſt tinged with yellow; the tail long and buſhy, partly white and partly black; the legs and belly black. This animal inhabits Peru, and other parts of South America: its peſtilential vapour overcomes even the panther of America, and ſtupefies that formidable enemy.

ZOROASTER, or ZERDUSHT, a celebrated ancient Philoſopher, ſaid to have been the reformer or the founder of the religon of the magi. It is wholly uncertain to how many eminent men the name of Zoroaſter belonged. Some have maintained that there was but one Zoroaſter, and that he was a Perſian; others have ſaid that there were ſix eminent founders of philoſophy of this name. Ham the ſon of Noah, Moſes, Oſiris, Mithras, and others, both gods and men, have by different writers been aſſerted to have been the ſame with Zoroaſter. Many different opinions have alſo been advanced concerning the time in which he flouriſhed. Ariſtotle and Pliny fix his date at ſo remote a period as 6000 years before the death of Plato. According to Laertius, he flouriſhed 600 years before the Trojan war; according to Suidas, 500. If, in the midſt of ſo much uncertainty, any thing can be advanced with the appearance of probability, it ſeems to be this; that there was a Zoroaſter, a Perſo-Median, who flouriſhed about the time of Darius Hyſtaſpes; and that beſides him there was another Zoroaſter, who lived in a much more remote period among the Babylonians, and taught them aſtronomy. The Greek and Arabian writers are agreed concerning the exiſtence of the Perſian Zoroaſter; and the ancients unanimouſly aſcribe to a philoſopher, whom they call *Zoroaſter*, the origin of the Chaldean aſtronomy, which is certainly of much earlier date than the time of Hyſtaſpes: it ſeems, therefore, neceſſary to ſuppoſe a Chaldean Zoroaſter diſtinct from the Perſian. Concerning this Zoroaſter, however, nothing more is known, than that he flouriſhed towards the beginning of the Babyloniſh empire, and was the father of the Chaldean aſtrology and magic. All the writings that have been aſcribed to Zoroaſter are unqueſtionably ſpurious.

ZOSTERA, in botany; a genus of plants of the claſs *gynandria*, order *polyandria*; and in the natural ſyſtem arranged under the ſecond order, *Piperitæ*. The ſpadix is linear, and fertile only on one ſide; there is no calyx nor corolla; the ſtamina are alternate; the ſeeds ſolitary and alternate. There are two ſpecies, the marina and oceanica; neither of which is a native of Britain.

ZOSIMUS, an ancient hiſtorian who lived at the end of the fourth and beginning of the fifth centuries. There are ſix books of his hiſtory extant; in the firſt of which he runs over the Roman affairs in a very ſuccinct manner from Auguſtus to Diocleſian; the other five are written more diffuſely. Zoſimus was a zealous Pagan; whence we find him frequently inveighing with great bitterneſs againſt the Chriſtian princes, particularly againſt Conſtantine the Great, and the elder Theodoſius. His hiſtory has been publiſhed with the Latin verſion of Leunclavius at Frankfort, 1590, with the other minor hiſtorians of Rome, in folio; and at Oxford in 8vo, 1679.

ZUG, a canton of Switzerland, bounded on the eaſt and north by that of Zurich, on the ſouth by Schweiz and Lucern, and on the weſt by the canton of Lucern and the Freye-Amt or Free Provinces. It is not above 12 miles either way; but very populous and fruitful, yielding wine, wheat, cheſnuts, and other fruits, in its vales, and excellent paſture on its mountains. The inhabitants of this canton are ſtaunch Roman Catholics. It lies in the dioceſe of Conſtance, and its government is democratical. There are two lakes in it abounding in fiſh, particularly large carps, pikes, and a ſpecies of trouts called *rotels*; as well as ſeveral woods full of game. Zug, which gives name to it, and is its capital, ſtands on the eaſt ſide of a lake of the ſame name, about ſeven miles long, and is a ſtrong neat town, containing a priory and two convents.

ZUINGLIUS (Ulricus), an able and zealous reformer, who laid the foundation of a ſeparation from Rome in Switzerland, at the ſame time that Luther did the like in Saxony, was born at Wildehauſen in 1487. While he officiated as preacher at Zurich, a Franciſcan ſent by Leo X. came to publiſh indulgences there; againſt which Zuinglius after the example of Luther, declaimed powerfully. In the courſe of this oppoſition he ſtarted a new doctrine, which he called *Evangelical Truth*; and from the beginning of 1519, to 1523, he preached not only againſt indulgences, but againſt other articles of the Romiſh church. But though Zuinglius made no leſs progreſs than Luther, he yet conducted himſelf with more moderation and prudence; and wiſhing to have the concurrence of the civil powers, procured two aſſemblies to be called at Zurich: by the firſt, he was authoriſed to proceed as he had begun; and by the ſecond, the outward worſhip and ceremonies of the church of Rome were aboliſhed. During theſe tranſactions, Zuinglius publiſhed ſeveral books in defence of his doctrines; but treating of the euchariſt, and preſcribing a form of celebrating the Lord's Supper different from Luther, he was involved in violent diſputes with the reſt of his reforming brethren. Interpreting the words *hoc eſt corpus meum*, by *hoc ſignificat corpus meum*, he maintained, that the body and blood of Chriſt are not *really* preſent in the euchariſt; and that the bread and wine are nothing more than external *ſigns* or *ſymbols*, deſigned to excite in the minds of Chriſtians the remembrance of the ſufferings of the Divine Saviour, and of the benefits which ariſe from them. This opinion, which was afterwards ſo plauſibly ſupported by the celebrated Hoadley (ſee SUPPER *of the Lord*), gave offence to Calvin as well as to Luther; but the doctrines of Zuinglius, which were moſt obnoxious to that eminent reformer, were thoſe which deny *election* and *reprobation*, and make the church as a ſociety wholly dependent on the ſtate. Reſpecting the divine DECREES, the opinion of Zuinglius and his followers differed very little from that of the PELAGIANS: for he maintained that heaven is open to all who live according to the dictates of right reaſon; and he ſeems to have denied the doctrine of original ſin. Inſtead of declaring with Calvin, that the church is a ſeparate independent body, veſted with the right of legiſlation for itſelf, Zuinglius aſcribed to the civil magiſtrate an abſolute and unbounded power in religious matters, allowing at the ſame time a certain ſubordination among the miniſters of the church. This was abundantly agreeable to the magiſtrates of Zurich; but the reſt of the Swiſs cantons diſallowing of their proceedings, other aſſemblies were called, and things tending to tumult, both ſides had recourſe to arms; when Zuinglius, who began as a preacher, died in arms as a ſoldier, in 1531. His works amount to four vols folio.

ZURICH, a canton of Switzerland, bounded to the north by Swabia and the canton of Schaffhauſen; to the ſouth by the town and territory of Rapperſchweil and the cantons of Switz and Zug; to the eaſt by the Thurgau, Toggenburg, and Utznach; and to the weſt by the free bailiages and county of Baden. It is about 60 miles from north to ſouth, and 48 from eaſt to weſt. With reſpect to its face, air, and ſoil, it is ſaid to be an epitome of all Switzerland, as containing in it hills, valleys, plains, cornlands, vineyards, lakes, and rivers. Their wines have a tartneſs at firſt, but the longer they are kept the more agreeable they are. The other products are excellent fruits, corn, paſture, fine clay, chalk, ſeveral coloured earths, pitcoal, turf, and ſulphur. There are alſo ſome mineral ſprings in the canton; and of the lakes, that of Zurich is the moſt conſiderable. The reformation was introduced here by Zuinglius in the year 1517. This canton is the firſt in rank, and inferior only to that of Bern in extent, power, and wealth; in conſequence of which, its repreſentatives preſide in the general diets, when held in any place belonging in common to the cantons; and the affairs relating to the whole confederacy are tranſacted in its offices. Its quota, for the defence of the ſeveral members of the confederacy, is 1400 men. Of one of the two armies raiſed on theſe occaſions, it nominates one of the commanders in chief, as Lucern does the other. Its revenue is ſaid to be about 150,000 crowns a-year; of which, one year with another, two-thirds are expended in the charges of government, and the reſt laid up in the treaſury. It can bring 50,000 fighting men into the field at a very ſhort warning.

ZURICH, the capital of a canton of the ſame name in Switzerland, ſtands in a pleaſant country, near where the river Aa iſſues from the lake that takes its name from the town, 23 miles from Schaffhauſen, and 114 from Geneva. After having been ruined by Attila the Hun, it is ſaid to have been reſtored by Thuricus, ſon of Theodoric king of the Goths, from whom it took the name of *Thuricum*, corrupted afterwards into that of *Zurich*. It is fortified in the modern way, and has wide ditches, faced with free ſtone. There are five arſenals in it, well ſtored with arms and artillery; an academy or college, having 15 profeſſors; a muſeum, or chamber of rarities; a ſtately town-houſe, the pillars in the front of which are of black marble, ſtreaked with white; and a town library. The ſovereignty and adminiſtration of all affairs are lodged in the greater and leſſer council, out of which are choſen the city-officers, as the councils are out of the 13 companies of burghers. There are ſeveral other councils or colleges, each of which has its particular department. Here are a great variety of ſilk, woollen, linen, cotton, and other manufactures; this being the place of the greateſt trade in all Switzerland. The town is well ſupplied with proviſions by and from its lake. The ſtreets are neat, and houſes well built, but not magnificent. In the town-library are ſeveral letters to Bullinger from lady Jane Gray daughter to the duke of Suffolk. In one of the arſenals is the figure of William Tell, dreſſed and armed in the ancient Swiſs manner, with the croſs-bow whence he ſhot the arrow that ſtruck the apple off his child's head.

Both men and women are ſo fond of muſic, that there are few of them that cannot play on ſome inſtrument. If a burgher goes out of town, or a peaſant enters it, without a ſword, they are liable to be fined. No perſons, whatever their rank or office may be, are exempted from the ſumptuary laws. The burgomaſters, who are the ſame as the advoyers at Bern, have the title of excellence. The hoſpitals here are very neat and well endowed; but they do not affect the ridiculous vanity of lodging the poor in palaces. Not only in this town and canton, and other parts of Switzerland, but alſo among the Griſons, the miniſters all preach covered. The country about the town is very pleaſant and fruitful; for both which it is not a little indebted to the lake, that extends 24 miles in length, and about two or three in breadth. The water is of a green colour, ſuppoſed to be owing to the melted ſnow that falls into it from the adjacent mountains. That part of it next Zurich is called the *Lower Lake*, and the other end the *Upper*. The cathedral, or great church here, is collegiate. The preſent city is ſaid to owe its origin to a nunnery, founded by the emperor Lewis I. near where the ancient Tigurum ſtood. E. Long. 8. 30. N. Lat. 47. 20.

What may be reckoned one of the greateſt curioſities of Zurich is the pump invented and erected here by H. Andreas Wirtz, a tinplate worker of this place. The invention ſhows him to be a perſon of very uncommon mechanical knowledge and ſagacity. As it is a machine which operates on a principle widely different from all other hydraulic machines, and is really excellent in its kind, we preſume that our readers will not be diſpleaſed with ſome account of it, although it be rather out of place here, and ſhould have appeared in the article *Water Works*.

Pl. DXLII. Fig. 16. is a ſketch of the ſection of the machine, as it was firſt erected by Wirtz at a dye-houſe in Limmat, in the ſuburbs or vicinity of Zurich. It conſiſts of a hollow cylinder, like a very large grindſtone, turning on a horizontal axis, and partly plunged in a ciſtern of water. The axis is hollow at one end, and communicates with a perpendicular pipe CBZ′, part of which is hid by the cylinder. This cylinder or drum is formed into a ſpiral canal by a plate coiled up within it like the main ſpring of a watch in its box; only the ſpires are at a diſtance from each other, ſo as to form a conduit for the water of uniform width. This ſpiral partition is well joined to the two ends of the cylinder, and no water eſcapes between them. The outermoſt turn of the ſpiral begins to widen about ¾ths of a circumference from the end, and this gradual enlargement continues from Q to S nearly a ſemicircle: this part may be called the Horn. It then widens ſuddenly, forming a Scoop or ſhovel SS′. The cylinder is ſupported ſo as to dip ſeveral inches into the water, whoſe ſurface is repreſented by VV′.

When this cylinder is turned round its axis in the direction ABEO, as expreſſed by the two darts, the ſcoop SS′ dips at V′, and takes up a certain quantity of water before it emerges again at V. This quantity is ſufficient to fill the taper part SQ, which we have called the Horn; and this is nearly equal in capacity to the outermoſt uniform ſpiral round.

After the ſcoop has emerged, the water paſſes along the ſpiral by the motion of it round the axis, and drives the air before it into the riſing-pipe, where it eſcapes.—In the mean time, air comes in at the mouth of the ſcoop; and when the ſcoop again dips into the water, it again takes in ſome. Thus there is now a part filled with water and a part filled with air. Continuing this motion, we ſhall receive a ſecond round of water and another of air. The water in any turn of the ſpiral will have its two ends on a level; and the air between the ſucceſſive columns of water will be in its natural ſtate; for ſince the paſſage into the riſing-pipe or Main is open, there is nothing to force the water and air into any other poſition. But ſince the ſpires gradually diminiſh in their length, it is plain that the column of water will gradually occupy more and more of the circumference of each. At laſt it will occupy a complete turn of ſome ſpiral that is near the centre; and when ſent farther in, by the continuance of the motion, ſome of it will run back over the top of the ſucceeding ſpiral. Thus it will run over at K 4 into the right hand ſide of the third ſpiral. Therefore it will puſh the water of this ſpire backwards, and raiſe its other end, ſo that it alſo will run over backwards *before* the next turn be completed. And this change of diſpoſition will at laſt reach the firſt or outermoſt ſpiral, and ſome water will run over into the horn and ſcoop, and finally into the ciſtern.

But as ſoon as water gets into the riſing-pipe, and riſes a little in it, it ſtops the eſcape of the air when the next ſcoop of water is taken in. Here are now two columns of water acting againſt each other by hydroſtatic preſſure and the intervening column of air. They muſt compreſs the air between them, and the water and air columns will now be unequal. This will have a general tendency to keep the whole water back, and cauſe it to be higher on the left or riſing ſide of each ſpire than on the right deſcending ſide. The exceſs of height will be juſt ſuch as produces the compreſſion of the air between that and the preceding column of water. This will go on increaſing as the water mounts in the riſing-pipe; for the air next to the riſing-pipe is compreſſed at its inner end with the weight of the whole column in the main. It muſt be as much compreſſed at its outer end. This muſt be done by the water column without it; and this column exerts this preſſure partly by reaſon that *its* outer end is higher than its inner end, and party by the tranſmiſſion of the preſſure on its outer end by air, which is ſimilarly compreſſed from without. And thus it will happen that each column of water, being higher at its outer than at its inner end, compreſſes the air on the water-column beyond or within it, which tranſmits this preſſure to the air beyond it, adding to it the preſſure ariſing from its own want of level at the ends. Therefore the greateſt compreſſion, viz. that of the air next the main, is produced by *the ſum of all the tranſmitted preſſures*; and theſe are the ſum of all the differences between the elevations of the inner ends of the water columns above their outer ends: and the height to which the water will riſe in the main will be juſt equal to this ſum.

Draw the horizontal lines K′K 1, K′K 2, K′K 3, &c. and *m n*, *m n*, *m n*, &c. Suppoſe the left hand ſpaces to be filled with water, and the right hand ſpaces to be filled with air. There is a certain gradation of compreſſion which will keep things in this poſition. The ſpaces evidently decreaſe in arithmetical progreſſion; ſo do the hydroſtatic heights and preſſures of the water columns. If therefore the air be denſe in the ſame progreſſion, all will be in hydroſtatical equilibrium. Now this is evidently producible by the mere motion of the machine; for ſince the denſity and compreſſion in each air column is ſuppoſed inverſely as the bulk of the column, the abſolute quantity of air is the ſame in all; therefore the column firſt taken in will paſs gradually inwards, and the increaſing compreſſion will cauſe it to occupy preciſely the whole right hand ſide of every ſpire. The gradual diminution of the water columns will be produced during the motion by the water running over backwards at the top, from ſpire to ſpire, and at laſt coming out by the ſcoop.

It is evident that this diſpoſition of the air and water will raiſe the water to the greateſt height, becauſe the hydroſtatic height of each water column is the greateſt poſſible, *viz.* the diameter of the ſpire. This diſpoſition may be obtained in the following manner: Take CL to CB as the denſity of the external air to its denſity in the laſt column next the riſing-pipe or main; that is, make CL to CB as 33 feet (the height of the column of water which balances the atmoſphere), to the ſum of 33 feet and the height of the riſing-pipe. Then divide BL into ſuch a number of turns, that the ſum of their diameters ſhall be equal to the height of the main; then bring a pipe ſtraight from L to the centre C. The reaſon of all this is very evident.

But when the main is very high, this conſtruction will require a very great diameter of the drum, or many turns of a very narrow pipe. In ſuch caſes it will be much better to make the ſpiral in the form of a cork-ſcrew, as in fig. 17. inſtead of this flat form like a watch-ſpring. The pipe which forms the ſpiral may be lapped round the fruſtrum of a cone, whoſe greateſt diameter is to the leaſt (which is next to the riſing pipe) in the ſame proportion that we aſſigned to CB and CL. By this conſtruction the water will ſtand in every round ſo as to have its upper and lower ſurfaces tangents to the top and bottom of the ſpiral, and the water columns will occupy the whole aſcending ſide of the machine, while the air occupies the deſcending ſide.

This form is vaſtly preferable to the flat: it will allow us to employ many turns of a large pipe, and therefore produce a great elevation of a large quantity of water.

The ſame thing will be ſtill better done by lapping the pipe on a cylinder, and making it taper to the end, in ſuch a proportion that the contents of each round may be the ſame as when it is lapped round the cone. It will raiſe the water to a greater height (but with an increaſe of the impelling power) by the ſame number of turns, becauſe the vertical or preſſing height of each column is greater.

Nay, the ſame thing may be done in a more ſimple manner, by lapping a pipe of uniform bore round a cylinder. But this will require more turns, becauſe the water columns will have leſs differences between the heights of their two ends. It requires a very minute inveſtigation to ſhow the progreſs of the columns of air and water in this conſtruction, and the various changes of their arrangement, before one is attained which will continue during the working of the machine.

We have choſen for the deſcription of the machine that conſtruction which made its principles and manner of working moſt evident, namely, which contained the ſame material quantity of air in each turn of the ſpiral, more and more compreſſed as it approaches to the riſing-pipe. We ſhould otherwiſe have been obliged to inveſtigate in great detail the gradual progreſs of the water, and the frequent changes of its arrangement, before we could ſee that one arrangement would be produced which would remain conſtant during the working of the machine. But this is not the beſt conſtruction. We ſee that, in order to raiſe water to the height of a column of 34 feet, which balances the atmoſphere, the air in the laſt ſpire is compreſſed into half its bulk; and the quantity of water delivered into the main at each turn is but half of what was received into the firſt ſpire, the reſt flowing back from ſpire to ſpire, and being diſcharged at the ſpout.

But it may be conſtructed ſo as that the quantity of water in each ſpire may be the ſame that was received into the firſt; by which means a greater quantity (double in the inſtance now given) will be delivered into the main, and raiſed to the ſame height by very nearly the ſame force.—This may be done by another proportion of the capacity of the ſpires, whether by a change of their caliber or of their diameters. Suppoſe the bore to be the ſame, the diameter muſt be made ſuch that the conſtant column of water, and the column of air, compreſſed to the proper degree, may occupy the whole circumference. Let A be the column of water which balances the atmoſphere, and b the height to which the water is to be raiſed. Let A be to $A+b$ as 1 to m.

It is plain that m will repreſent the denſity of the air in the laſt ſpire, if its natural denſity be 1, becauſe it is preſſed by the column $A+b$, while the common air is preſſed by A. Let 1 repreſent the conſtant water column, and therefore nearly equal to the air column in the firſt ſpire. The whole circumference of the laſt ſpire muſt be $1+\frac{1}{m}$, in order to hold the water 1, and the air compreſſed into the ſpace $\frac{1}{m}$ or $\frac{A}{A+b}$.

The circumference of the firſt ſpire is $1+1$ or 2. Let D and d be the diameters of the firſt and laſt ſpires; we have $2:1+\frac{1}{m}=D:d$, or $2m:m+1=D:d$. Therefore if a pipe of uniform bore be lapped round a cone, of which D and d are the end diameters, the ſpirals will be very nearly ſuch as will anſwer the purpoſe. It will not be quite exact, for the intermediate ſpirals will be ſomewhat too large. The conoidal fruſtum ſhould be formed by the revolution of a curve of the logarithmic kind. But the error is very trifling.

With ſuch a ſpiral, the full quantity of water which was confined in the firſt ſpiral will find room in the laſt, and will be ſent into the main at every turn. This is a very great advantage, eſpecially when the water is to be much raiſed, The ſaving of power by this change of conſtruction is always in proportion of the greateſt compreſſion of the air.

The great difficulty in the conſtruction of any of theſe forms is in determining the form and poſition of the horn and the ſcoop; and on this greatly depends the performance of the machine. The following inſtructions will make it pretty eaſy.

Let ABEO (fig. 18.) repreſent the firſt or outermoſt round of the ſpiral, of which the axis is C. Suppoſe it immerged up to the axis in the water VV′, we have ſeen that the machine is moſt effective when the ſurfaces KB and O n, of the water columns are diſtant the whole diameter BO of the ſpiral. Therefore let the pipe be firſt ſuppoſed of equal caliber to the very mouth E e, which we ſuppoſe to be juſt about to dip into the water. The ſurface O n is kept there, in oppoſition to the preſſure of the water column BAO, by the compreſſed air contained in the quadrant OE, and in the quadrant which lies behind EB. And this compreſſion is ſupported by the columns behind, between this ſpire and the riſing pipe. But the air in the outermoſt quadrant EB is in its natural ſtate, communicating as yet with the external air. When, however, the mouth E e has come round to A, it will not have the water ſtanding in it in the ſame manner, leaving the half ſpace BEO filled with compreſſed air; for it took in and confined only what filled the quadrant BE. It is plain, therefore, that the quadrant BE muſt be ſo ſhaped as to take in and confine a much greater quantity of air; ſo that when it has come to A, the ſpace BEO may contain air ſufficiently denſe to ſupport the column AO. But this is not enough: For when the wide mouth, now at A a, riſes up to the top, the ſurface of the water in it riſes alſo, becauſe the part AO $o\,a$ is more capacious than the cylindric part OE eo which ſucceeds it, and which cannot contain all the water that it does. Since, then, the water in the ſpire riſes above A, it will preſs the water back from O n to ſome other poſition $m' n'$, and the preſſing height of the water-column will be diminiſhed by this riſing on the other ſide of O. In ſhort, the horn muſt begin to widen, not from B, but from A, and muſt occupy the whole ſemicircle ABE; and its capacity muſt be to the capacity of the oppoſite cylindrical ſide as the ſum of BO, and the height of a column of water which balances the atmoſphere to the height of that column. For then the air which filled it, when of the common denſity, will fill the uniform ſide BEO, when compreſſed ſo as to balance the vertical column BO. But even this is not enough; for it has not taken in enough of water. When it dipped into the ciſtern at E, it carried air down with it, and the preſſure of the water in the ciſtern cauſed the water to riſe into it a little way; and ſome water muſt have come over at B from the other ſide, which was drawing narrower. Therefore when the horn is in the poſition EOA, it is not full of water. Therefore when it comes into the ſituation OAB, it cannot be full nor balance the air on the oppoſite ſide. Some will therefore come out at O, and riſe up thro' the water. The horn muſt therefore *1ſt*, Extend at leaſt from O to B, or occupy half the circumference; and, *2dly*, It muſt contain at leaſt twice as much water as would fill the ſide BEO. It will do little harm though it be much larger; becauſe the ſurplus of air which it takes in at E will be diſcharged, as the end E e of the horn riſes from O to B, and it will leave the preciſe quantity that is wanted. The overplus water will be diſcharged as the horn comes round to dip again into the ciſtern. It is poſſible, but requires a diſcuſſion too intricate for this place, to make it of ſuch a ſize and ſhape, that while the mouth moves from E to B, paſſing through O and A, the ſurface of the water in it ſhall advance from E e to O n, and be exactly at O when the beginning or narrow end of the horn arrives there.

We muſt alſo ſecure the proper quantity of water. When the machine is ſo much immerſed as to be up to the axis in water, the capacity which thus ſecures the proper quantity of air will alſo take in the proper quantity of water. But it may be erected ſo as that the ſpirals ſhall not even reach the water. In this caſe it will anſwer our purpoſe if we join to the end of the horn a ſcoop or ſhovel QRSB (fig. 19.), which is ſo formed as to take in at leaſt as much water as will fill the horn. This is all that is wanted in the beginning of the motion along the ſpiral, and more than is neceſſary when the water has advanced to the ſucceeding ſpire; but the overplus is diſcharged in the way we have mentioned. At the ſame time, it is needleſs to load the machine with more water than is neceſſary, merely to throw it out again. We think that if the horn occupies fully more than one-half of the circumference, and contains as much as will fill the whole round, and if the ſcoop lifts as much as will certainly fill the horn, it will do very well.

N. B. The ſcoop muſt be very open on the ſide next the axis, that it may not confine the air as ſoon as it enters the water. This would hinder it from receiving water enough.

The following dimenſions of a machine erected at Florence, and whoſe performance correſponded extremely well with the theory, may ſerve as an example.

The ſpiral is formed on a cylinder of 10 feet diameter, and the diameter of the pipe is 6 inches. The ſmaller end of the horn is of the ſame diameter; and it occupies $\frac{3}{4}$ths of the circumference, and it is $7\frac{8}{10}$ths inches wide at the outer end. Here it joins the ſcoop, which lifts as much water as fills the horn, which contains 4340 Swediſh cubic inches, each = 1,577 Engliſh. The machine makes 6 turns in a minute, and raiſes 1354 pounds of water, or 22 cubic feet, 10 feet high in a minute.

The above account will, we hope, ſufficiently explain the manner on which this ſingular hydraulic machine produces its effect. When every thing is executed by the maxims which we have deduced from its principles, we are confident that its performance will correſpond to the theory; and we have the Florentine machine as a proof of this. It raiſes more than $\frac{10}{11}$ths of what the theory promiſes, and it is not perfect. The ſpiral is of equal caliber, and is formed on a cylinder. The friction is ſo inconſiderable in this machine, that it need not be minded: but the great excellency is, that whatever imperfection there may be in the arrangement of the air and water columns, this only affects the elegance of the execution, cauſing the water to make a few more turns in the ſpiral before it can mount to the height required; but waſtes no power, becauſe the power employed is always in proportion to the ſum of the vertical columns of water in the riſing ſide of the machine; and the height to which the water is raiſed by it is in the very ſame proportion. It ſhould be made to move very ſlow, that the water be not always dragged up by the pipes, which would cauſe more to run over from each column, and diminiſh the preſſure of the remainder.

If the riſing-pipe be made wide, and thus room be made for the air to eſcape freely up through the water, it will riſe to the height aſſigned; but if it be narrow, ſo that the air cannot get up, it riſes almoſt as ſlow as the water, and by this circumſtance the water is raiſed to a much greater height mixed with air, and this with hardly any more power. It is in this way that we can account for the great performance of the Florentine machine, which is almoſt triple of what a man can do with the fineſt pump that ever was made: indeed the performance is ſo great that one is apt to ſuſpect ſome inaccuracy in the accounts. The entry into the riſing-pipe ſhould be no wider than the laſt part of the ſpiral; and it would be adviſable to divide it into four channels by a thin partition, and then to make the riſing-pipe very wide, and to put into it a number of ſlender rods, which would divide it into ſlender channels that would completely entangle the air among the water. This will greatly increaſe the height of the heterogeneous column. It is ſurpriſing that a machine that is ſo very promiſing ſhould have attracted ſo little notice. We do not know of any being erected out of Switzerland except at Florence in 1778. The account of its performance was in conſequence of a very public trial in 1779, and honourable declaration of its merit, by Sig. Lorenzo Ginori, who erected another, which fully equalled it. It is ſhortly mentioned by Profeſſor Sulzer of Berlin, in the *Sammlungen Vermiſchlen Schriſten* for 1754. A deſcription of it is publiſhed by the Philoſophical Society at Zurich in 1766, and in the deſcriptions publiſhed by the Society in London for the encouragement of Arts in 1776. The celebrated Daniel Bernouilli has publiſhed a very accurate theory of it in the Peterſburg Commentaries for 1772, and the machines at Florence were erected according to his inſtructions. Baron Alſtromer in Sweden cauſed a glaſs model of it to be made, to exhibit the internal motions for the inſtruction of artiſts, and alſo ordered an operative engine to be erected; but we have not ſeen any account of its performance. It is a very intricate machine in its principles; and an ignorant engineer, nay the moſt intelligent, may erect one which ſhall hardly do any thing; and yet, by a very trifling change, may become very powerful. We preſume that failures of this kind have turned the attention of engineers from it; but we are perſuaded that it may be made very effective, and we are certain that it muſt be very durable. Fig. 20. is a ſection of the manner in which the author has formed the communication between the ſpiral and the riſing pipe. P is the end of the hollow axis which is united with the ſolid iron axis. Adjoining to P, on the under ſide, is the entry from the laſt turn of the ſpiral. At Q is the collar which reſts on the ſupports, and turns round in a hole of bell-metal. *f f* is a broad flanch caſt in one piece with the hollow part. Beyond this the pipe is turned ſomewhat ſmaller, very round and ſmooth, ſo as to fit into the mouth of the riſing-pipe, like the key of a cock. This mouth has a plate *e e* attached to it. There is another plate *d d*, which is broader than *e e*, and is not fixed to the cylindrical part, but moves eaſily round it. In this plate are four ſcrews, ſuch as *g*, *g*, which go into holes in the plate *f f*, and thus draw the two plates *f f* and *d d* together, with the plate *e e* between them. Pieces of thin leather are put on each ſide of *e e*; and thus all eſcape of water is effectually prevented, with a very moderate compreſſion and friction.

ZUTPHEN, a ſtrong and conſiderable town of the United Provinces in Guelderland, and capital of a county of the ſame name. It has a magnificent church, and is ſurrounded with walls. It was taken by the French in 1672, who in 1674 delivered it up to the States-General. It is ſeated at the confluence of the rivers Berkel and Yeſſel, nine miles ſouth-eaſt of Deventer, and 55 eaſt by ſouth of Amſterdam. E. Long. 6. 0. N. Lat. 52. 10.

ZUYDER-ZEE, a great gulph or bay of the German Ocean, which extends from ſouth to north in the United Provinces, between Frieſland, Over-Yeſſel, Guelderland, and Holland. It is ſo called from its ſituation towards the ſouth. It is ſaid that the Zuyder-zee was formerly a lake, and that the land is ſwallowed up which united North-Holland with Frieſland.

ZYGOMA, in anatomy, a bone of the head, or rather an union or aſſemblage of two proceſſes or eminences of bones; the one from the os temporis, the other from the os malæ: theſe proceſſes are hence termed the *zygomatic proceſſes*, and the ſuture that joins them together is denominated the *zygomatic ſuture*.

ZYGOMATICUS, in anatomy, a muſcle of the head, ariſing from the *Os Zygoma*, whence its name, and terminating at the angle of the lips.

ZYGOPHYLLUM, BEAN CAPER, in botany; a genus of plants of the claſs of decandria and order monogynia, and in the natural ſyſtem arranged under the 14th order, *Gruinales*. There are 11 ſpecies, partly ſhrubby and partly herbaceous plants, all natives of warm climates, though ſome of them are hardy enough to endure the open air in this country.

ZYMOSIMETER (formed from ζυμωσις *fermentation*, and μετρον *meaſure*), an inſtrument propoſed by Swammerdam in his book *De Reſpiratione*, wherewith to meaſure the degree of fermentation occaſioned by the mixture of different matters, and the degree of heat which thoſe matters acquire in fermenting, as alſo the heat or temperament of the blood of animals.

FINIS.

BRITISH MUSEUM

ERRATA not pointed out at the end of any preceding Volume.

N. B. *b* added to the number of the line ſignifies " from the bottom of the page."

Vol.	*page.*	*col.*	*line.*	
I.	368	2	Marg.	After " Index," add " at *Spirit of wine*."
II.	216	2	31 *b*.	For " ARCHIMIDES," read " ARCHIMEDES."
	250	2	22	For " ſloping," read " ſtopping."
	770	2	7 *b*.	For " n° 79." read " 578."
III.	258	1	20	For " 50th," read " 57th."
	283	1	marg.	For " See *Index*, &c." read " See MEDICINE, n° 359, &c,"
	342	2	25	Dele " MEDICINE and."
	805	2		After the laſt line read " cauſed the ſoldiers and all the inhabitants to be put to."
IV.	86	2	11 *b*.	For " MEDICINE." read " SURGERY."
	374	2	12 *b*.	For " tar," read " water."
	392	1	23 *b*.	For " vapour," read " heat."
	392	1	1 *b*.	For " 807 degrees," read " 811."
V.	137	1	31	For " MEDICINE-*Index*," read " *Catarrh*, MEDICINE-*Index*."
	606	1	23	For " the only oſtenſible," read " only the oſtenſible."
VI.	181	1	19 *b*.	For " Elvet," read " Wear."
VIII.	120	2	4 *b*.	For " See *Index*," read " See MEDICINE, n° 396, 397, 400."
	124	1	39	For " *Ornithyology*," read " *Ichthyology*."
	191	2	18	For " *Ichthology*," read " *Ornithology*."
	293	1	11	For " queen's palace at Weſtminſter," read " Windſor caſtle."
	311	1	11	For " *venery*," read " *venary*."
	390	2	16 *b*.	For " *Polydectes*," read " *Philoctetes*."
	497	2	27 *b*.	For " Cumberland," read " Northumberland."
	521	2	19 *b*.	For " 155," read " 355."
	743	2	16	For " dibblers," read " droppers."
IX.	6	1	4	At " AMLB," read " Plate CCXL. fig. 1."
X.	114	2	3 *b*.	For " 1694," read " 1664."
	731	2	16 *b*.	For " from E to B, and from B to C," read " from B to E, and from C to E." inſerting an E in the fig. where AD and CB croſs each other.
XI.	475	1	12 *b*.	For " n° 50." read " n° 54."
	482	2	19	For " loquacity," read " logomachy."
	631	2	5	For " μιτφια," read " μιτρια," or " μιτρον."
				In the article METHODISTS, *paſſim*. For " Hanſon," read " Hampſon."
XII	278	Note		For " Low," read " LAW."
	409	2	25 *b*. 22 *b*.	For " BC," read " AC."
XIII	204	2	18	For " 364th," read " 304th."
	577	2	5 *b*.	For " γινομιαι," read " γινομαι."
	709	2	25	For " 9," read " *g*."
XIV.	141	1		Before the article " PERCHE" inſert " PERCH, in ichthyology. See PERCA."
	178	2	33	For " PERSICANA," read " PERSICARIA."
	196	2	27	For " Teith," read " Tay."
	196	2	29	For " Blair of Drummond," read " Stob-hall."
	214	1	28 *b*.	For " bottom," read " top."
	669	2	18 *b*.	For " 667," read " 669."
	671	2	16	For " rine," read " pine."
XV.	373	1	6 *b*.	For " Wenderdon," read " Wenderborn."
XVI.	9	2	25	For " 1697," read " 1679."
	533	1	10 *b*.	For " Emelia," read " Emelius."
	591	2	6 *b*.	For " ſacrifices," read " ſcriptures."
	592	1	26	For " demand," read " demeanor."
XVII.	99	Note	5 *b*.	For " it is abſurd," read " is it abſurd."
	512	2	7	Add " See MURÆNA."
	610	2	22	For " an Engliſh gallon," read " half an Engliſh gallon."
	782	2	22	For " Dorſetſhire," read " Hampſhire."
XVIII.	129	1	27 *b*.	For " (fig. 28. *b*)," read " (fig. 26. *b*)."
	143	1	marg.	For " 338," read " 238."
	187	2	20	For " 337," read " 237."
	187	2	22, 23, 25,	For " 338," read " 238."

ER.

ERRATA not pointed out at the end of any preceding Volume.

Vol.	*page.*	*col.*	*line.*	
XVIII.	297	2	32 *b.*	Read " For almoſt every ſpecies of quadrupeds has a ſpecies of tænia peculiar to itſelf."
	419	Note	6 *b.*	For " layman," read " clergyman likewiſe, but."
	453	2	39	Read " ἱμασθαι."
	455	1	6 *b.*	For " this," read " his."
	455	Note	1 *b.*	Read " *Harmonia.*"
	480	1	15	Dele " ;"
	490	2	22	Dele " the" before the word " interceſſion."
	497	1	2 *b.*	For " phyſicians," read " philoſophers."
Plate CCCXCVIII.			fig. 1.	For what appears to be " E *c* D," read E *f* D.
			3.	For " 1M;" read " CM."
CCCCLXXXVIII.				The crooked pipe on the right of fig. 38. ſhould be marked " 38 *a.*"

DIRECTIONS

DIRECTIONS FOR PLACING THE PLATES OF VOL. XVIII.

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DXII.	592

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